INDIGENOUS KNOWLEDGE AND ITS POTENCY IN MITIGATING DROUGHT INDUCED FAMINE AMONG COMMUNITIES LIVING IN KERIO VALLEY, KENYA

BY

FLORENCE A.C. MURGOR

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DECLARATION

This Thesis is my original work and has not been presents for a degree in any other University or examination body.

FLORENCE. A.C. MURGOR _____ _____
SES/D. PHIL/18/2009 Signature Date

DECLARATION BY SUPERVISORS

This Thesis has been submitted for examination with our approval as University Supervisors.

PROF. HELLEN IPARA SIGNATURE_____ DATE _____
School of Natural Resources Management
Department of Wildlife Management
University of Eldoret
Eldoret, Kenya

DR. MARK KIPTUI SIGNATURE_____ DATE _____

School of Environmental studies
Department of Human Ecology
University of Eldoret
Eldoret, Kenya

DEDICATION

This thesis is dedicated to the almighty God, the creator and giver of all things, to my parents and my children for their love, patience, kind heartedness and gentle encouragement which helped me get through the entire research process.

ABSTRACT

The term 'indigenous knowledge' is used to describe the knowledge systems developed by a community as opposed to the scientific knowledge that is generally referred to as 'modern' knowledge. Indigenous knowledge is the basis for local-level decision-making in many rural communities. It has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities. Drought is a recurring challenge to the livelihoods of communities living in Kerio valley, and those living in the arid and semi-arid zone of Kenya. The purpose of this study was to assess indigenous knowledge and its potency in mitigating drought induced famine among the residents of Kerio valley. The study population consisted of respondents from household of residents living in Kerio valley, government officers from the Ministries of Agriculture, Water, and Livestock, Non-Governmental Organizations and Community Based Organization. Cross -sectional survey based on a sample drawn from three areas: Keiyo, Marakwet and Baringo Districts was employed in the study. The sample for the study was selected using stratified and systematic sampling methods. Data was collected from primary and secondary sources. Research instruments used were questionnaires, interview schedule, observations checklist and focus group discussions. The study established that although the occurrence of locusts and army worms was likely to lead to crop destruction and hence famine, their occurrence was often unpredictable; and consequently, the main cause of famine was found to be drought which was most prevalent and tends to occur periodically. The study found that drought induced famine has a combination of effects on the community. These combinations gravitated around loss of human and livestock lives, hunger, reduced agricultural output, and lack of water. Results further indicated that there are positive correlations between indigenous knowledge and famine mitigation ($r=0.329$, $p<0.01$), indigenous knowledge to mitigate famine and famine mitigation ($r=0.166$, $p<0.001$), and between proper utilization of indigenous knowledge and famine mitigation ($r=0.796$, $p<0.001$). Results also showed a significant negative correlation between indigenous knowledge to predict famine and famine mitigation ($r= -0.276$, $p<0.001$). The implication of the negative result is that high levels of indigenous knowledge to predict famine are likely to lower actual famine mitigation since the prediction would have prepared the community members. The regression coefficients showed that all the four elements of indigenous knowledge namely; general indigenous knowledge ($p=0.118$, $p<0.00l$), indigenous knowledge to predict famine ($p=-0.288$, $p<0.0l$), indigenous knowledge to mitigate famine ($p= 0.077$, $P=0.021$), and proper utilization of indigenous knowledge ($p = 0.822$, $p<0.01$) were significant predictors of mitigation of drought induced famine. From the study findings, it was concluded that mitigation of drought induced famine can be represented as a function of general indigenous knowledge to predict famine, indigenous knowledge to mitigate famine, and proper utilization of indigenous knowledge. The study recommends the need to document indigenous knowledge about drought prediction and occurrence and mitigation of drought induced famine to avoid the information being lost as the elderly custodians of the knowledge disappear from the scene. Indigenous knowledge should also be incorporated into national policy and development documents. Laws to safeguard intellectual property rights relating to indigenous knowledge should be enacted.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADB - African Development Bank

ASAL -Arid and Semi-Arid Land

CBO - Community-based Organization

CGIAR - Consultative Group on International Agricultural Research

CIMMYT - International Maize and Wheat Improvement Center

CLIMDEV- Climate for Development in Africa

DEPHA- Development Platform for the Horn of Africa

ECA - Economic Commission for Africa

FAO - Food and Agriculture Organization

FSSD -Food Security and Sustainable Development Division of UNECA

GEF - Global Environment Facility

GHA - Greater Horn of Africa

GIEWS -Global Information and Early Warning System

GOK – Government of Kenya

IDS - Institute of Development Studies

IFAD - International Fund for Agricultural Development

IGAD - Intergovernmental Authority on Development

IK - Indigenous Knowledge

KNBS-Kenya National Bureau of Statistics

NASA – National Aeronautics and Space Administration

NEPAD - The New Partnership for Africa's Development

NGO - Non-Governmental Organization

OCHA - Office for the Coordination of Humanitarian Affairs

SASOL- Sahelien Solutions Foundation

TEK - Traditional ecological knowledge

UNCCD - United Nations Convention to Combat Desertification

UNDP - United Nations Development Programme

UNECA - United Nations Commission for Africa

UNEP - United Nations Environmental Programme

UNFCCC - United Nations Framework Convention on

WHO - World Health Organization

WFP - United Nations World Food Programme

OPERATIONAL DEFINITION OF TERMS

Arid and Semi- arid land - This is a land that characterized by low erratic rainfall of up to 700mm per annum, periodic droughts and different associations of vegetable cover and soil. In semi arid, interannual; rainfall varies from 50-100% in the arid zones of the world with averages of up to 700mm

Community - A group of people living in the same place or having a particular characteristic in common. Or a group of people have a feeling of fellowship with others, as a result of sharing common attitude, interest and goals.

Drought – It is a period of prolonged of abnormally low rainfall; shortage of water. It is generally associated with dry climates. It occurs virtually in all climatic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberrations; it differs from aridity, which is restricted to low rainfall regions and is permanent feature of a climate.

Famine – It is a situation of extreme and general scarcity of food. However, the occurrence of extreme climatic events such as drought, leading to severe food shortages, has been on the increase, occasioned by climatic change. An example of famine is when there is no food and people are starving due to severe hunger.

Food Crisis – is the result of a dysfunctional food system that occurs due to a long extreme shortage of food, which results in deaths. Due to food crisis, people are undernourished as a result of physical unavailability of food, their lack of social or economic access to adequate food, and /or inadequate food utilization.

Indigenous knowledge – It is the knowledge of a community accumulated over generations of living in a particular environment. It covers all forms of knowledge including technologies; know how, skills, practices and beliefs that enable the community to achieve livelihoods within their environments. It is

traditional cultural knowledge that includes intellectual, technological, ecological, and medical knowledge.

Indigenous people – Refers to the original human inhabitants of a place who are the originators and consumers of the Indigenous knowledge.

Local community involvement - The participation of the local community in the forecast and realization in mitigating drought induced famine in their areas.

Potency – Effectiveness of indigenous, knowledge, quality and the strength of the applicability of Indigenous Knowledge.

Poverty – Is the inability to afford basic and non-food items. In practical terms, it translates as food insecurity and the question that arises in the study is how indigenous knowledge can be utilized to improve food security.

Standard of living – It is a measure of the quality of life experienced by person or group, as defined by indicators such as income and life expectancy.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Droughts remain a perennial problem in sub-Saharan Africa, with major droughts occurring every few years, often resulting in famine. Drought is a recurring extreme climate event over land characterized by below-normal precipitation over a period of months to years. Drought is a temporary dry period, in contrast to the permanent aridity in arid areas. Drought occurs over most parts of the world, even in wet and humid regions. This is because drought is defined as a dry spell relative to its local normal condition. On the other hand, arid areas are prone to drought because of the low rainfall that generally associated with dry climates (Wilhite, 2002).

Drought is often classified into three types namely: Meteorological, Agricultural and Hydrological, droughts (Giannini *et al.*, 2003). Meteorological drought is a period of months to years with below-normal precipitation. It is often accompanied with above-normal temperatures, and precedes and causes other types of droughts. Meteorological drought is caused by persistent anomalies (e.g., high pressure) in large-scale atmospheric circulation patterns, which are often triggered by anomalous tropical sea surface temperatures or other remote conditions. Agricultural drought is a period with dry soils that results from below-average precipitation, intense but less frequent rain events, or above-normal evaporation, all of which lead to reduced crop production and plant growth. Hydrological drought occurs when river stream flow and water storages in aquifers, lakes, or reservoirs fall below long-term mean levels. Hydrological drought develops more slowly because it involves stored water that is depleted but not replenished. A lack of precipitation often triggers agricultural and hydrological

droughts, but other factors, including more intense but less frequent precipitation, poor water management, and erosion, can also cause or enhance these droughts (Giannini *et al.,* 2003).

The responses to drought induced famine are varied, but most of them focus on the provision of food aid during the worst part of the crisis, and occasionally, seeds to help restore cultivation when the rains return. Despite this, very few aid programs appreciate the value of traditional knowledge in drought management. Indigenous societies in Africa and other parts of the world faced with drought have developed methods of adapting to and mitigating droughts, but this knowledge is often ignored by aid providers and policy makers, who tend to impose their own opinions on indigenous communities with disastrous consequences (Sen, 1981).

One of the most important principles of the Convention to Combat Desertification is the recognition of the value of traditional knowledge in drought management that local communities and indigenous people have accumulated over time (United Nations, 2008). There is evidence that traditional and indigenous methods employed to cope with drought are well adapted to local conditions, and consequently remain an integral part of the strategy for the development and implementation of management policies for drought induced famine at local levels. Notable examples include Tonk District of Rajasthan in India where farmers used traditional adaptation practices for drought management such as growing new crops such as vegetables, fodder and higher value medicinal crops for commercial sale; use of environmentally sound fertilizers (vermiculture); improved storage (Institute of Development Studies, 2005).

There are various researches on indigenous knowledge that are successfully used to combat drought and famine (Mapeta, 2000). These researches emphasize the importance of assessing and incorporating local indigenous knowledge, capacities and needs in order to develop and implement equitable and community-based solutions to mitigating drought and famine (Ndiaye, 2004). This implies that long-term investment of financial and technical resources into capacity development and drought mitigation and preparedness activities is required. The experiences of communities in the Indian state of Rajasthan who manage drought and famine by traditional adaptation practices, including growing new crops for commercial sale, use of environmentally sound fertilizers (vermiculture), improved storage for fodder and food grains, and improved water conservation and harvesting techniques are well documented (Institute of Development Studies, 2005).

Among pastoral communities, indigenous methods of mitigating drought induced famine involve the management diversification and splitting of herds. According to Devitt (1978), the most common strategy used to reduce the risk of drought induced famine among pastoralists is to increase the herd size as fast as possible. This strategy is closely linked to the concept of critical herd size, which suggests that there is a minimum number of livestock that a herd must contain to be a viable unit. Furthermore, Devitt (1978) posit that larger herds are more robust than smaller ones because drought reduces a small herd to its breeding nucleus quickly, the labour intensive nature of traditional pastoralism strains the resources of small herd owners, and the higher frequency of droughts and famines means that owners of small herds often have no time to rebuild their stock before the next drought (*ibid*).

The indigenous strategy of coping with drought directly contradicts the advice of governments and donor NGOs, who encourage pastoralists to keep smaller herds to reduce pressure on resources like water and pasture. The fact is that the indigenous people are aware of: that drought will occur regardless of the pressure exerted on resources by livestock which implies that external advice may not be connected to the local situation as experienced by indigenous people.

Acknowledging the importance of IK to local agriculture and in the mitigation of drought induced famine can encourage projects that are compatible with agro-ecological conditions as well as being socially acceptable. Indigenous knowledge is not static, and progression in its use is made through innovation, as it is with other forms of knowledge. However, viability of management structures associated with it depends on who is willing to support them, and also use of local knowledge and local decisions in the mitigation of drought induced famine all of which are critical and conducive to increasing productivity and sustainability.

Although, drought and famine are viewed as two different concepts, they are closely connected. Droughts are caused by the prolonged absence of rainfall, while famines are caused by lack of food, which may be a consequence of failed rains, human intervention manifested through activities such as war and poor policy or a combination of the two (Wilhite and Glantz 1985). Since drought is a natural phenomenon whose causes are difficult to ascertain, most of the literature reviewed concentrates on drought induced famine.

Famine develops progressively; the first stage is characterized by a series of efforts to increase adaptability through enhancing the ability to purchase food, by selling labour and herds of livestock. For example, when farmers anticipate crop failures, they start selling less important livestock like sheep and goats to get money to buy food. Majority also sell their labour to earn needed cash. Consequently, the prices of both labour and livestock drop, which further diminishes their ability to buy food. Soon the farmers are forced to sell the mainstay of their herds (Sen, 1981).

The second phase of a developing famine begins when men seek work off farm employment, which means the land is farmed more marginally, and whatever herds that remain are moved into farm lands, where they hasten the degradation of the land (Sen, 1981). Thus both the herds and land lose some of their productive value, which can only be restored through re-stocking and investing in the land, and also takes resources that will have to come from the government and external sources, as the farmers and herders will not have the saved income to invest (*ibid*).

The third stage of famine occurs when people are forced to flee physically from their homes or areas they inhabit (Sen, 1981). Once non-farming sources of income from sale of livestock are depleted, families abandon their villages, and this often results in migration into feeding camps where they become dependent on aid, and away from the traditional sources of their income (Caldwell, 1975). As a consequence, the migrating and relocated communities are not able to utilize their indigenous knowledge to mitigate drought and its impacts like famine. This in turn negates and undermines the invaluable role of indigenous knowledge (IK) in mitigating drought induced famine. This sought to address the significance of indigenous knowledge and

its potency in mitigating drought induced famine among the communities living in Kerio Valley in Rift Valley of Kenya.

1.2 Statement of the Problem

Drought and drought induced famine has been a recurrent problem not only in Kerio Valley and its surroundings, but also in many parts of Kenya. Efforts to mitigate the use of both traditional and conventional measures among them giving food relief, relocation of affected people and irrigation farming, among others, have varying success. The most frequent approach to mitigating drought induced famine has been to provide relief food in the short term, and to suggest modifications to agriculture in order to boost food production in the long term. However, these interventions, usually by governments or donor funded Non-Governmental Organizations tend to ignore the indigenous knowledge held by local communities they are trying to help. Many of these interventions do not succeed because local communities do not respond positively to programs developed for different environments, and they may be unfamiliar with technology developed by others and brought to them by strangers.

According to Wilhite and Glantz (1985), drought is a naturally occurring phenomenon of prolonged water deficit. Famine, on the other hand, is the scarcity of food which causes widespread hunger. Although famine may be caused by many factors, including drought (hence the term “drought induced famine”), there are systems of indigenous knowledge which have been employed over the years to mitigate against the onset of drought induced famine and enhance the adaptability and resiliency of its users. Such knowledge is specific to particular environments and micro-climates, and this explains why famine prevention methods from one location may not be effective

in another area (Richards, 1986). Although there are several research findings on strategies for coping with drought, the diversity of responses employed by different communities' means that there has never been a comprehensive study of how drought induced famine should be mitigated. Such a study is necessary given the ecological and cultural diversity of Kenya's ethnic communities.

Problems associated with mitigating drought and famines in the past have been caused by the top-down, complex and expensive nature of external interventions most of which are spearheaded by national government, Non Governmental Organizations (NGO) and development partners. As a result, insufficient attention has been given to the contributions of local knowledge and decision-making the famine mitigation process. Ignoring indigenous knowledge has resulted in the misallocation of resources aimed at mitigating drought induced famine and the application of inappropriate management strategies. Therefore, indigenous knowledge must be strengthened through co-operation with external actors such as NGOs and integrated in government programmes in order to facilitate a unified approach to combating drought and famine ((Institute of Development Studies, 2005). Therefore, there is inadequate knowledge of what indigenous communities do to safeguard themselves against the ravages of drought induced famine. In order to provide adequate understanding and also contribute to knowledge on this topic, the study sought to assess the significance of indigenous knowledge and its potency in mitigating drought induced famine among these communities.

1.3 Justification of the study

This study is significant since it is hoped that findings and recommendations will assist policy makers from Ministry of Agriculture, Ministry of Environment and other

stakeholders in planning and mitigating drought induced famine in other parts of Kenya. The study would stimulate debate on impacts of drought induced famine on the resident's livelihoods as well as the indigenous knowledge based mitigation measures. The effects of drought induced famine include loss of lives of both livestock and humans. It is therefore, important that the use of IK in mitigating drought induced famine will offer key lessons and suggestions on local solutions which could enhance the local communities' resilience to drought. This research will provide insightful reference to policy makers, education and extension officers, researchers and scholars in Kenya in regard to community based strategies for combating drought induced famine in other parts of Kenya, particularly the Arid and Semi-Arid Land (ASALs).

Findings of this study will benefit farmers and other stakeholder residing in drought prone areas that face similar challenges. Findings will also help identify the major problems hindering the efficiency of indigenous knowledge coping strategies of drought induced famine and propose solutions to mitigating these problems. This will in turn help in establishing a deeper understanding of the concept of indigenous knowledge and how it used in mitigating drought induced famine. The study will provide useful information to the farmers and other stakeholders on key drought induced famine mitigation measures and equip them with knowledge on how to deal with drought induced famine

1.4. Objectives of the Study

The main objective of the study was to assess the role of indigenous knowledge and its potency in mitigating drought induced famine among residents of Kerio Valley in Kenya.

Specifically, the study was guided by the following objectives:-

a) To establish the rate and frequency of occurrence of drought induced famine.
b) To examine the effects of drought induced famine on the livelihoods of communities living in Kerio valley
c) To determine the effectiveness of indigenous knowledge in mitigating the effects of drought induced famine among the communities living in the area.
d) To determine whether appropriate usage of indigenous knowledge reduces the effects of drought induced famine among communities living in the valley.
e) To suggest policies measures to be adopted for effective drought mitigation and famine reduction among local communities and other stakeholders living in Kerio valley.

1.5 Research Questions

The study was guided by the following research questions:

(a) How often does drought induced famine occur among the communities living in Kerio Valley?
(b) Are there any relationship between drought induced famine and the livelihoods of communities living in Kerio valley?
(c) What is the effectiveness of indigenous knowledge in mitigating the effects of drought induced famine among communities living in Kerio valley?
(d) Is the utilization of indigenous knowledge effective in mitigating the effects of drought induced famine among communities living in Kerio Valley?

(e) Which strategies measures should be adopted by local communities living in Kerio Valley and other stakeholders to promote effective mitigation of drought induced famine?

1.6 Hypotheses of the study

To address the study objectives, the following hypotheses were tested:

H_0: There is no relationship between drought induced famine and the livelihoods of communities living in Kerio valley and mitigating strategy adopted.

H_0: There is no relationship between appropriate usage of indigenous knowledge and the reduction in the effects of drought induced famine among communities living in Kerio valley

1.7 Assumptions of the study

(i) The answers given through the research instruments will be honest responses.

(ii) Respondents will report their personal opinion accurately.

(iii) The study population and the sample selected for the study operate within the same environmental conditions and will give related responses that will be true and reliable with regard to indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio Valley

(iv) Local communities living in Kerio Valley and other stakeholders involved in mitigating drought induced famine in the selected study area will cooperate in the course of this study and will be able to give the required information without any hesitation.

1.8 Scope and Limitations of the study

1.8.1 Scope of the study

The study focused on the role of indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio Valley. The study was restricted geographically to Kerio Valley, and was undertaken among three communities that occupy Kerio Valley, namely the Keiyo, Marakwet and Tugen. The study targeted respondents who comprised of members of the selected communities' households living in Kerio valley, government officers from the Ministry of Agriculture and Livestock, Non-Governmental Organizations and Community Based Organizations operating in the area

Kerio Valley was chosen as a study site because of documented evidence of the increased problem of drought which has continued despite coping strategies and planning measures being in place. Likewise, incidences of drought recorded are many and have had profound effects on residents, livestock, livelihood and the natural resources base at large

1.8.2 Limitations of the study

The study encountered a number of limitations among them the selection of the sample size. Although the study area traverses various districts among them Keiyo, Baringo and Marakwet, and is inhabited by diverse commonality with some district culture, only the Keiyo, Marakwet and Tugen were sampled. The selection of the three was limited by manpower and resource constraints. It is envisaged that this sample represented the study area and other areas in Kenya faced with similar or

related drought induced famines. Therefore, findings of this study can provide a basis for future studies in other districts faced with similar challenges in Kenya.

Climatically, Kerio valley is an arid and semi-arid area with low rainfall and the formation of rift valley elicited warps, steps and rugged escarpment making it difficult to access the area. Despite this, the researcher and her team had to trek long distances through the steep rugged terrain to collect data. The two elements (science and indigenous knowledge to forestall drought-induced famine) are continually interacting and influencing each other this activating the process of drought-induced mitigation. Therefore, it was necessary to obtain data concerning the role of each in determining the effective mitigating measure to drought induced famine. Keeping these objectives in view, a comprehensive questionnaire was prepared to collect perceptional responses of these categories. However, despite the above mentioned shortcomings, various measures were taken to ensure that the study process was objective, accurate, valid and reliable.

Keiyo, Baringo and Marakwet districts were located far apart from each other and this posed a challenge especially when it came to movement during data collection. The condition of the roads was generally so poor that access to some of the study areas was a constraint. The most common means of transport in the area was motor cycle whose riders do not posses driving licenses or safety gear. Despite these limitations, a four wheel vehicle was hired to easy movement to the study areas. However, all the appropriate scientific approaches were undertaken to ensure that the confidence levels of the sampled was high enough and were implemented.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents literature related to drought induced famine and the role and potency of indigenous knowledge in mitigating it. The chapter is subdivided into sub-sections guided by the objectives of the study. The specific areas covered here included theoretical and conceptual frameworks underpinnings of the study

2.2 Overview of Drought and its implications

Wilhite and Glantz (1985) argue that the process of defining the phenomenon is highly important as it ―determines the likely response of societies to drought events. Worsening drought, water restrictions, and wildfires have been widely featured in news reports across the world during recent Years (NASA, 2004). Globally, drought areas increased more than 50% during the 20th century largely due to the drought conditions over the Sahel and Southern Africa during the latter part of the century while changes in wet areas were relatively small. The Palmer Drought Severity Index from 1870 to 2002 shows the dominance of precipitation variations in its spatial and temporal variability. The biggest source of drought worldwide is El Nino Southern Oscillation, which also highlights the concurrent nature of floods and droughts, with droughts favored in some areas during El Nino, while wet areas are favored in other areas. These tend to switch during La Nina in the tropics and subtropics (Cole *et al.* 2002).

Paleo studies show dramatic observed changes in drought and the hydrological cycle over many parts of the world. A growing wealth of paleo-data reveals that decades-long droughts (sometimes termed "mega-droughts"), such as the current Sahel drought, are not uncommon (Trenberth, *et al*, 2003). Moreover, this scale of drought has been eclipsed in the past by droughts lasting a century or more (Laird *et al*, 1996).Thus, the full range of drought variability is potentially much larger than has been seen in the last 100 years.

For example, in North America, Dust Bowllength events occurred on average one to two times per century and longer, 10-25-year events occurred as well (Giannini *et al.*, 2003). A drought lasting over 20 years across much of the conterminous United States occurred in the late 16th century and it appears that droughts in the Sierra Nevada region have lasted over 100 years in the past (Stine, 1994). Although the most detailed reconstructions of past North American drought have been realized through analysis of tree rings, strong supporting evidence is provided by limnological indicators on lake levels and aeolian sand deposits that indicate dune reactivation. Luminescence dating techniques that do not depend on the presence of organic matter provide new insights into the latter. Mega-droughts in the past have had major impacts on civilizations. Convincing evidence from closed basin lakes in the Yucatan peninsula of Mexico suggests that a series of three droughts around 810,860, and 910 A.D. coincided with the collapse of the Mayan civilization (Haug *etal.*, 2003).

Kenya has an area of approximately 587,000 square kilometers. According to GOK (1991), 70-80% of this area is dry land while the rest (20%) is covered by water. Kenya's land mass can be broadly classified into seven agro-climatic zones based on

the moisture index. According to this classification, arid and semi-arid lands (ASALs) fall within zones IV to VII and occupy about 88 per cent of the total land area (GOK, 1991). These areas are also prone to droughts whose severity may sometimes lead to famine.

Although drought and famine are distinct phenomena, they are to some extent inter-related. A drought, according to Folley (1957) is a temporary, severe reduction of available water compared to normal times. Palmer (1965) defines drought as a period of months or years during which the actual moisture supply at a given place consistently falls short of the climatically appropriate moisture supply. According to the World Meteorological Organization (1984), drought is defined as an extended period of abnormally dry weather that causes water shortages and crop damage. A drought starts when total rainfall is well below average for several months. Other signs of drought include: unusually low river flows, low groundwater and reservoir levels, very dry soil, reduced crop yields or even crop failure, and algae blooms in reservoirs and lakes. Also, high temperature low humidity and high evaporation rates leading to rapid loss of surface water. Groundwater is not replenished because not enough rain is falling to wet the soil's entire surface area and to be absorbed properly (World Meteorological Organization, 1984).

Drought conditions lead to increased growth of algae in lakes, ponds and other slow-moving bodies of water. In this water bodies becomes no longer a safe place for fish and other aquatic life. Animals that drink from the rivers or streams often get sick and die; and swimmers in affected waters may become ill. The ecology of an area may be affected by the drying of wetlands, with wading birds dying out. Crop production will

be lower than usual; and trees may die. Wildfires spring up; lack of irrigation can lead to famine and disease. Sociological consequences of drought range from social unrest to relocation of populations to war (Glantz, 1997).

There are four types of drought: meteorological, agricultural, hydrologic, and socio-economic (Wilhite and Glantz, 1985). While these drought types overlap to some extent, they differ and sometimes create confusion in the identification of what some people may feel is a drought or not. Perhaps most crucial is the realization that drought is not just a lack of rain, but can also be defined according to its impacts such as most direct effects of drought manifested through withering and/or stunted crops, empty reservoirs and desiccated grazing lands. There are also widespread, costly indirect consequences such as price increases, greater food imports, migration from rural to urban areas, and step-like changes in environmental degradation.

Meteorological drought is often measured as a designated period of time with precipitation less than a specified amount. Such a view considers the degree and duration of dryness when compared to a long-term average (called normal). The availability of moisture at different times in the growing season to meet crops' needs is the basis for classifying a drought as agricultural. A hydrologic drought refers to a period when stream flows are unable to supply established users under a given water management system. Agricultural drought is a period that associated with dry soils below-average precipitation, intense but less frequent rain events which lead to reduced crop production and plant growth. Socio-economic definitions of drought relate to the supply and demand of specific goods. A drought-related shortage of food crops, for example, marks a drought condition in the context of human needs.

Significantly, humans can create a drought situation through land-use choices or excess demand for water (Glantz, 1997; Wilhite and Glantz, 1985).

While drought itself is periodic and unavoidable, its adverse effects penetrate many facets of society such as land quality, acreage planted, export crop acreage, migration, labor supply, urbanization, food imports, and rural poverty (Glantz, 1997). As it gradually worsens, it reveals interdependent socio-economic conditions. However, it must be remembered that all definitions of drought are relative, as there is no universally accepted standard of adequate rainfall. Indeed, what may be considered adequate in one place may fall far short of expectations in another? This observation is supported by Roger *et al.*, (1999), who argue that the term 'normality,' in relation to weather, depends on the length of time for which records have been continuously kept. Thus 'normal' rainfall as measured over a century may differ significantly from 'normal' rainfall as measured over a longer period of time.

A famine situation is regarded as extreme lack of food security which causes widespread hunger (Reutlinger and Sclowsky, 1986). Other authors prefer to use the terms "food security" and "food insecurity" rather than "famine" (Sen, 1981; Blench and Marriage 1998). Other authors (Ndiaye, 1994; Danaher, 1994; Poulson, 1994; and Smith, 1991) attribute hunger to man-made causes without giving full consideration to the effect of drought on famine. On the other hand, it is widely believed that famine is an entirely natural phenomenon. Despite this, vulnerability to weather is a function of preparedness as well as of the event (drought) in itself. Therefore, the current study makesa linkage between drought and famine. Hence for the purpose of the current study, a drought induced famine refers to a period of low moisture supply which creates food insecurity, leading to widespread hunger (Foster, 1992).

A large number of people globally are affected by drought induced famine. Drought affected more than 4.4 million people in Kenya and more than 12 million people in the Horn of Africa from 1999 to 2001 (OCHA, 2001). These statistics were corroborated by the International Federation of the Red Cross which reports that the Government of Kenya declared drought a national disaster at the beginning of 2006, with the number of people affected increasing from 2.5 million in mid-December 2005, to 3.5 million by mid-January 2006 (IFRC, 2006). In recent years, at least 485 million people or 65% of the African population was affected by drought (Reuters, 2007). Estimates from individual countries report increasing areas affected by drought and/or desertification. It was estimated that 35% of the land in Ghana was affected by drought in 2002 (Brown, 2006). Further, Seventy percent of Ethiopia, 49% of Swaziland, 10% northern states of Nigeria and more than 30% of the land area of Burundi, Rwanda, Burkina Faso, Lesotho and South Africa is under severe or very severe threat of drought (Brown, 2006).

As indicated in the preceding sections, there are four different types of drought namely meteorological, hydrological, and agricultural and socio - economic drought. These types were categorized by Thomas (1965). Meteorological drought occurs when there is a precipitation deficiency over a pre-determined period of time, such as 50 percent of normal precipitation over a six-month time period. These parameters vary over time and space. Consequently, food production is reduced, while the risk of environmental degradation increases.

Hydrological drought is caused by deficiencies in surface and subsurface water supplies relative to average conditions at various points in time through the seasons. Hydrological drought results in lack of water for efficient agricultural production, hydroelectric power generation and for domestic and industrial use. Agricultural drought occurs due to lack of availability of soil water to support crop and forage growth rather than the departure of normal precipitation over a specified period of time. The combined effect of depleted ground water and increased evaporation losses reduce crop and livestock yields. This affects food production acutely, leading to food insecurity, hunger, starvation and sometimes death. Despite this, Thomas (1965) does not acknowledge that famine can be avoided even during drought, by ensuring that food reserves are adequate to sustain the population until agricultural production can be restored to previous or sustainable levels. Lastly**,** socio-economic drought occurs due to variations in relationships between the supply and demand for commodities or economic goods (such as water, livestock forage, or hydroelectric power) that depend on precipitation. In an event of socio-economic drought, the supply of water varies annually as a function of water availability while the demand for the water fluctuates and this is often associated with a positive trend as a result of increasing population, development, and other factors. Social drought is thus a component of the three forms of drought above, as each of the first three types of drought has socio-economic consequences on economic growth, poverty reduction, food security, water, biodiversity, energy and on migration.

The four types of drought defined above may induce famine whose magnitude and effect often vary from place to place. However, it must be emphasized that while the foregoing studies have made a significant contribution to our understanding of what

drought is, they have not sufficiently distinguished between famine and drought, and that famine can be avoided, by taking measures in advance to ensure that drought will not induce famine. Therefore, this study highlights how such measures can be developed and implemented, using indigenous knowledge.

2.3 Causes of Drought induced famine

Drought is a complex phenomenon, and it is difficult to attribute its occurrence to a single cause. According to Berani and Rodier (1995), the underlying cause of most droughts is related to changing weather patterns manifested through the excessive build up of heat on the earth's surface, meteorological changes which result in a reduction of rainfall, and reduced cloud cover, all of which result in greater evaporation rates. The resultant effects of drought are exacerbated by human activities such as deforestation, overgrazing and poor cropping methods, which reduce the water retention of the soil, and improper soil conservation techniques, which lead to soil degradation. The Intergovernmental Panel on Climate Change (IPCC, 2007) concurs with this scenario, attributing the occurrence of drought, and its increasing frequency, to atmospheric warming; a condition that has been compounded by anthropogenic factors attributed human activities such as mining, use of pesticides, cement manufacturing, waste management and the possible consequences of altered atmospheric patterns.

Although drought induced famine is a consequence of drought, although it does not however, necessarily follow that famine must accompany drought (United Nations Secretariat of the International Strategy for Disaster Reduction, UN/ISDR, 2007). According to (UN/ISDR, 2007), some regions are more prone to drought than others,

and drought induced famine is a by product of differing capacities of countries to effectively prepare for and respond to the effects of drought. As a result, the number of people affected by drought and the types of impacts experienced (for instance, drought induced famine) will vary by region. UN/ISDR (2007) also compares the effects of prolonged drought in Africa, which can contribute to famine, malnutrition, loss of life and emigration with the effects of droughts in developed countries, which primarily result in economic losses. Thus it is fair to say that while droughts are inevitable, drought induced famines are not. Hence the current study examined the contribution that indigenous knowledge towards mitigating drought induced famines. The study sheds light on how indigenous knowledge can be incorporated with scientific knowledge in order to be implemented by all stakeholders.

2.4 Status and trends of drought induced famine

Droughts continue to have significant impacts in both developed and developing countries. The latter still suffer from droughts the most. The increasing exploitation of water resources and associated water scarcity coupled with the growing concern that future climate change will exacerbate the frequency, severity, and duration of drought events and associated impacts explains the increasing attention that individual countries are paying to drought-related issues (Wilhite, 2004). Since drought is a global phenomenon, it is important to focus on a global development perspective in order to understand the pattern of various drought-related characteristics and impacts worldwide. Such characteristics should reflect multiple aspects of drought, ranging from quantification of drought hazard and vulnerability of water resource systems - to measures of preparedness to face future droughts.

According to FAO (2004), there are 1.2 billion undernourished people in the world today due to drought induced famine. Drought is currently the single most common cause of food shortages in the world. In 2006, recurrent drought caused crop failures and heavy livestock losses in part of Ethiopia, Somalia and Kenya (See appendix H).

In Asia and the pacific region 525 million or 17% of the total population of 3 billion suffer from under nourishment and the worst hit countries are North Korea, Mongolia, Cambodia and Bangladesh. In addition, there are millions of drought affected people in Tajikistan, Pakistan, Iran, Armenia and Georgia. Two thirds of Africa is classified as deserts or dry lands. These are concentrated in the Sahelian region, the Horn of Africa and the Kalahari in the south. Africa is especially susceptible to land degradation and bears the greatest impact of drought and drought induced famine. It is estimated that two-thirds of African land is already affected to some degree and drought affects at least 485 million people or 65% of the entire continents population (Reuters, 2007). Climate change is set to increase the area susceptible to drought, and famine in the region. Under a range of climate scenarios, it is projected that there will be an increase of 5-8 percent of arid and semi arid lands in Africa (IPCC, 2007).

Plate 2.1 Stock loss due to persistent drought in 2006 at Kajiado County. (Source: WFP/Evelyn Hockstein, 2006)

Estimates from individual countries indicate increasing areas affected by or prone to drought and/or desertification. It is estimated that 35 percent of the land area (about 83,489 km^2 or 49 out of the 138 districts) of Ghana is drought prone, with the Upper East Region and the eastern part of the Northern Region facing the greatest hazards (Brown, 2006). Seventy percent of Ethiopia and 80% of Kenya is under constant threat of drought, while estimates within Swaziland suggest that between 49 and 78% of the land is at risk, depending on the assessment methodology used (Government of Swaziland, 2000). Drought persistently affects each of the 10 northern states of Nigeria (Brown, 2006). It is also estimated that more than 30% of the land area of Burundi, Rwanda, Burkina Faso, Lesotho and South Africa is under severe or very severe threat of drought. The prevalence of drought and famine undermine and pose

serious threats to the livelihoods of millions of people struggling to edge out a living. Therefore, innovative ways need to be found to mitigate against drought induced famine. The current study hypothesizes that if well utilized, indigenous knowledge can play a critical role in this.

Africa has witnessed a high frequency of occurrence and severity of drought. This is likely to continue, as climate change is set to exacerbate the occurrence of climate related disasters including drought. Current climate scenarios predict that the driest regions of the world will become even drier, (UNESCO, 2006) signaling a risk of persistence of drought in many parts of Africa which will therefore bear greater and sustained negative impacts. With foreknowledge, drought can be prevented from inducing famine. Therefore the current research investigates how indigenous knowledge can be used to predict drought in order to implement mitigation measures.

Drought is a climatic condition, and it is often viewed as a shock event punctuating a period of acceptable climatic variation. A climatic shock such as drought is a discontinuity that is sufficient to be classified as unpredictable and life-threatening. The nature of the climatic shock is determined by a region's ability to cope. Thus a rainfall deficit over a month in a sparsely populated region may cause drought; but a similar deficit can become a drought induced famine if the population is ill-prepared to manage it (Glantz, 1997). This suggests that there is a relationship between the frequency of droughts and that frequency of drought induced famine. Such a suggestion can be contested on the ground that some drought induced famines may be the consequence of poor management since droughts interventions have been concentrated on formal coping strategy mainly relief food supply. However, this has

not been effective and this scenario can be addressed by emphasizing on indigenous knowledge and its potency in mitigating drought induced famine. Also, the integration of informal and formal drought coping strategies will make them more effective and sustainable as the current study intends to show.

In spite the influence of poor policies on the mitigation of famines, the impacts and consequences of the variability of rainfall in Africa is well documented (Dalby, 1977; Cossians, 1983; Bennke, 1988; Awoundo, 1990; Nunow, 1994, 2000; Dahl and Hjort, 1997; Adano and Witsenburg, 2004)), and the timing and intensity of rain is important with regard to crop production and grazing. However, the question as to whether rainfall in Africa is actually declining has been the subject of much debate, although there has been no satisfactory response since the answer is dependent on the length of the sample period and the reliability of data, especially from earlier periods (Nicholson, 1983). Analyses that begin in the 1950s certainly show a decline, as the 1960s were generally a period of high rainfall. In the Near East for example, in Jordan, it is widely believed that rainfall has been declining in the century. However, an analysis of figures dating back to 1921 suggested that there was no significant long-term trend (Blench, 1998). In southern Africa, a warming of around 0.05°C per decade has been recorded over the last century, and this has been accompanied by two or three severe drought years in the early 1990s. However, recent years have been wetter, casting doubt on the identification of trends (Hulme, 1996; Oliver and Farbridge, 1987). From the foregoing review, it is evident that the unpredictability of rainfall is definitely a factor in drought induced famines, although the foregoing authors have not alluded to the connection between the two.

On the other hand, Gebremedhin (1997) contends that famine is caused by a complex set of social, economic and political factors that differ depending in a spatial and time context. Despite this, the author does not report anything about climate or rainfall. Such a view overemphasizes the human factor in drought induced famines, and underestimates the impact of weather. The author alludes that hunger has been a part of human experience for centuries and that an understanding of the main causes of hunger and starvation has been hampered by myths and misconceptions about the importance of population growth, land use, farm size, technology, trade and environmental factors.

In southern Africa, droughts are often linked to the El Niño phenomenon. The phenomenon that is associated with the reduction of southern Africa‘s rainfall, an impact that has led to the region experiencing recurrent drought conditions (SADC, 2008). Wilhite (2002) argues that a stronger El Niño signal is a clear sign of difficult drought seasons ahead. The destructive droughts of 1875-1876 (northern China), 1877-1878 (Brazil, India and Morocco) and 1888 1889 (Russia, Korea and Ethiopia), for example, were linked to El Niño effects (Wisner, *et al*., 2004), while the occurrence was blamed for the 1992 drought in southern Africa (Chenje and Johnson, 1994). The current study not only hypothesizes that all of these factors play a role in the emergence of famines, but also intends to demonstrate that trends in drought induced famines are influenced more by the weather than by any other factors.

2.5 Impacts of drought induced famine

Extreme droughts have major impacts on both ecological systems and on society (AMCEN/UNEP, 2002). Droughts have long contributed to human migration, cultural separation, population dislocation and the collapse of prehistoric and early historic

societies (Pandey *et al.,* 2003). According to the World Water Forum (2000), one-third of people in Africa live in drought-prone areas and are vulnerable to the impacts of droughts, including famine. During the mid-1980s the economic losses from droughts totaled several hundred million U.S. dollars (Tarhule and Lamb, 2003). A large number of authors are in agreement concerning the impact of droughts in the Sahel, the Horn of Africa and southern Africa, particularly since the end of the 1960s (Richard *et al.,* 1986; Brooks, 2004; Christensen *et al.,* 2007; Trenberth *et al.,* 2007). Whilst the aforementioned authors have closely examined the economic effects of droughts, they have not given due consideration to drought induced famine as one of the effects. The following sections nonetheless, shed light on the impacts of drought induced famine on specific aspects of the economy, environment and livelihoods.

2.5.1 Impacts on economic growth

One way to measure the impact of a disaster is to look at changes in Gross National Product (GNP) or Gross Domestic Product (GDP). Over the last three decades, specific droughts have reduced GNP by at least one percent in countries in East Africa, Europe, North America, South America, Southeastern Asia/Australia, Southern Asia, and West Africa (World Conference on Disaster Reduction, 1994). Drought can have dramatic deleterious effects on nations' economies, which tend to reveal themselves immediately and are short-term in duration. Simple and intermediate economies are especially susceptible, because they are driven by a large agricultural sector. Food availability and prices, employment, access to imports, government expenditures, availability of social services, and credit sources are all influenced by drought. Countries unable to hurdle drought events and achieve longer-term economic development, suffer longer-range effects of drought.

Drought induced famine has a major impact in Africa, because the majority of the populations in most African countries live in rural areas and practice rain-fed agriculture. Therefore drought threatens agricultural production on these marginal lands (United Nations Convention to Combat Desertification, UNCCD, 2004; Conserve Africa, 2006), this undermining economic development. The impact of drought and climatic variability in both economic and mortality terms is generally larger for predominantly agricultural economies, which are predominant in Africa. UNCCD (2004) estimated that drought caused income losses worldwide totaling to US$ 42 billion per year. However, estimates of what proportion of this loss was due to drought induced famine were not calculated, GDP loss from reduced agricultural productivity due to drought in Ethiopia was estimated at $130 million per year (UNCCD, 2004).

The World Bank and the United Nations International Strategy for Disaster Reduction (UN/ISDR 2007) reports that the drought of 1990/1991 in Zimbabwe resulted in a 45 percent drop in agricultural production, a 62 percent decline in the value of the stock market, a 9 percent drop in manufacturing output and a GDP drop of 11 percent. Similarly, in Kenya, the drought of 1999-2001 cost the economy some 2.5 billion dollars. As a proportion of the national economy this is a very significant loss and can best be thought of as 2.5 billion dollars of foregone development in terms of hospitals and schools not built. Such serious economic impacts call for measures of limiting the effects of droughts and drought induced famines. Indigenous knowledge has the potential to do this especially in terms of sustaining agricultural production in times of drought. Hence, this study aimed at assessing the role of and potency of indigenous knowledge in realizing this.

The economic effect of drought induced famine in the rural areas is mainly felt in terms of the time and effort required to get water. Since people rely mainly on streams and dams, the economic impact is severely felt in terms of water quality and distances traveled in search of water. Another economic implication on the rural population is in extreme cases where people have to buy water at exorbitant prices, even though most people in these areas are unemployed. This has implications on poverty levels, as the increased cost of water affects their purchasing power and negates government efforts to reduce poverty.

UNEP (2008) reports that drought has had a devastating impact on the economy of Swaziland, with about 90,000 cattle dying in the drought of 1999, and causing a major economic shock as cattle are a major source of wealth in the country. Because of the persistent droughts that occur in the country from time to time, food insecurity is high, and drought induced famine is an ever-present possibility. Furthermore, production of the country's staple food, maize, has been on a long-term decline, dropping by 70 percent over the last five years in some areas (Edje, 2004), due to the fact that arable land is uncultivated because of delayed rains, the high risk of making a loss from agriculture and shortages of seeds for alternative crops, among other reasons.

Drought is one of the major threats among natural hazards to people's livelihoods and socio-economic development. Drought is one of the major natural hazard threats to people's livelihood and community socio-economic development. Each year, disasters originating from prolonged drought not only affect tens of millions of people, but also contribute to famine and starvation among millions of people, particularly in some African countries. In 2006, extreme drought affected several countries in the Horn of Africa. Especially hard hit were people in the countries of Ethiopia, Somalia, Kenya,

Eritrea, and Djibouti, where nearly 18 million people were estimated to be suffering from food shortages during the drought's peak in early 2006 (ISDR/World Bank, 2007). UNICEF surveys revealed acute malnutrition rates of approximately 20 percent among children in many drought-affected communities (ibid). Therefore indigenous knowledge should be enhanced to help these farmers to overcome the hazards of drought induced famine.

2.5.2 Environmental Impacts

Pimentel *et al* (1994) state that poverty poses a serious environmental threat in many low-income countries, because millions of people live near the subsistence minimum, and have to exploit natural resources with inappropriate technologies in order to survive. The authors also state that export-oriented agriculture undermines both the position of the poor as well as the environment. When commodity prices rise, small subsistence farmers are pushed on to marginal land by cash crop producers seeking to profit from higher commodity prices. To support this, they cite the stabilization policies designed by the International Monetary Fund (IMF) which caused severe hardship and economic crisis for millions of people in Africa, forcing the landless poor to survive by farming marginal lands. The result was serious deforestation and soil erosion (Danaher, 1994).

Generally, it is not only the quest for increased food production that threatens to destroy the environment, but also the damage to the environment is often inflicted by commercial cropping patterns of corporate farms who export non-food crops while forcing the rural majority to eke out a meager living on marginal lands (Danaher, 1994). Thus, unless there is concerted action, many of the subsistence farmers already living on the verge of poverty will be moving into marginal lands, which will cause a considerable amount of resource degradation and lead to environmental damage and

global warming. Therefore the key impact of drought induced famine on the environment is that it leads to less judicious exploitation of land resources, causing soil erosion, which leads to poor harvests, which in turn encourages more degradation by farmers, and so on. This vicious cycle can be countered by the use of indigenous knowledge to promote sustainable farming practices. Indigenous knowledge, particularly agricultural and environmental knowledge, gained international recognition after the United Nations Conference on Environment and Development (UNCED) held in June 1992 in Rio de Janeiro. Agenda 21, one of the environmental agreements signed at UNCED, emphasizes that governments and intergovernmental organizations should respect, record, and work toward incorporating indigenous knowledge systems into research and development programs for the conservation of biodiversity and sustainability of agricultural and natural resource management systems. Despite this, most countries among them Kenya has been slow in adopting and implementing the aforesaid declarations and agreements thus leading to the continued marginalization of indigenous knowledge.

Changes in a variety of ecosystems are already being detected, particularly in southern African ecosystems due to the combined effects of drought, drought induced famine and poor agricultural practices. In response to the problems associated with sustainable agriculture, indigenous peoples in Africa have developed farming methods that harm the environment as little as possible. For instance, UNEP (2008) documents the use of grass strips as a form of land management in Swaziland. These are pieces of land with traditional vegetation, one to one-and-a-half meters wide, which are left between fields to control soil erosion and conserve biodiversity. The strips also serve as sources of medicinal plants and feed for livestock. As a consequence, these

indigenous based practices have been used to improve land management, enhance soil conservation and mitigate environmental degradation.

Similar environmental conservation methods have been recorded in other parts of Africa. For example, agro-pastoral communities practiced controlled grazing to conserve vegetation. They practiced grazing rotation to avoid overexploitation of vegetation. Among the Lake Victoria communities, for example, this rotational grazing was practiced as a form of transhumance where animals were grazed in the higher areas during the wet season and brought back to the river banks and lake shores during the dry seasons (UNEP, 2008). In the drier areas of Makueni and Kwale districts of Kenya, livestock was moved from pasture to pasture in order to maintain the ecological balance, while in Kitumbeini division of Arusha region in Tanzania the Maasai pastoralists practiced the *ronjo* system, a traditional method of dividing the village into pasture zones to conserve their pasturelands and prevent drought-borne disasters. However, pure pastoralism was the most common practice of the Maasai, who seasonally moved their herds to take advantage of the rangeland. These different farming systems clearly show that indigenous knowledge in agriculture was more than sufficient to meet the needs of African communities, and that it can still be used today to mitigate against drought induced famine.

The relationship between human activity and rainfall levels is difficult to establish. While it is clear that lack of rainfall may lead to drought induced famine, it is not clear whether a drought induced famine can have knock-on effects that affect rainfall levels. Regardless of these factors, rainfall patterns exhibit notable spatial and temporal variability (Hulme *et al.,* 2005). Inter annual rainfall variability is large over

most of Africa. In West Africa, a decline in annual rainfall has been observed since the end of the 1960s, with a decrease of 20 to 40% noted between the periods 1931-1960 and 1968-1990 (Nicholson, 1983; Chappell and Agnew, 2004). In the tropical rain-forest zone, declines in mean annual precipitation of around 4% in West Africa, 3% in North Congo and 2% in South Congo for the period 1960 to 1998 have been noted (ibid). A 10% increase in annual rainfall along the Guinean coast during the last 30 years has, however, also been observed (Nicholson, 1983). Although these findings are not conclusive on whether rainfall and drought induced famine form an interlocking cycle, it would be wise if indigenous knowledge is adopted as a precautionary measure to ward off the threat of famine. This study aimed at doing this.

Christensen *et al* (2007) report that terrestrial vegetation cover is associated with dynamic feedbacks on the physical climate. An increase in vegetation density, for example, has been suggested to result in a year-round cooling of 0.8 C in the tropics, including tropical areas of Africa (Bounoua *et al.,* 2000). This lends support to the idea that indigenous cultivation practices may prevent droughts from occurring, and may mitigate their effects when they do occur. Further, the complexity of the interactions precludes 'simple interpretations'; for instance, the role of human-induced factors together with climate, can contribute to changes in vegetation that feed back into the overall physical system in complex ways (Eklundh and Olsson, 2003; Held *et al.,* 2005; Herrmann et al., 2005; Olsson *et al.,* 2005). Therefore, the study will investigate the interactions between natural phenomena and human activity and make suggestions on how indigenous knowledge can contribute to filling the knowledge gap identified.

2.5.3 Impacts on water and food security

Drought influences water availability, which is projected to be one of the greatest constraints to economic growth in the future. Human welfare and progress have been closely associated with access to freshwater. However, in the last century rapid population growth and development of human activities have interfered with hydrological processes. Issues related to freshwater quantity and quality are becoming serious in many regions of the world. Arid and semi-arid regions face increasing stress from water scarcity (See appendix I), while most of the globe faces growing pollution problems as a result of environmental change and lack of adequate management. The population of water-short countries was estimated to be 550 million in 1998 and is expected to increase to 1 billion by the year 2010, while estimations on water quality pick out that 1 billion people do not have access to clean water, and 1.7 billion do not have sanitation (World Watch News Release, 2006).

According to a report by the International Atomic Energy Agency (IAEA), only about 0.007 percent of all the earth's water is accessible for human use. Competition for fresh water is increasing. Since 1900, demand has increased six times, more than double the rate of population growth. Unplanned settlements in most of Africa's urban centers, currently representing about 60 percent of the urban population, is another major contributor to the problem, as the ever-expanding settlements have had a marked impact on surface and groundwater resources(Bakenaz, 2006).In Africa, climate change is expected to intensify the continent’s increasingly critical water situation. Reduced annual average rainfall and its run-off would increase drought in southern Africa. This would lead to a further decrease in stream flow and the ability of groundwater to ‘recharge’. Therefore, the study will investigate the interactions

between climate change, groundwater resources and human activity and make suggestions on how indigenous knowledge can contribute to filling the knowledge gap identified.

Furthermore, it is projected that by 2025 Southern Africa will also join most countries in North Africa that can already be classified as having absolute water scarcity today (UN/ISDR 2007). Thus it is imperative for policy makers to realize the importance of the issue and to adopt indigenous knowledge, wherever appropriate, to prevent the projected state of affairs from becoming a reality.

These dire predictions on water security mean that countries will not have sufficient water resources to maintain their current level of per capita food production from irrigated agriculture - even at high levels of irrigation efficiency - and they will also be unable to meet reasonable water needs for domestic, industrial, and environmental purposes. To sustain their needs, water will have to be transferred out of agriculture into other sectors, making these countries or regions increasingly dependent on imported food. By the year 2025, it is thus estimated that nearly 230 million Africans will be facing water scarcity, and 460 million will live in water-stressed countries. Already, 14 African countries are subject to water stress or water scarcity, increasing to 25 countries by 2025 (UNCCD, 2004), a situation that will further exacerbate perilous food security and economic underdevelopment. Although this scenario can be averted by using indigenous knowledge in resource management, this remains a conjectural matter.

Projections of water availability for the Nile region are just as pessimistic, with most scenarios estimating a decrease in river flow of up to more than 75 per cent by the year 2100. This would have significant impacts on agriculture, as a reduction in the annual flow of the Nile greater than 20 per cent will interrupt normal irrigation (UN/ISDR 2007). Such a situation could cause conflict because the current allocation of water, negotiated during periods of higher flow, would become untenable (Simms, 2005). Thus all governments in the region will have to find ways and means of forestalling this outcome. Consequences of the foregoing in terms of famine indigenous knowledge has the potential to mitigate drought induced famine. Hence, this study aimed at assessing the role of and potency of indigenous knowledge in realizing this.

Drought induced famine also has effects on the volume of water in rivers and other reservoirs, which has continuously decreased over the years due to changes in land use. Lakes continue to be degraded (Wilhite, 2002) by a combination of siltation, reduced inflow and encroachment by invasive plant species. Collection pans, wetlands and streams are targets of encroachment by agricultural activities. This could have contributed significantly to the drying up of some of these water sources in arid and semi-arid lands leading to severe shortage and low recharge of underground reserves. The Lorian swamp located in North-Eastern part of Kenya is an example (UNEP/GOK 2000) of how reduced water volumes have directly affected the water levels in boreholes in Biyamadhal area of North Eastern province. Such activities mean that in the event of drought, the reserves which would have mitigated the situation will not be available, and so local communities will be unable to mitigate

against the effects of drought. This is in sharp contrast with the systems of indigenous knowledge.

A number of countries in Africa already face semi-arid conditions that make agriculture challenging, and climate change will likely reduce the length of growing seasons and also force large regions of marginal agriculture out of production (UN/ISDR, 2007). Projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected. This would adversely affect food security in the continent, unless intervention strategies are sought (ibid). Indigenous knowledge has the potential to turn things around.

The loss of natural resources, environmental degradation (Van Crowder *et al.,* 1998) and drought (UNCCD, 2004) affects food security. The poor households that are affected by drought do not have adequate resources to deal with food shortages leading to food insecurity and famine that affects millions of people. If land degradation continues at the current pace it is projected that more than a half of cultivated agricultural area in Africa could be unusable by the year 2050 and the region may be able to feed just 25 percent of its population by 2025. Because agriculture is one of the main economic activities in Africa (which represents around 40 percent of the region's GDP and employs about 60 percent of the active labour force), this would lead to a catastrophe with unprecedented repercussions. In two northern regions of Ghana namely Upper West And Upper East severely hit by soil degradation, it is estimated that malnutrition among children increased from 50 percent in 1986 to 70 percent in 1990 (Environmental Protection Agency of Ghana, 2006). From these observations, it is reasonable to suggest that there have been

climate changes in the past, and that use of indigenous knowledge was capable of helping communities adapting to them. Therefore, it should be able to deal with the changes expected in the future.

The UN/ISDR (2007) states that the most severe consequence of drought is famine, and that food aid to Africa accounts for approximately 50 percent of the yearly budget of the World Food Aid Programme. The consecutive droughts that have occurred in Africa since 2001 have led to serious food shortages. At the height of the Horn of Africa's drought in 2000, 3.2 million Kenyans were dependent on food aid, and malnutrition reached 40 percent of the population, more than 3 times the normal level (Simms, 2005). In 2005, Concern, a charitable NGO, in partnership with the Diocese of Malindi, Kenya, provided seed and technical support to 2,129 farm households who were severely affected by drought (UNCCD, 2004). During the year 2005 many other African countries faced food shortages because of the combined effects of severe droughts (Nhambura, 2006; Radford and Vidal, 2005) and desertification that could become semi-permanent under climate change. The worst affected countries included Ethiopia, Zimbabwe, Malawi, Eritrea and Zambia, a group of countries where at least 15 million people would go hungry without aid (FAO, 2005). The situation in Niger, Djibouti and Sudan also deteriorated rapidly. Many of these countries had their worst harvests in more than 10 years and were experiencing their third or fourth consecutive severe drought. This shows that rainfall is the most critical factor in the presence or absence of drought. Therefore, means of storing runoff water should be developed to prevent against drought. Building of local communities' indigenous knowledge is critical in promoting the sustainability of such efforts.

The Sahelian drought and famine of 1968 to 1974 is a horrific reminder of the combined effects and impacts of drought and famine. In a span of six years, hundreds of thousands of people died and millions of animals perished (McHarry *et al.*, 2002). Images of starving children, dead livestock and desolate land quickly grabbed the world's attention and catapulted the Sahel to centre stage (McHarry *et al.*, 2002). In Africa as a whole, food consumption exceeded domestic production by 50% in the 1980s and more than 30% in the 1990s (WWI, 1998). Although agriculture will remain for many years a major contributor to the economies of most developing countries (Van Crowder *et al.*, 1998), in some countries, however, its share of GDP will progressively decline as drought and famine take their toll with food shortages increasing at the same time. This calls for the cultivation of more indigenous, drought resistant crops. Part of the problem of food insecurity in Africa is the increasing consumption of non- indigenous staple foods, which in many cases need to be imported.

2.5.4 Social Impacts

The social impacts of drought on vulnerable communities are enormous. This kind of vulnerable hotspot consists of areas currently experiencing food insecurity and risk of drought, together with a lack of resources to import food (for example southern and eastern Africa, parts of Latin America, and central Asia). The UN Intergovernmental Panel on Climate Change projects a reduction in crop yields in most tropical and subtropical regions caused by mid-continental droughts. Some crops in tropical locations would be decimated because many are already grown in climate conditions near their maximum temperature tolerance. Africa and parts of Latin America are considered to be the most vulnerable regions (McCarthy *et al*, 2001).

Decreased availability of water as a result of climate change could affect populations in the subtropics where water is already scarce. Currently about a third of the world's population (1.7 billion people) live in water stressed countries, and that number is projected to increase to 5 billion people by 2025 (McCarthy *et al*, 2001; National Research Council, 2001; World Health Organization, 1999; Kovats et al, 2000). Decreases in annual average stream flow are anticipated in central Asia and southern Africa, and the food supply may be affected. Politically inflexible regimes can exacerbate climate crises, as may have occurred during the recent severe drought in North Korea (Woodward *et al*, 2000).

Despite technological advances such as improved crop varieties and irrigation systems, agricultural productivity depends largely on weather conditions (McMichael *et al*, 2000). According to FAO (1999), 790 million people in developing countries are malnourished. Nearly half the populations of countries in central, southern, and eastern Africa are already undernourished, and these regions are highly vulnerable. In addition, diarrhoea and diseases such as scabies, conjunctivitis, and trachoma are associated with poor hygiene and result from a breakdown in sanitation if water resources become depleted (Patz, 2001).

In Ethiopia, a recent quantification of the economy-wide impacts of drought has shown disastrous consequences on poverty, hunger, migration and social instability (UNCCD, 2006). In semi-arid countries, one structural adaptation measure is to promote more dynamic and sustained growth of investments in multipurpose hydraulic infrastructure development. This would allow shifting towards a more water-resilient path. At the same time, and with the same level of priority, it is necessary to develop efficient institutions and interventions aimed at decreasing the

vulnerability of the economy to drought shocks. Such institutions and interventions includes meteorological department of Kenya that is involved drought monitoring and early warning. At the national level, drought monitoring systems should be based on a single climatic index like the one that has been developed in China, Australia, and United States and European countries like Canada, Denmark, Finland, Germany, Italy, Japan, Luxembourg, Norway, United Kingdom of Great Britain, Northern Ireland, Sweden, Switzerland (ISDR/World Bank, 2007).

The toll of drought induced famine on human health in Kenya can be inferred from reported decreases in weights of for example children in the Kerio Valley catholic mission clinic (Long, 2000), which corroborated with those of a survey based on weight for height method by UNICEF (2000). Drought induced famine also corresponds with decreased hygiene standards due to shortage of water, causing water borne diseases such as cholera. Thus more research needs to be conducted on how famine induced drought interacts with other factors to cause massive loss of life. The proposed study aimed at doing this with a view of generating data to aids in policy formulation to mitigate this.

Competition for water at the few available sources can also lead to conflicts. This is another social impact of drought induced famines. In Kieni, Nyeri farmers competed for water to irrigate their crops, disadvantaging the farmers downstream this leading to confrontations ((Long, 2000). The prolonged drought also intensified the conflict between the Pokot and Marakwet in the Kerio valley, as the Pokot fed their livestock on the Marakwet's irrigated crops (Long, 2000). Further, the movement of large herds into urban centres due to inadequate pasture led to congestion on roads and quarrels

with city residents in affected estates. The Integrated Regional Information Networks (IRIN, 2000) estimated that up to 75% of Kajiado district's herds were driven into towns due to scarcity of pasture and water as a result of drought. Consequences of the foregoing in terms of famine indigenous knowledge has the prospective to mitigate drought induced famine. Hence, this study aimed at assessing the role and potency of indigenous knowledge in mitigating drought induced famine among communities living in Kerio valley, Kenya.

2.5.5 Impact on biodiversity

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001; 2006) underscores the fact that human–nature relations in arid and semi-arid zones (ASALs) of the globe will have to change rapidly in order to adapt to climate change. This is in order to preserve biodiversity – the variety of species on the planet. The biodiversity that exists in dry lands and other habitats underpins ecosystem services that are vital for livelihoods of millions of people in Africa. Biodiversity is the foundation for sustainable development both in Africa and globally. The dry areas of the world are the origin of a large number of globally important cereals and food legumes, such as barley, wheat, faba beans and lentils (IPCC, 2001; 2006).

However, dry land areas do not support the whole of Africa's population. Four hundred million people, who represent two thirds of sub-Saharan Africa's population, rely on forest goods and services for their livelihood. They are also affected by drought, land degradation and desertification. These factors remain some of the most

serious threats to the management, sustainable use and equitable sharing of benefits of biodiversity.

The projected devastating impacts of climate change will escalate biodiversity degradation and loss associated with drought induced famine. These factors affect biodiversity directly and indirectly. Direct impacts include habitat and species degradation and loss, leading to overall loss of economic and biological productivity. For instance on rangelands, overgrazing not only reduces the overall protective soil cover and increases soil erosion, but also leads to a long-term change in the composition of the vegetation. Plant biodiversity will change over time, unpalatable species will dominate, and total biomass production will be reduced. These in turn trigger and contribute to indirect impacts. Soil erosion contributes to denudation and pollution of wetlands and water bodies. As biological and economic productivity deteriorates, communities are forced to migrate to other areas or to engage in other coping activities that also contribute to biodiversity degradation (UNCCD, 2006). Since ecosystems all over the world are finely balanced, proper care should be taken to avoid upsetting them beyond the point where equilibrium can be restored naturally. In some parts of the world, this equilibrium has been maintained through use of indigenous knowledge and cultural practices.

In West Africa the movement of people south towards sub-humid and humid tropical areas has resulted in loss of primary forests and woodlands, repeated logging of the secondary vegetation, and depletion of a number of species (UNEP 2006). More direct degradation of land resources also occurs in the arid and sub-humid parts. These include the extraction of tree resources outside forests for charcoal making

(about 150 million tonnes/year from the savannah and woodland areas), and the use of high-value woods. Most affected are the Meliacaea *family* (*Khaya species*), *Pterocarpus erinaceus,* and *Dalbergia melanoxylon (ibid).*

Drought induced famine disrupts the diversity of plants**,** change in tree cover that reduces the quality,habitat and species degradation and loss, leading to overall loss of economic and biological productivity. It can cause gradual loss of net biomass, change in species composition and soil degradation. Logging can contribute to soil degradation if not followed by adequate regeneration or if it causes soil compaction erosion or loss of forest productivity. Other causes of degradation are overgrazing, repeated fires, insect infestations, insect borne disease, invasion of exotic or parasitic plants and air pollution.. This practice (known as shifting cultivation, slash and burn agriculture or subsistence agriculture) has been used for millennia by indigenous communities across Kenya, Africa and part of Asia and Latin America. Cleared patches are usually only a hectors or two in size and rarely exclude all woody stems. Cut wood is used for shelter, charcoal and firewood. Clear plots are planted to crops for 1-3 years before they are abandoned and left to forest.

According to Sanchez (1976), when population pressure is low and plenty of land is available, planting, cutting and regrowth cycles of 30-50 years do not reduce soil productivity. Loss of wildlife and plant species is probably negligible. But rising population and short fallow periods of a decade or less creates severely degraded sites and a vegetative cover that clearly seldom returns to forest. Thus FAO considers the bulk of todays shifting cultivation in the tropics to be deforestation. Debates about the causes of deforestation are often as heated as those about yearly rates and amounts lost. The major cause cited by FAO and others is over population and land scarcity.

Individual communities and companies cut forest to produce food. Another one is cattle ranching activities that deforest areas to produce pasture for husbandry that supports export meat market. Eventually the cause of causes of deforestation is irrelevant if the effect is the same: widespread loss of forest habitat and associated organisms. The local, regional and global context of biological, economic, political and social realities however, must be considered when evaluating ways to stop or slow deforestation practice. Therefore selective harvesting practices need to be introduced to control rapid deforestation caused by the need for energy (UNEP 2008).

The impact of drought induced famine on biodiversity has become a major cause for concern in the world in general and in Kenya in particular. With the population over 40 million people in Kenya, the pressure on limited natural resources for increased agricultural production has been mounting, causing encroachment in marginal areas. Rapid population growth, increasing livestock population, overstocking and the relentless cutting down of trees has all exposed the environment to great risk during times of drought. Therefore, the current study recognizes the usefulness and practicability of local communities' indigenous knowledge in mitigating the effects of drought induced famine. Therefore indigenous knowledge should be enhanced to help local communities t**o** mitigating the effects of drought induced famine on biodiversity.

2.5.6 Impact on Energy

The impacts of drought and desertification on the energy sector are felt primarily through losses in hydropower potential for electricity generation and the effects of increased runoff (and consequent situation) on hydropower generation. The gravity of impacts of electricity generation is further established by the case of Ghana, where for

the first half of 2007, the water level at the Akosombo dam had fallen below the minimum level of 72.152 metres. This led to reduction in hydro-electricity generation and hence loads shedding of electricity in the whole country (UN/ISDR, 2007). Energy impacts are also experienced through changes in the growth rates of trees on which a vast majority of people rely for firewood. There is need for concerted efforts in the conservation and management of scarce water resources to be complemented by replanting logged areas with trees that are tolerant of higher temperatures, thinning drought-stressed forests and developing pesticides which have shown to be successful in this regard. India, for example, has developed a participatory forest management approach with an aim to strengthen rural livelihoods by improving the local natural resource base and by involving local populations in the protection and regeneration of degraded lands. Productivity is restored through tree plantations and soil and water conservation measures.

In Kenya, The Seven Forks dams, which are all located along the Tana River, have had relatively high average levels over the years. However, there was a sharp drop in water levels during the 1999-2000 droughts, which had an impact on the economy as hydropower contributes 70% of the country's energy. Masinga, the main dam in the series reduced power generation by as much as 98% (UNEP/GOK 2000). This critically hampered capacity to generate electricity because Gitaru and Masinga power stations had to close down while Turkwel generated negligible electricity. A possible solution is to diversify to other sources of energy such as wind and solar and geothermal that requires neither rainfall nor fossil fuels. Thus available water can be used for mitigation of drought. One of the most important principles of the Convention to Combat Desertification has been the recognition of the value of traditional knowledge in drought management that local communities and indigenous

people have accumulated over time in their interaction with nature. Traditional and indigenous mechanisms and methods to cope with the impacts are well adapted to local conditions. There is evidence that traditional knowledge and methods remain an integral part of indigenous strategy for the development and implementation of drought management policies and measures at the local level.

Rainwater harvesting strategies need to be developed for the domestic, agricultural and industrial sectors as has been done successfully in India. In so doing, the use of low cost technologies as well as increasing damming of rivers where other environmental impacts are taken into consideration is also recommended. This will provide water not only for domestic purposes, but also for productive uses such as irrigation and electricity generation, thus contributing to poverty alleviation. For example in Mongolia ordinary herders can listen to and make use of government funded scientifically driven weather forecasts although scientific prospects for early warning vary by climatic region across the world. There is therefore a need to integrate technological early warning with a local understanding of drought and its impacts, with field level monitoring and with appropriate local level planning and action (Morton, 2001). Weather forecast, early warning and indigenous based monitoring mechanisms were embedded in indigenous knowledge systems of local communities and their role and potency in predicting the occurrence of drought and drought induced famine had varying success in a spatial and time context.

2.5.7 Impact on Migration

Drought induced famine and scarcity of water disrupt the social setup of people. In extreme cases, there is migration to other areas. Some people move their families

from urban to the rural areas as water scarcity worsened (Acosta-Michlik, *et al.*, 2005). As vulnerability due to the combined impacts of drought induced famine and socio-economic susceptibility increase, the greater is the probability of human migration (Acosta-Michlik, *et al.*, 2005). Drought is displacing huge populations of people and forcing them to leave their homes and lands in search of better livelihoods.

Desertification and drought related migration take many forms with the majority occurring as internal migrations (Nanyunja, 2005) and within national boundaries (Mora and Taylor, 2006; Lein, 2000; Zaman, 1991). At greatest risk are those at the low end of the socio-economic spectrum, both in developed and developing regions. Availability of natural resources for example prompts pastoralists along the borders of Ethiopia, Kenya and Uganda to migrate away from areas of dwindling resources; thus raising competition over finite resources with incidence of conflict increasing when these individuals move into areas of crop growing communities (Meier and Bond, 2005). On the other hand, the migration of pastoralists to areas of higher productivity alleviates stress on less productive or exhausted land. Therefore, if the movement of pastoralists is restricted, already marginal land becomes more overused.

Johnson (1975) observes that if pastoralists face a long journey, stock deaths increase, and they must weigh likely losses from the migration against comparable losses were they to stay on suboptimal land. Therefore, it is difficult to assess whether there is any solution to drought induced migration, as water is not available everywhere at the same time. A more precise measurement and eventually forecasting of drought induced displacement would require a better understanding of the mechanisms linking environment stress and demographic behavior. The identification of these mechanisms entails considering different factors, levels of determination, and

temporal and spatial scales (Massey et al. 2007). Furthermore, prolonged droughts may result in disruption of livelihoods, progressive impoverishment, and general deterioration of population's living conditions. Over time, vulnerable households in drought-prone regions like the Sahel, North East Brazil or South America's Arid Diagonal have developed a number of coping strategies in the face of prolonged drought, including (but not limited to) different forms of mobility of the household members.

Previous research on impact of migration has shown that significant factors associated with departures were the severity of the climatic event, human vulnerability to the event, and the type and degree of diversification of local survival strategies. Timing is also of the essence. Initial differences among households and individuals in their tendency to drought-induced migration – based on prior socio-economic and demographic household conditions – disappear over time as an absolute limit is reached in terms of water and food availability, and in time situationcoping mechanisms fail (Caldwell 1975; Faulkingham and Thorbahn 1975; Monimart 1989; Findley 1994; Middleton and Thomas 1997; Ezra 2001; Ezra and Kiros, 2001; Meze-Hausken 2000; Henry *et al.* 2003; Henry *et al.* 2004; Adamo, 2003; Brauch, 2006). The foregoing example shows that a critical understanding is that drought induced displacement rarely act alone. Therefore indigenous knowledge should be enhanced to help local communities t**o** mitigating the effects of drought induced famine. Hence, this study aimed at assessing the role and potency of indigenous knowledge in mitigating drought induced famine among communities living in Kerio valley, Kenya. Drought induced displacement cannot be easily disentangled from the rest of the social, economic and political factors and processes leading to out-migration. More

recently, Kniveton *et al.* (2008) insisted once again on the relevance of considering the multiplicity of factors influencing migration decisions. Also, populations' responses to risks and uncertainties are usually multifaceted. Except in cases of sudden environmental disasters, migration is just one among several possible responses and adaptations to environmental change (Bilsborrow 1992; Black 2001; Tacoli 2007; Adger *et al.* 2007). As people are more likely to migrate toward opportunities than away from problems (Meyerson *et al.* 2007), environmental deterioration may count among the factors, but it is not usually the main reason for leaving. Therefore indigenous knowledge should be enhanced to help local communities t**o** mitigating the effects of drought induced famine displacement.

2.6 Drought induced famine Awareness, Knowledge and Management

Today, the world has a wealth of knowledge and information on disaster risk reduction at its disposal. However, the key issue is collecting, collating, compiling, sharing, and using this knowledge and information in a proactive way through awareness-raising and educational initiatives so that people can make informed decisions and take action to best protect themselves, their property and livelihoods from natural hazard, such as drought induced famine. This area requires participation from government, as it is difficult for other organizations to coordinate and come up with the resources necessary to effectively alleviate drought. Therefore indigenous knowledge should be enhanced to help farmers to overcome the hazards of drought induced famine.

Generally, drought induced famine awareness and knowledge management activities should be guided by the following four principles: first, that the effects of drought can

be substantially reduced if people are well informed and motivated toward a culture of disaster prevention and resilience; secondly, effective information management and exchange requires strengthening dialogue and networks among researchers, practitioners, and stakeholders in order to foster consistent knowledge collection and meaningful message dissemination; third, that public awareness programs should be designed and implemented with a clear understanding of local perspectives and needs, and promote engagement of the media to stimulate a culture of disaster resilience, including resilience to drought and strong community involvement; and finally, that education and training are essential for all people in order to reduce local drought risk. Therefore indigenous knowledge should be enhanced to help local communities t**o** mitigating the effects of drought induced famine.

2.6.1 Use of indigenous knowledge in mitigating effects of drought induced famine

The term ‘indigenous knowledge’ is used to describe the knowledge systems developed by a community as opposed to the scientific knowledge that is generally referred to as 'modern' knowledge (Ajibade, 2003). Indigenous knowledge is the basis for local-level decision-making in many rural communities. It has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities. Incorporating indigenous knowledge into drought prevention policies can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable (Robinson and Herbert, 2001). Scientists therefore need to overcome their reluctance to indigenous knowledge, and cooperate with local communities to ensure mitigation against drought induced famine.

However, it is important to remember that indigenous communities monitor environmental conditions, including the weather, and are able to make meaningful predictions and to take appropriate actions to protect against drought induced famine. In the past, indigenous communities were well aware of the disasters that could affect them and had the knowledge and administrative structures to cope with them. At the same time, they knew that a well-conserved environment helped prevent natural disasters and enabled people to combat against natural disasters when they occurred (Mhita, 1999). Further, vulnerable communities in the drought -prone Tonk district of Rajasthan in India use traditional adaptation practices for drought management. These include: growing new crops such as vegetables, fodder and higher value medicinal crops for commercial sale; use of environmentally sound fertilizers (vermiculture); improved storage for fodder and food grains; and improved water conservation and harvesting techniques through bunding of fields, construction of anicuts and digging and deepening ponds and wells (Institute of Development Studies, 2005).Outcomes of the foregoing in terms of famine, indigenous knowledge has the potential to mitigate drought induced famine. Hence, this study aimed at assessing the role and potency of indigenous knowledge in mitigating drought induced famine among communities living in Kerio valley, Kenya.

2.6.2 Indigenous knowledge in weather forecasting

Local communities and farmers in Africa have developed intricate systems of gathering, predicting, interpreting and decision-making in relation to weather. A study in Burkina Faso showed that farmers' forecasting knowledge encompasses shared and selective experiences. Elderly male farmers formulate hypotheses about seasonal rainfall by observing natural phenomena (Roncoli *et al.*, 2001). The most widely

relied upon indicators are the timing, intensity and duration of cold temperatures during the early part of the dry season (November to January). Other forecasting indicators include the timing of fruiting by certain local trees, the water level in streams and ponds, the nesting behaviour of small quail like birds, and insect behaviour in rubbish heaps outside compound walls (Roncoli *et al.,* 2001). The foregoing techniques can be used together with modern ones, especially since the dissemination of information has been simplified by technology.

The Nganyi clan of Bunyore in western Kenya is known for their powers in predicting rain. The clan has been associated with community rainfall activities for over 100 years, and they have three shrines where they worship and communicate with their ancestors and gods for the purposes of monitoring and predicting rain. Within the shrine there exist certain plants, reptiles, birds and insects that benefit from the conserved environment. The shrines are sanctuaries for nature conservation and they have been gazetted by the Kenya government as protected shrines (UNEP, 2008).Some of the techniques employed by the smallholder farmers in Buhera and Chikomba in Zimbabwe to predict drought seasons—an important step to inform measures to mitigate the impacts of those droughts—included the usage of animal and plant behaviour. The farmers use spiders, wild fruit availability, as well as wind direction to predict how the season will pan out, something similar to those revealed by FAO (2004) and Mapeta (2000). Furthermore, Common indigenous post-harvest handling and processing of traditional vegetables in Swaziland have previously been documented (Masarirambi et al., 2009). Hence the current study examined the contribution indigenous knowledge can make towards militating against drought induced famines.

2.6.3 Role of Indigenous knowledge in mitigation and adaptation to drought

African farmers have developed several adaptation options to cope with current climate variability, but such adaptations may not be sufficient for future changes of climate. African communities and farmers have always coped with changing environments. They have the knowledge and practices to cope with adverse environments and shocks. The enhancement of indigenous capacity is the key to empowerment of local communities and their effective participation in the development process (Leautier, 2004). People are better able to adopt new ideas when these can be seen in the context of existing practices. A study in Zimbabwe observed that farmers' willingness to use seasonal climate forecasts increased when the forecasts were presented in conjunction with and compared with local indigenous climate forecasts (Patt and Gwata, 2002). This is an example of collaboration between scientific and indigenous knowledge to forestall effects of drought-induced famine.Therefore**,** the current study examined the contributions that indigenous knowledge can make towards mitigating drought induced famines.

Local farmers in several parts of Africa have been known to conserve carbon in soils through the use of zero-tilling practices in cultivation, mulching, and other soil-management techniques (Dea and Scoones, 2003). Natural mulches moderate soil temperatures and extremes, suppress diseases and harmful pests, and conserve soil moisture. The widespread use of indigenous plant materials to combat pests that normally attack food crops, has also been reported among small-scale farmers (Gana, 2003). It is likely that climate change will alter the ecology of disease vectors, and such indigenous practices of pest management would be useful adaptation strategies. Other indigenous strategies that are adopted by local farmers include: controlled bush

clearing; using tall grasses such as *Andropogon gayanus* for fixing soil surface nutrients washed away by runoff; erosion-control to reduce significantly the effects of runoff; restoring lands by using green manure; constructing stone dykes; managing low-lying lands and protecting river banks (AGRHYMET, 2004).

Adaptation strategies that are applied by pastoralists in times of drought include the use of emergency fodder, culling of weak livestock for food, and multi-species composition of herds to survive climate extremes (Seo and Mendelsohn, 2006). During drought periods, pastoralists and agro-pastoralists change from cattle to sheep and goat husbandry, as the feed requirements of the latter are lower (Seo and Mendelsohn, 2006). The pastoralists' nomadic mobility reduces the pressure on low-capacity grazing areas through their cyclic movements from dry areas to wetter areas.

African women are particularly known to possess indigenous knowledge which helps to maintain household food security, particularly in times of drought and famine. They often rely on indigenous plants that are more tolerant to droughts and pests, providing a reserve for extended periods of economic hardship (Ramphele, 2004; Eriksen, 2005). In southern Sudan, for example, women are directly responsible for the selection of all sorghum seeds saved for planting each year. They preserve a wide range of varieties of seeds that will ensure resistance to the range of conditions that may arise in any given growing season (Easton and Roland, 2000). Such indigenous techniques have been effective for long periods of time; therefore their scientific value can be determined using well organized studies.

In all communities, technologies and know-how in cultivating indigenous drought resistant and early-maturing crops played a critical part in preparing for famines

caused by prolonged drought or other natural calamities such as invasion of locusts or armyworms. Such crops included hardy species such as cassava (*Manihot esculenta*), pumpkins (*Cacumis melo*), cowpeas (*Phaseolus multiflorus*) and sorghum bicolor (*Elesine corocana*). So important was the cassava for famine preparedness, for example, that along the lakeshores of Lake Victoria. A study in Nigeria showed that farmers are able to use knowledge of weather systems such as rainfall, thunderstorms, windstorms, harmattan (a dry dusty wind that blows along the north-west coast of Africa) and sunshine to prepare for future weather (Ajibade and Shokemi, 2003).

2.6.4 Merging science and indigenous knowledge to forestall drought-induced famine

Famine is a common natural disaster experienced periodically in most of sub-Saharan Africa as well as some part of the Asia. Recently, however, the occurrence of extreme climatic events such as drought, leading to severe food shortages, has been on the increase. One of the main causes of such droughts is climate change. A study was conducted in Buhera district in south central Zimbabwe to evaluate local farmers' knowledge on droughts and the various coping mechanisms available to farmers in times of drought-induced famine in the aftermath of the 2001/2002 drought that affected most of the southern Africa sub region (Mushove, 2003) revealed that drought has far reaching consequences on humans, livelihood, livestock and the economy. Despite this, results showed that farmers had adopted indigenous knowledge based coping strategies to mitigate and adapt to consequences of such droughts. Therefore, this study will highlight how indigenous knowledge can be incorporated with scientific knowledge to developed and implemented by all stakeholders in mitigating drought induced famine.

In a study conducted in Mongolia, the rapidly improving prospect for early warning presented by remote sensing and climate forecasting was demonstrated (Morton, 2001). The scientific prospects for early warning vary by climatic region across the world. There is therefore a need to integrate technological early warning with a local understanding of drought and its impacts, with field level monitoring and appropriate local level planning and action. However, the success of such a programme depends on the accuracy of weather forecasts. If the forecasts are inaccurate then local communities will discard it in favour of indigenous knowledge. A good example of how indigenous knowledge can be integrated with modern technology is related by CARE Kenya (CARE International in Kenya). In Nyanza province, Kenya, the Luo community uses indigenous knowledge to produce clay pots which are used to store drinking water. The climate is hot and the clay pots are used because of their evaporative cooling effect on the water. CARE Kenya used this mode of indigenous knowledge to sell to the local communities a more hygienic version of the clay pots (UNEP, 2008).

Furthermore, minimum tillage and agro-forestry were also practiced in Tanzania. These methods of land use and management were used to promote higher yields. In addition, the people also practiced what the Tanzania study described as precision farming that is identifying parts of the field that had more fertility than others. For example, spots that used to have anthills, cattle kraals, or household wastes were selected for planting (UNEP, 2008).

Again, Mushove (2003) examined interactions between scientists and indigenous land users involved in co-management systems and noted that, although co management is

supposed to combine scientific and indigenous expertise, the model and process for co-management is not integrative at all, but scientific and bureaucratic. Usher (2000) echoed this when stating that although indigenous knowledge ("traditional ecological knowledge") is required to be incorporated into Canadian resource management and environmental assessments there is little understanding of what TEK is and how to implement it in policy. As shown by Usher (2000), these reasons and methods remained unclear until the end of the 1990s. In 1999, others such as Nadasdy (1999) still believed that indigenous knowledge and the engagement of indigenous peoples were not taken seriously and were merely paid lip-service for political reasons. Nadasdy (2003) called for a more critical look at "successful" co-management efforts and the political, as well as methodological obstacles, to the integration of indigenous knowledge. By 2000, a number of indigenous knowledge projects in the Canadian Arctic and Alaska had made advances in participatory methods for working with arctic communities (Krupnik and Jolly, 2002). For example the Tuktu (caribou) and Nogak (calves) Project (Thorpe et al., 2001, 2002) which documented Inuit knowledge of Bathurst caribou and calving grounds in the Kitikmeot region of Nunavut from 1996 to 2001 established a local advisory. Therefore, this study will emphasize how indigenous knowledge can be integrated with scientific knowledge to developed and implemented by all stakeholders in mitigating drought induced famine.

2.7 Policies to enhance drought induced famine mitigation

The goal of mitigation and preparedness is to reduce drought vulnerability and foster drought-resilient societies. Mitigation can be defined as any structural/physical measures such use appropriate crops, sand dams, and engineering projects or non-structural measures like policies, awareness, knowledge development, public

commitment, and operating practices undertaken to limit the adverse impacts of natural hazards, environmental degradation, and technological hazards (Sugule and Walker, 1998). Preparedness is defined as established policies and specified plans and activities taken before an apparent threat to prepare people and enhance institutional and coping capacities, to forecast or warn of approaching dangers, and to ensure coordinated and effective response in an emergency situation (Sugule and Walker, 1998).

Drought impacts and losses can be substantially reduced if authorities, individuals, and communities are well prepared, ready to act, and equipped with the knowledge and capacities for effective drought management. It should be recognized that mitigation and preparedness have a greater impact on reducing the scale and effects of drought disasters than ad-hoc emergency response measures.

Although drought can be disastrous to local people and livelihoods, they also create a "window of opportunity" to develop capacities that reduce drought risk in the long term, including the sharing of expertise, knowledge, and lessons learned. To make the best of a poor situation, resources may even be pre-positioned to maximize the utilization of these opportunities when they occur (Patt and Gwata, 2002). Long-term drought mitigation and preparedness activities can be incorporated into drought response and recovery processes where political will is strong and drought is in the minds and hearts of those affected.

The private sector should be encouraged to foster a culture of disaster reduction, putting greater emphasis on and allocating resources to pre-drought activities such as

risk assessments and early warning systems. Drought is a complex phenomenon that affects a wide range of groups and sectors. Addressing drought in a holistic manner requires that stakeholders coordinate their efforts to maximize effectiveness and minimize redundancy and competing goals (Patt and Gwata, 2002).

The ability to assess and incorporate local indigenous knowledge, capacities, and needs into drought mitigation and preparedness strategies is also essential in order to develop and implement equitable and community-based solutions. Planning at all levels should be collaborative and inclusive. As gaps in capacity are identified, resources and expertise should be targeted to meet these needs. Appropriate long-term investment of financial and technical resources into capacity development and drought mitigation and preparedness activities will be required to sustain these efforts.

According to World Meteorological Organization (1984) Considerable progress is being made in drought monitoring and early warning systems in many countries. The increased emphasis on improving these systems is largely the result of the mounting impacts of drought, reflecting greater societal vulnerability. . A few examples from various countries are included to illustrate some of the approaches being taken in drought-prone regions. The authority that monitors drought development in China is the Beijing Climate Center of the China Meteorological Administration. Beijing Climate Center has used the Standardized Precipitation Index since 1995 to monitor drought occurrence and development in China on a 10-day basis. The monitoring results are published in the China Drought Monitoring Bulletin issued by BCC (ibid).

The Greater Horn of Africa, like many parts of the tropics, is prone to extreme climate events such as droughts and floods. In an effort to minimize the negative impacts of

extreme climate events, WMO and the United Nations Development Programme established the regional Drought Monitoring Centre (DMC) in Nairobi and a sub-centre in Harare in 1989 covering 24 countries in the eastern and southern African sub-region. In 2003, DMC Nairobi became a specialized institution of the Intergovernmental Authority on Development (IGAD) and was renamed the IGAD Climate Prediction and Applications Centre (ICPAC). The participating countries of ICPAC are Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Uganda and United Republic of Tanzania. The Centre is responsible for climate monitoring, prediction, early warning and applications for the reduction of climate-related risks in the Greater Horn of Africa (ibid).

Drought is a normal, recurrent feature of the South African climate. Droughts have in the past resulted in significant economic, environmental and social impacts and highlight the country's continuing vulnerability with regard to this natural phenomenon. During low rainfall periods, policymakers, agriculturalists, businesses and the general public often require additional rainfall data for decision-making and planning (ibid). In response to recurring drought in South Africa, the South African Weather Service (SAWS) established a drought monitoring desk where information regarding observed rainfall and long-range forecasts could be presented in one place for easy access (ibid). The Palmer Drought Severity Index is used to characterize drought in Portugal. This index has been adapted and calibrated to the specific climatic conditions of mainland Portugal. The Palmer Drought Severity Index performs a parameterized computation of the soil water balance and compares the estimated soil moisture content with its climatologically mean (ibid).

2.8 Summary of Literature review

Literature in the foregoing sections has reviewed issues concerning indigenous knowledge and its potency in mitigating drought induced famine. A growing body of empirical analyses clearly indicates that certain indigenous knowledge technologies, know-how and practices, if popularized and integrated with modern knowledge systems can help to alleviate drought induced famine and poverty. Studies reviewed have alluded to the cultivation of indigenous drought-resistant and early-maturing crop varieties and traditional techniques of food preservation and storage as some of the best practices to alleviate drought induced famine. Therefore, indigenous knowledge remains an immensely potent force, at least potentially, in environmental conservation and natural disaster management. It has also been reported that communities had powerful structures that exercised authority to ensure smooth compliance with the rules and obligations in times of disasters, drought and famine. Every member of the community grew up knowing the rules and a quick justice process in the courts of elders ensured efficient enforcement of judgments and strict observance of the rules. Further, knowledge, skills and practices accumulated overtime were intergenerational transferred through various channels among cultural practices, indigenous institutions and social systems among others.

However, the main challenge to indigenous knowledge as a tool for alleviating poverty and mitigating drought induced famine is that it has not been popularized as an effective way of dealing with many of the environmental and food security challenges that face the communities. Another challenge facing indigenous knowledge is the increasing pressure on land and demand for fuel wood as a result of fast growing populations and increasing poverty. In many cases people have now started to violate some of the traditional rules that enabled the communities to

conserve nature and its biodiversity and live harmoniously with it. Taking into account the challenges facing the indigenous knowledge systems in Kenya, this study examined the role and potency of indigenous knowledge in mitigating drought induced famine among communities living in Kerio valley with a view of proposing measures that can enhance the integration of indigenous knowledge with scientific knowledge for effective mitigation of drought induced famine.

2.9 Theoretical Framework

This study utilized interrelated theories as a theoretical framework due to the fact that no single theory is able to explain the total variance of human needs and survival due to the complexities of human behavior. The study utilized human ecology theory, ethno- methodology theory and rational theory.

The human ecology theory looks at humans as beings whose survival depends on mastering their social physical and economic environment by establishing a stable balance with nature - or habitat. This theory views mankind as interacting with his fluid and changing environment through a perceptual and cognitive filter composed of taboos, myths, culture and experiences. The human ecology theoretical approach was found to be important in this study because it explains the idea behind some of the practice and approaches the local communities have been using and in order to adapt to changing environments and conditions and introduce new practices (Moran 1979 cited in Makenzi, 2004). Proponents of this theory argue that humans utilize their indigenous knowledge to use and manage their environment and resources and adapt to changing conditions brought by phenomena like climate, drought and other unpredictable events. The human ecology theory is very relevant to this study,

because the indigenous knowledge covers all forms of knowledge including technologies, knowhow, skills, practices and beliefs that enable the community to achieve stable livelihoods within their environment. It is traditional cultural knowledge that includes intellectual, technological, ecological, and medical knowledge. Indigenous knowledge used in mitigating drought induced famine in ASAL areas are part of relationship between human and environments.

The ethno-methodology theory identifies the ways in which people actively construct reality and then act on the basis of their social constructions. Ethno methodologists unravel the methods that native people use to construct their social and economic environment in their everyday lives. Contrary to what is designated as the "orthodox consensus", an ethno methodological perspective (Garfinkel, 1967) would aim to explore how human beings establish a stable balance with nature through their behaviour. Ethno methodological research on human behaviour processes, however, seems to be more ethically compromised as any other kind of investigation, particularly because of its reliance on close inquiry and the use of dissonant situations.

Finally, another relevant theory for the study is the rational theory by Max Weber (1858). According to this theory, all human action is directed by meaning. Hence, in order to understand and explain action, the meanings and motives which lie behind it, all human action must be appreciated. Rational action involves a logical evaluation of various means of attaining a goal and the selection of most suitable means. According to Weber, rational action is the procedural attainment of a definitely given and practical end by means of an increasingly precise calculation of means (Weber 1858). These means are actually the indigenous knowledge and its potency to achieve an end.

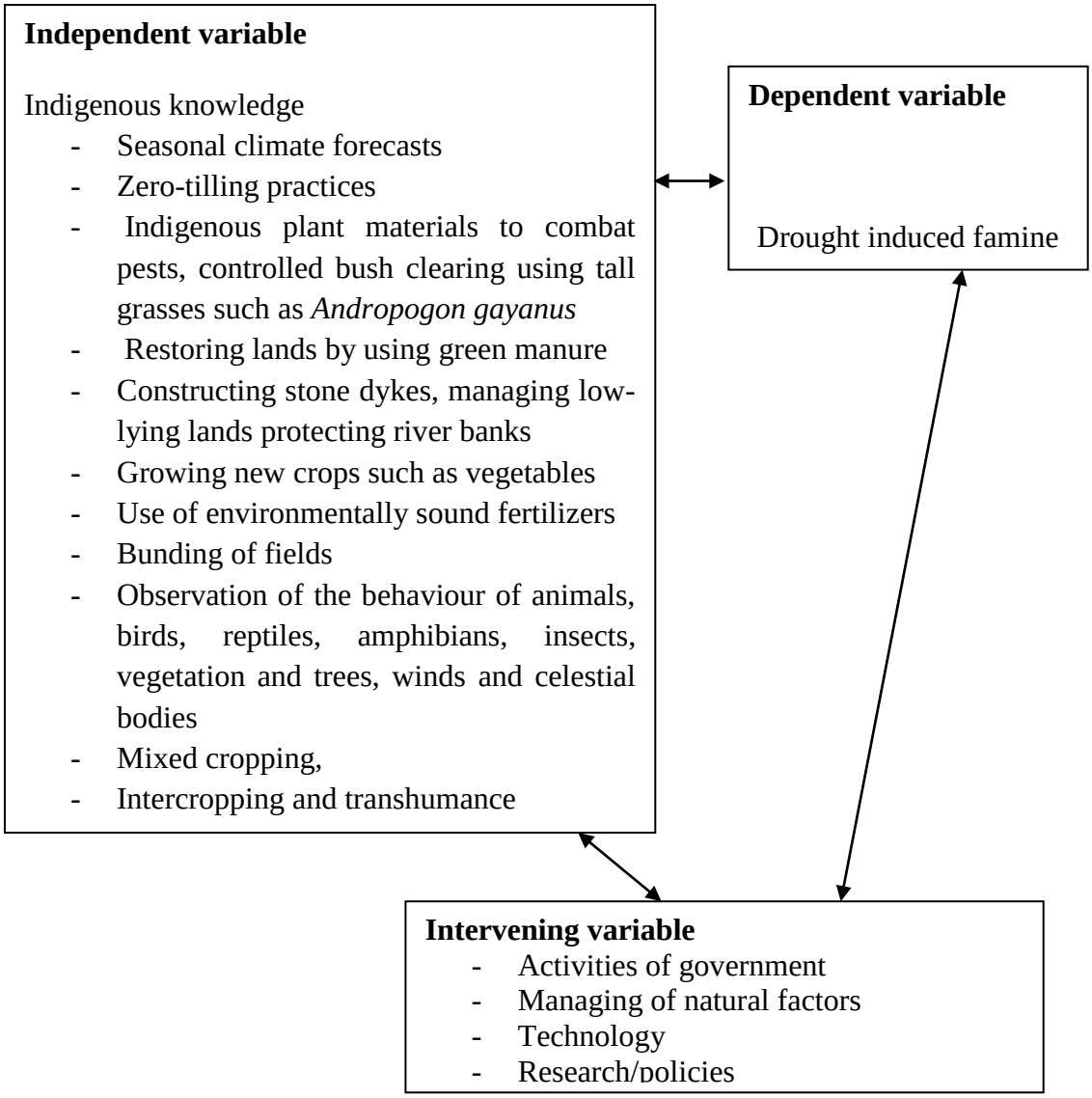
Further, Blau (1974) cited in Kiptui (2008) adopts this interpretation arguing that Weber saw rationality as a way of maximizing efficiency. In addition, Albrow (1974) argues that Weber saw rational bureaucratic procedures as the most effective means of measuring efficiency not necessarily of ensuring it. The rational theory was found to be very relevant to this study, because the indigenous knowledge used in mitigating drought induced famine in ASAL areas are rational moves. This is because failure to adopt effective drought mitigation among the local community with drought induced famine may mean starvation or even death.

2.10 Conceptual framework

This study was based on the conceptual relationship between independent and dependent variable where indigenous knowledge is itemized as an independent variable while drought induced famine is itemized as a dependent variable. The independent variable, that is, indigenous knowledge is broken down into categories depending on its usage mitigating drought induced famine among local communities such as: seasonal climate forecasts, zero-tilling practices use indigenous plant materials to combat pests, controlled bush clearing using tall grasses such as *Andropogon gayanus*, restoring lands by using green manure, constructing stone dykes, managing low-lying lands, protecting river banks, growing new crops such as vegetables, using environmentally sound fertilizers, bunding of fields, observation of the behaviour of animals, birds, reptiles, amphibians, insects, vegetation and trees, winds, temperatures and celestial bodies, mixed cropping, intercropping and transhumance. The dependent variable, drought induced famineis caused by deficiencies in surface and subsurface water supplies. Drought results in lack of water for efficient agricultural production, which affects food production acutely, leading to food insecurity, hunger, starvation and sometimes death.

For indigenous knowledge to be judged as having effectively mitigated drought induced famine there is need for improvements on all measurements of effectiveness of thecategories of indigenous knowledge as shown in figure 2.1. There is therefore a need to integrate technological early warning with a local understanding of drought and its impacts, with field level monitoring and appropriate local level planning and action.

Figure 2.1 Conceptual framework for the study



(Source: Author, 2011)

From figure 2.1 above, it can be inferred that if the local community adopts indigenous knowledge and co-management as a strategy of dealing with the problem of drought in the study area (Kerio valley area of Kenya) it will help to mitigate drought-induced famine. Co-management is the co-operation between the local community, the government and other stakeholders. The local community should be consulted as regularly as possible. Their indigenous knowledge of coping with

drought induced famine should be modified and upgraded to promote its adaptability, potency and effectiveness.

The intervening variables are secondary inputs to enable the community to carry out their roles of managing drought. The government has officers in charge of the environment, livestock and fisheries. They are supposed to assist the community to device strategies of managing drought induced famine. Non-government organizations and development partners normally step in to aid victims when drought has gone beyond the management of the community. The government on the other hand should provide enabling legislation, enforcement and other assistance necessary.

CHAPTER THREE

RESEARCH METHODOLOGY

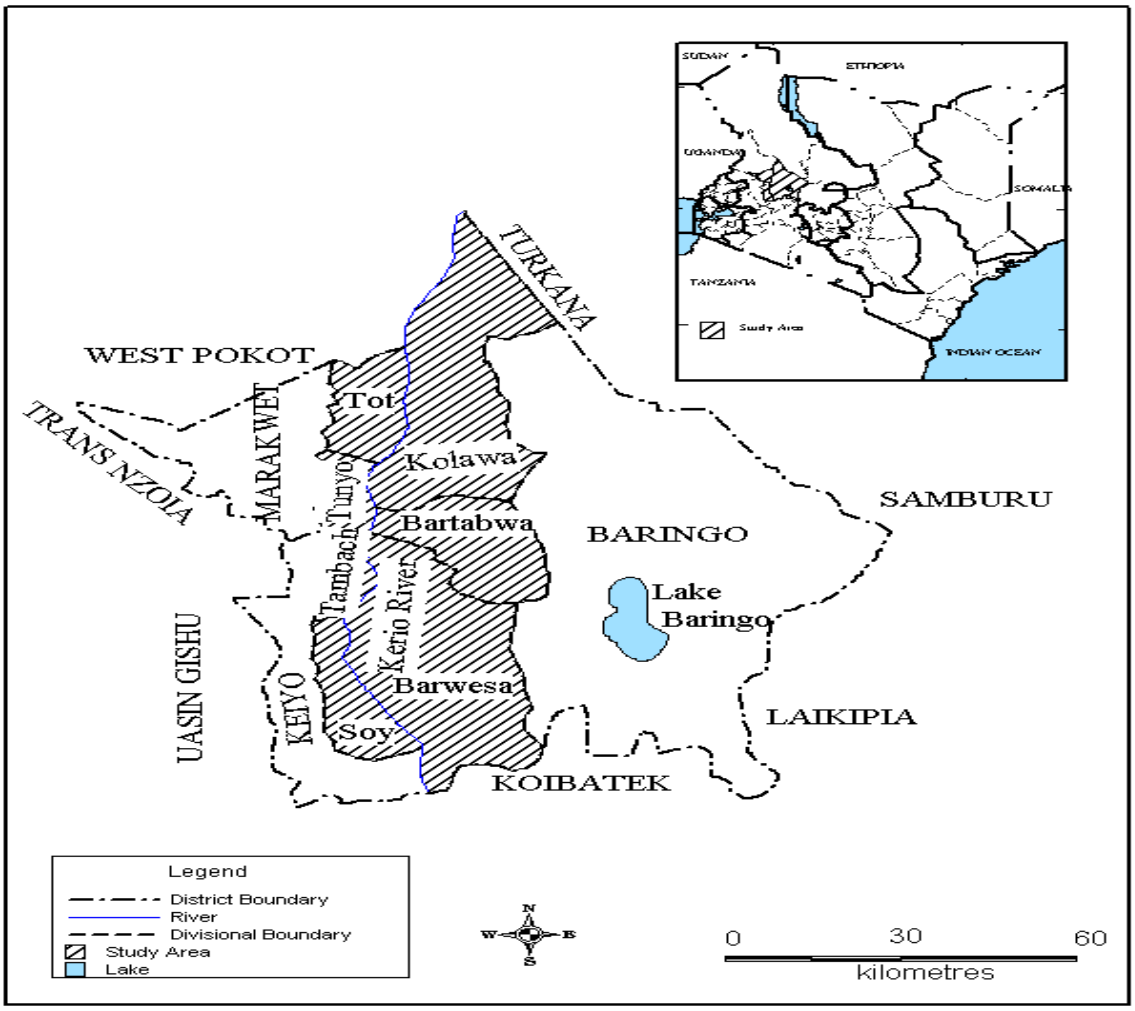
3.1 Introduction

The chapter focuses on the study area, methodological and procedures and modalities in data collection. It specifically covers the research design, determination of the sample size, sampling design, sampling procedures, data collection methods and instruments, validity and reliability of data collected, sources of data, and methods of data analysis techniques for presentation and discussions of results.

3.2 Study Area

3.2.1 Location

Kerio valley lies in South/North direction between the Tugen hills to the east and the Elgeyo escarpment to the west. The altitude ranges between 800-1000 meters above sea level. Kerio valley is a low lying stretch bound to the west by the rift valley created by volcanic activities playing a major role in the adjacent landscapes of Tugen hills and Elgeyo escarpment. The latter illustrates the main features of the rift valley wall. Part of the process of the rift valley formation has been the warping up of areas on either side of the faults (Chemursoi, 2000). The Kerio valley is shared by 4 districts namely Baringo, Keiyo, Marakwet, Turkana and Baringo east and their common border is the Kerio River.



(Source: Moi University cartography department, 2011)

The Keiyo sub-ethnic group occupies the southwestern part of the valley defined by the rift valley faults. Keiyo area is a narrow strip of land which covers 1150sq.kms (Chebet and Diet 2000). It extends from latitude 0 10’ to 0 52’ north and longitude 35 25’ to 35 45’ east. Tambach and soy divisions are within the study area, while Tugen people occupy the south eastern end of Kerio valley below the Tugen hills in the east. There are five divisions traversed by Kerio valley namely, Barwesa, Tenges, Bartabwa and Kolowa in east Baringo. Baringo district is bordered by Turkana to the north, Samburu and Lakipia districts to the east, Koibatek to the south and Keiyo, Marakwet and West Pokot to the west and covers an area of 655 sq.km divided into eleven

divisions. The study area included Kolowa, Tenges, Barwesa and Salawa. The Marakwet people occupy the north part of the valley which is covered by two divisions namely Tunyo and Tot. Marakwet district covering an area of 1588 sq.kms divided into seven administrative divisions of which Tunyo and Tot fall in the study area.

The study area was selected after considering factors such as accessibility, perennial problems of drought induced famine and the significance of the study information to farmers and other stakeholders. Therefore it was expected that these target population would provide the required sample size for the study.

3.2.2 Topography geology and Climate

Kerio valley is basically an ASAL area characterized with low unreliable average rainfall of 700mm per annum. The temperatures are high ranging from between 30-40 degrees centigrade (Cheserek, 2007).

3.2.3 Population

The 2009 census showed that Kerio valley has a combined population of 118,694 persons. Soy division posted the highest population of 20,354 persons, Tambach, 18676, Tot, 17744, Kapsaraman 16472, Kolowa, 14990, Tunyo, 10588 Tenges, 10302 and Barwesa 9568 and Salawa.

3.2.4 Socio – economy Activities

The communities living in Kerio valley practice agro-pastoralism and rear cattle, goats and sheep. Livestock is an important part in the culture as it provides food, dowry, and is also a bank or is used to evaluate the status of the family (Chesaina, 1991). Crop farming is part of the economic activities and drought resistant crops

grown include cassava and finger millet while maize, beans and wheat are grown on the highland plateau. Bee keeping and hunting are practiced in the lowlands, and honey harvested is used for medicinal purposes as well as food. Hunting is a "peripheral" activity carried out by young boys and herdsmen while herding livestock in the grazing fields as a way of eliminating carnivorous animals that pose a threat to livestock and human life (Chemursoi, 2000).

3.3 Research Design

This study utilized a cross –sectional survey design based on a sample drawn from Keiyo, Marakwet and Baringo Districts. A Cross –sectional survey usually relates to the present state of affairs and involves an attempt to provide a snapshot of how things are at a specific time in which the data is collected (Fraenkel *et al,* 2000). It is often characterized by the selection of random samples from large populations to obtain empirical knowledge of a contemporary nature (Berg (2001). This method allows generalizations to be made about experiences, characteristics, views and attitudes of the entire population being studied. Survey research is capable of collecting background information and difficult to get data and the researcher would not have the opportunity to motivate or influence respondents responses. Sproull (2000) recommends the survey technique for research where attitudes, ideas, comments and public opinion on a problems or issues are studied. The descriptive analysis approach was chosen for the present study, because it seeks to gain insight into a phenomenon as a means of providing basic information in an area of study (Bless and Higson-Smith 2000). The cross –sectional survey was adopted in this study based on the conceptual relationship between the independent variable and the dependent variable.

3.4 Target Population

A population consists of all elements-individuals, items, or object-whose characteristics are being, studied (Leedy, 2003). A population refers to the group of people or study subjects who are similar in one or more ways and which forms the subject of the study in a particular survey (Neuman, 2000). A target population is that population to which a researcher wants to generalize the results of a study (Mugenda and Mugenda, 2003). Therefore, the target populations for this study were 118,694 people who constitute members of three communities living in Kerio valley. In addition, government officers from the Ministries of Agriculture, Water and Livestock, and staff of Non-governmental organizations (NGO) and Community Based Organizations (CBO) were also targeted (see Table 3).

Table 3.1 Target Population

Categories or respondents	**Target population**
Members of communities living in Kerio valley	118,694
Officials from the Ministries of Agriculture, Water and Livestock	11
Staff of Non-governmental organizations and Community Based Organization	7
Total	**118, 712**

(Source: KNBS, 2010)

3.5 Sampling procedures and sample Size

Sampling is a process of selecting a portion or sub-set of population on which research will be conducted, in order to ensure that conclusions from the study are generalized to the entire population. The population being large, the sampling

procedures was adopted. In selecting a sampling procedure, the probability sampling was chosen. Among the many sampling designs available, multi stage, cluster, stratified and systematic sampling were adopted for the study. In the first stage, the overall population of members of communities' household in Kerio valley was stratified into three districts according to the geographical location of the study, Baringo, Keiyo and Marakwet. In the second stage, the population was stratified into eight categories according to divisions, Soy, Tambach, Kipsaraman, Kolowa, Tunyo, Tenges, Barwesa and Salawa. Stratified random sampling enabled the proper identification of the subgroups in the population to be represented in the sample in the same proportion as they exist in the population. In the third stage, having identified the study divisions, each division was further sub-divided into four clusters giving a total of 32 (4*8=32) to determine the sample size. Households in each cluster were identified and numbered.

In the final stage, a systematic sampling was performed in the study for selection of households where every tenth (10*32=320) household was selected and its occupants interviewed. Systematic sampling by instinct is more representative of the population than some other samplings method such as simple random sampling. The intention of the researcher was to get a sample of 320 respondents in the study area where every tenth household were interviewed. The starting point was randomly picked from any point. Random selection ensures the law of statistical regularity which states that if on an average the sample chosen is a random one, the sample will have the same composition and characteristics of the universe (Kothari, 2009). The respondent in every household was the head of that household but in his/her absence, the spouse would respond. Where both parents were absent, another visit was organized.

Kerlinger (2003) states that a sample size of a study should be considered to be adequate so long as it is large enough to allow for reliable analysis of cross-tabulation, provide desired level of accuracy in estimates of the larger population, and test for significance of difference between estimates.

Finally, purposive sampling was used to select officers from the Ministries of Agriculture, Water, Livestock, and staff from non-governmental organizations and community Based Organizations thus giving a total of 18 respondents (see Table 3.1 and 3.2). Purposive sampling was preferred in selecting government officers from the Ministries of Agriculture, Water, Livestock, non-governmental organizations and community based organizations because they are known and are of small numbers and also the expert knowledge they possessed. Further, purposive sampling is considered adequate as it takes into account the objectives, purpose and variables of the study. Table 3.2 gives a breakdown of the selected sample.

Table 3.2 Distribution of selected Sample

Categories or respondents	**Target population**	**Sample size**
Communities living in Kerio valley	118,694	320
Officers of Ministries of Agriculture, Water, Livestock	11	11
Officials from NGOs and CBOs	7	7
Total	**118, 712**	**338**

(Source: KNBS, 2010)

3.6 Types and Sources of Data

The study generated data from primary and secondary sources. Primary data was sourced using questionnaires, personal interviews, observations and focus group discussions. Secondary sources included internet, textbooks, government publications, journals and other published and unpublished works. Other sources included key informants among them, acknowledged authorities within the area of the study who provided valuable information used to compliment and validate that from other sources. Secondary data was sourced from libraries, archives and government offices among others. Internet information on indigenous knowledge and its role in the mitigating drought induced famine was gathered from journals and environmental magazines. This provided a better understanding of the research problem and study findings. Information on the National Environmental Protection Agency enabled the researcher to get a broader view and a deeper understanding of drought and drought induced famine. Other sources consulted included web pages of (IGAG), formerly the Drought monitoring centre in Nairobi, so as to enable the researcher get latest information about drought induced famine

3.7 Data collection instruments

Data collection is a precise, systematic method of gathering data relevant to research or of addressing research objectives, and research questions or hypotheses (Burns and Grove 1993). Data was collected by means of questionnaires, semi-structured interviews FGDs, observation and document examination (triangulation approach). Triangulation approach is chosen because it offers the use of different research techniques giving many advantages. Denzin (1970), for example, suggested that the use of triangulation approach offers greater validity and reliability than a single

methodological approach. Dixon et al. (1988) state that most hypotheses and research objectives can be researched using more than one technique of data collection; providing detailed data about the phenomenon being investigated. Therefore the following instruments namely: questionnaires, interview schedules, observations schedules and focus group discussions guides were used.

3.7.1 Questionnaires

Questionnaires (see Appendices A, B and C) were found appropriate for gathering the views of a large number of people about a particular phenomenon (Kothari, 2009). Questionnaires were used to gain an understanding of indigenous knowledge and its effectiveness in mitigating drought induced famine. Variables in the questionnaire were measured appropriately using relevant constructs. For instance effectiveness of the IK was measured on a five point likert scale to quantify or measure it.

The questionnaires contained various items that solicited for responses pertaining to research variables, such as: the relationship between drought induced famine and the livelihoods of the communities living in Kerio valley and mitigating strategy; and whether there is relationship between proper utilization of indigenous knowledge and the reduction of the effect of drought induced famine among communities living in Kerio valley. Questionnaires had both open and close-ended questions as well as structured questions with either Yes or No answer or True or False alternatives. The instrument also contained unstructured items that captured the opinion, feelings and suggestions of the respondents. The main issues sought by the questionnaire include: what is drought, categorization of drought and drought induced famine, causes of drought induced famine, status and trends of drought induced famine and its impact on economic growth, environment, water and food security, social life, biodiversity,

energy, and migration, drought induced famine awareness, knowledge and management, indigenous knowledge in weather forecasting and mitigation and adaptation, combining science and indigenous knowledge to avert effects of drought-induced famine, drought induced famine coping strategies, and policies to enhance the mitigation of drought induced famine.

Questionnaires were preferred because of their ability to reach a large number of respondents within a short time and to elicit personal ideas from the respondents due to the openness of some questions (Kothari, 2009). Pre-testing of questionnaires was used to measure the reliability and validity of the questionnaire items and for improving the quality of questions before the main study. Samples of the questionnaire used are provided as appendices B and D.

3.7.2 Interview Schedule

The study used the personal interview schedule to collect information from key respondents drawn from government ministries and departments, NGO and CBOs in order to verify the reliability of the information gathered through questionnaires and personal observation. This tool was used on local communities that reside within Kerio valley and experience and live with drought. To obtain detailed information on the respondents the researcher was assisted by two trained research assistants. At the end of every interview, responses were checked to ensure all the questions were answered so as to avoid return visits to respondents' homes.

The advantage of an interview is that the respondents provided in-depth information which is not possible to get using a questionnaire. In the interviews, confusing questions were clarified. It was also possible to probe for more information. This technique was useful in seeking in-depth information that could not be captured in the

questionnaires. The personal interview approach creates confidence on the part of the respondents and as they gained interest in the subject, more reliable, valid and objective results were realised. The interviews were informally conducted through discussions using a set of structured questions (see appendix C). The informal structure of the interviews was preferred to other techniques since it creates a more relaxed atmosphere and therefore encourages more complete and unplanned response from the interviewees. A sample of the interview questions used is given in appendix D.

3.7.2.1 Translation of interview and questionnaire questions

Interview and questionnaire questions were written in English but translated into Kiswahili and Kalenjin languages, which are the dominant languages used by communities living in Kerio valley. In order to ascertain if the translated versions into Kiswahili and *Kalenjin* languages relayed the intended meaning of the questions as written in English, research assistants that attained A- in KCSE English with a good understanding of English, Kiswahili and *Kalenjin* languages assisted in the translation of questions so that they are clearly understood without losing their meaning. More corrections on the questions were done after the pilot studies.

3.7.3 Focus Group Discussions

Neuman (2000) asserts that focus group discussions (FGDs) encourage participants to express their own opinions on the subject of discussion. It was on the basis of this, that the FGD were used to gather information related to feelings and opinions of the different groups of participants involved in the study. Focus group discussions explored in more detail, issues concerning indigenous knowledge and its potency in mitigating drought induced famine as well as other issues pertaining to the study. Information generated through FGDs could not have been obtained through other

techniques such as in-depth interviews and questionnaires. Focus groups discussions provided the researcher with rich data on indigenous knowledge and its potency in mitigating drought induced famine. Focus group discussions were conducted in each of the three districts that fell under Kerio valley namely: Biretwo in Keiyo, Kiboino in Baringo and Tot in Marakwet disricts respectively, focus group discussion picture is provided below.

Plate 3.1 Respondents to the study and the research Assistant in Kerio Valley. (Source: Author, 2012)

The technique was useful as the participants' helped each other to recall critical information on other issues, and were more free and interactive than in the individual

interviews. A sample of the questions used to guide focus group discussions is provided in appendix E and G respectively.

3.7.4 Observation Checklist

Personal observation is an appropriate technique particularly as it ascertains facts drawn from the respondents; provides a basis to substantiate some issues that may not have been obviously understood by either party in the survey; and minimizes chances of recording incorrect data. Observation indicators are helpful for assessment of physical condition of the study area. It enabled the researcher to observe the infrastructure of the sub-locations like the roads, telecommunications and social amenities among other phenomenon. In addition, the living standards and lifestyles of communities living in Kerio valley were observed. Participatory observation was used to observe and verify the peoples' livelihoods and behaviors. Picture of participatory observation is provided below.

Plate 3.2 Focus group respondent discusion group. (Source: Author, 2012)

This technique was also used to determine the extent of the impact of drought induced famine, and resources available to support and promote people's livelihoods. The researcher recorded observations develop using a pre-developed checklist and cross-checked the strength of the information given by the respondents. A sample of the observation schedule is provided in appendix F and I respectively.

3.8 Validity and Reliability of Research Instruments

In order to lessen the danger of obtaining inaccurate answer to research questions emphasis on two particular research designs were considered: validity and reliability (Saunders et al. 2007). Validity is the ability of a chosen instrument to measure what it is suppose to measure. Reliability is the extent to which research results would be stable or consistent if the same technique is repeatedly. Moreover the way the measuring is conducted and how the information is processed affects the outcome of research (Fraenkel and Wallen, 2006).

3.8.1 Validity of Research Instruments

Validity is the degree with which a test measures what it actually wishes to measure. In this study, the question posited was whether there is a relationship between drought induced famine and the livelihoods of communities and the strategy used to mitigate this. Also, whether there is a relationship between proper utilization of indigenous knowledge and the reduction of the effect of drought induced famine among communities living in Kerio valley. Yin's (1994) solution for assuring construct validity is: to use multiple sources of information, to establish a chain of evidence, and to have key informants review the report. Construct validity refers to a

construction of questionnaire items that will elicit responses sought for. Multiple sources of information namely review of previous empirical research, primary data in the form of interviews with senior Government officers from the Ministries of Agriculture, Water, Livestock, and researcher's direct observation were used to validate the foregoing..In this study, content validity was ascertained by comparing the responses of the various respondents.

3.8.2 Reliability of Research Instruments

In this context the definition of reliability is straightforward: a measurement is reliable if it reflects mostly true score, relative to the error. This is about the results of the investigation, which has to be reliable. If nothing changes in a population between two investigations in the same purpose, it is reliable. From the deductive point of view, if the measure yields the same results on different occasions, or from an inductive point of view if similar observation be made by different researcher on different occasions.

Kothari (2009) asserts that there may be four threats to reliability: subject error; has to do with when interview is carried out, it is of great importance to select a neural time and date. subject bias; it is a great problem in organization where management is an authoritarian character where the interviewee(s) may say what the manager wants them to say, not what they feel, observer error; can be lessened with a high degree of structure to the interview schedule and observer bias; where the question about the interviewer interprets the data received.

The questionnaire was tested for reliability by conducting reliability analysis in SPSS using data collected using 20 pilot questionnaires administered to respondents, prior to the actual research. Cronbach's coefficient alpha obtained to determine the internal consistency of the items. This is a method of estimating reliability of test scores by the use of a single administration of a test (Mugenda and Mugenda, 2003). Cronbach's Alpha is the most common form of internal consistency reliability coefficient. By convention, a lenient cut-off of 0.60 is common in exploratory research; alpha should be at least 0.70 or higher to retain an item in an "adequate" scale; and many researchers require a cut-off of 0.80 for a "good scale" (Lankshear and Knobel, 2004). Regarding the above explanation, in this research the researcher used Cronbach's alpha to test the reliability of the 5 items on 'the role of indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valleywere: rate and frequency of occurrence of drought induced famine was 0.850, effects of drought induced famine on the livelihoods was 0.874, effectiveness of indigenous knowledge in mitigating the effects of drought was 0.840, utilization of indigenous knowledge was 0.835, and policy measures to be adopted for effective drought mitigation was 0.803. Therefore, the calculated results were considered reliable since they yielded a reliability coefficient of 0.70 and above.

3.9 Preliminary Screening of data

The preliminary data collected from the field were coded and cleaned to remove outliers or missing values and categorized manually according to the questionnaire items using frequency distribution tables and percentages. Simple descriptive statistics such as percentages have an advantage over more complex statistics since they can easily be understood especially when making results known by a variety of readers.

The coded data was then transferred to a computer sheet and was processed using Statistical Package for Social Sciences (SPSS) version 18. Martin and Acuna (2002) observe that SPSS is able to handle large amounts of data; it is time saving and also quite efficient.

3.9.1 Response rate and missing data

Out of a targeted sample of 320 households, 315 questionnaires were returned giving a percentage rate of 98.5%. A total of 13 questionnaires 1.5% were discarded as a result of non response, being improperly filled or incompleteness. The researcher ended up with 302 usable questionnaires which represent a response rate of 94.4%. This shows a high response rate for the questionnaires distributed.

Missing value analysis (MVA) was performed to check for patterns of missing data and the sizes of the missing values. Missing value analysis was designed to highlight patterns of missing values as well as to replace them in the data set. The missing value analysis results showed that the percentage of missing values was less than 6%. Considering the sample size, this percentage of missing values was not serious and the values were therefore replaced with the series mean of the items in question. This was consistent with most studies with large sample sizes given that almost any procedure for handling missing values was expected to yield similar results (Saunders *et al.,* 2007).

3.9.2 Assessment for normality

When conducting statistical analysis for hypothesis testing, appropriate conclusions can only be drawn when the assumptions guiding the specific analysis are sound. Generally, the assumptions include independence of error, homogeneity of variable and normality. Normality in particular can often be addressed prior to hypothesis testing through data screening procedures. Normality is a test that each variable and all linear combinations of the variable are normally distributed. This means that the residuals of analysis are also normally distributed and independent (Kline, 1998).

Normality of the variables in the data set was examined using Skewness and Kurtosis. A Skewed distribution refers to the degree to which the distribution is pulled in a direction a way from the centre typically the result of extreme observations (Witte & Witte, 2008). Previous research has suggested that appropriate Skewness values are those that range from -2 to +2 while Kurtosis values for appropriate "Peakedness" are those that range from -6 to +6 (Bryne, 1998). The score of Skewness and Kurtosis on each item was therefore analyzed and reported. Those items that were found to lack normality were evaluated and were either removed from further analysis or reformed.

3.9.3 Reliability of the scales

Cronbach's alpha coefficients were used to establish the reliability of the scales used in this study. The role of indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley into five scales measuring the rate and frequency of occurrence of drought induced famine, effects of drought induced famine on the livelihoods, effectiveness of indigenous knowledge in mitigating the effects of drought, utilization of indigenous knowledge and policy measures to be adopted for effective drought mitigation. Table 4.1 shows the results of the reliability analysis.

Table 3.1 Reliability of the Scales

Scale	**Cronbach's alpha**
Rate and frequency of occurrence of drought induced famine	0.850
Effects of drought induced famine on the livelihoods	0.874
Effectiveness of indigenous knowledge in mitigating effects of drought	0.840
Utilization of indigenous knowledge	0.835
Policy measures to be adopted for effective drought mitigation	0.803

Therefore, the Cronbach's alpha coefficients calculated results were all above the accepted minimum of 0.7 indicating that the scales were reliable.

3.10 Data Analysis and Presentation

The data collected for the purpose of the study were adopted and checked for completeness and accuracy. Statistical Package for Social Sciences (SPSS) version 18 software and Microsoft Excel were used for all the data analysis and interpretation. The data were analyzed statistically using descriptive analysis techniques encompassing frequency distribution; percentages, mean, median and standard deviation were used. In order to analyze the relationship between indigenous knowledge and mitigation of drought induced famine, Pearson's product moment correlation was used. Mitigation of drought induced famine was measured by averaging the responses to the items on effectiveness of indigenous knowledge, effectiveness of indigenous knowledge in mitigating drought induced famine and effectiveness of indigenous knowledge in predicting weather patterns. Indigenous knowledge was measured in terms of general indigenous knowledge, indigenous knowledge to predict famine, indigenous knowledge to mitigate famine, and proper utilization of indigenous knowledge. Further analysis on selected variable was done using multiple regressions.

Multiple regressions are a statistical technique used to examine the way a number of independent variables relate to one dependent variable. These procedures attempt to predict a single dependent variable from any number of independent variables entered into regression equations. The Multiple Regressions Analysis was used to determine the relationship between droughts induced famine and the livelihoods of the communities living in Kerio valley and the mitigating strategy used. Likewise, the

relationship between proper utilization of indigenous knowledge and the reduction of the effect of drought induced famine among the communities living in Kerio valley was determined through multiple regressions analysis. Results are presented using tables and figures, qualitative descriptions and photographs.

3.10 Ethical considerations

Creswell (2003) recognized ethics as the application of moral principles while interacting with others in order to be respectful and fair and promote healthy relationships. This entail that, it is not enough for the researchers to be aware of fundamental principles guiding ethical decisions, they should also be concerned about ethics so as to be cautious of hurting people who have something to do with the research.

Keeping in line with fundamental principles guiding ethical decisions, permission to carry out the study was sought from the Government of Kenya through the School of Environmental Studies, Department of Human Ecology, University of Eldoret, Ministry of Higher Education, Keiyo, Marakwet and Baringo Districts and from the participants who participated in the study. This was done through letters written to Districts Commissioners, Keiyo, Marakwet and Baringo Districts. The nature and the purpose of the research were explained to the respondents by the researcher before undertaking the research. The participants were assured of anonymity of their identity and responses confidentiality and voluntary participation. No names or person identification numbers were reflected on the questionnaires except the numbers for questionnaires, which was done for purposes of identification during data and questionnaire processing. Results of the study will be availed to the Keiyo, Marakwet and Baringo Districts and to those participants interested in knowing the results.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents results of the study guided by the objectives. First results from the questionnaire for community households are given, followed by those from interviews with Agricultural extension officers and council of elders, government officials, NGOs and CBOs. Results based on data collected from focused group discussion were qualitatively analyzed to establish key thematic issues pertaining to indigenous knowledge in mitigating drought induced famine.

4.2 Demographic characteristics

This section discusses the demographic characteristics of the sample farmers in the study areas. It is used to provide a base for further analysis of the specific research objectives and their findings using descriptive statistics, frequency tables and percentages. Respondents were asked to provide information regarding demographic characteristics that included gender, age, marital status, level of education and religious affiliation. Demographic characteristics were considered since they affect respondent socio-economic behavior. This information was paramount because it shed light on the nature and caliber of respondents and their grasp on the role of indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley. Table 4.1 shows the distribution of demographic characteristics

Table 4.1 Demographic characteristics of respondents

Demographic Variable	Response	Frequency	Percentage
Gender	Male	211	69.9
	Female	91	30.1
Age (years)	18-24	68	22.5
	25-34	87	28.8
	35-44	19	6.3
	45-54	30	9.9
	55-64	15	5.0
	65 and above	83	27.5
Marital	Single	46	15.2
	Married	222	73.5
	Widowed	19	6.3
	Separated	15	5.0
	Divorced	0	.0
Education	Illiterate	61	20.2
	Primary	67	22.2
	Secondary	21	7.0
	College	68	22.5
	University	85	28.1
Religious affiliation	Catholic	222	73.5
	Orthodox	20	6.6
	Protestant	38	12.6
	Traditional belief	22	7.3
Total		**302**	**100**

(Source: Author, 2014)

Results presented in Table 4.1 indicate that a majority of the respondents were male (69.9%). More respondents aged between 25-34 years (28.8%), followed with 65 years and above (27.5%) and 18-24 years (22.5%). With regards to marital status, a majority of the respondents were married (73.5%), 15% were single and none was divorced. On the level of education, 28.1% were of University level, 22.5% were of college level, 22.2% were of primary level and 20.2% were illiterate. Most of the respondents were affiliated to the Catholic Church (73.5%), with 12.6% being Protestants, 7.3% practicing traditional beliefs and 6.6% were Orthodox.

4.3 Respondents knowledge about Indigenous knowledge

Indigenous knowledge was the key independent variable for this study. Indigenous knowledge was therefore assessed by considering the following key elements; indigenous knowledge framework, prediction of occurrence of drought induced famine, strategies and activities adopted to overcome and mitigate drought induced famine.

4.3.1 Framework for indigenous knowledge for mitigating drought induced famine

Respondents were required to provide information regarding the framework for indigenous knowledge that included family size, land holding, experience, occupation, length of stay in location and language used. The framework for indigenous knowledge was considered critical to household's indigenous knowledge to mitigate drought induced famine. Table 4.3 which show results on respondents view.

Table 4.2 Framework for Indigenous Knowledge

Variable	Response	Frequency	Percentage
Family size	0-4	64	21.2
	5-9	149	49.3
	10-14	68	22.5
	15 and above	21	7.0
Land holding (Ha)	0-0.4	234	77.5
	0.5-1.4	47	15.6
	1.5-2	21	7.0
Experience in mitigation (years)	< 5	110	36.4
	6-10	45	14.9
	>10	147	48.7
Length of stay in location (years)	0-10	111	36.8
	20-39	78	25.8
	40-59	30	9.9
	60-79	43	14.2
	80 and above	40	13.2
Occupation	Accountant	22	7.3
	Civil servant	19	6.3
	Farmer	153	50.7
	Pastoralist	19	6.3
	Sociologist	19	6.3
	Teacher	50	16.6
	Technologist	20	6.6
Language	Native local	281	93.0
	Exotic/foreign	21	7.0

(Source: Author, 2014)

From the results, 49.3% households had a family size of 5-9, 22.5% had family sizes of 10-14, 21.2% had 0-4 and only 7% of the households had a family size of 15 and above. A majority of the households (77.5%) owned a land holding of 0-0.4 Ha. Regarding experience in mitigation, 48.7% of respondents had experience of over 10 years. However, a sizeable proportion (36.4%) had experience of less than 5 years in mitigation. 36.8% of respondents had resided in the location for between 0-10 years while over 13% had resided in the current location for over 80 years. With regards to occupation, 50.7% were farmers 16.6% were teachers, 7.3% were accountants, 6.3% were civil servants, and 6.3% were pastoralists. The main language used was the native local language (*Kalenjin*) (93%). However, a few of the respondents (7%) used exotic /foreign language.

The foregoing results imply that most of the respondents have the necessary elements for indigenous knowledge. In particular, most families were fairly large. Consequently in cases of famine, there would be need for knowledge for mitigation. In addition, most of the respondents being farmers and having many years of experience in mitigation implies that they have necessary indigenous knowledge to mitigate drought induced famine.

4.3.2 Knowledge in prediction of occurrence of drought induced famine

Knowledge in prediction of occurrence of drought induced famine was assessed by analyzing among others the degree of knowledge on drought induced famine, events and indicators of famine, community knowledge of prediction of occurrence of drought induced famine, accuracy of predictions and knowledge of those involved in prediction of drought induced famine.

Table 4.3 Prediction of occurrence of drought induced famine

Variable	Response	f	%
Degree of indigenous knowledge on drought induced famine	Beginning	0	.0
	Fair	114	37.7
	Good	188	62.3
	Not sure	0	.0
	No knowledge	0	.0
Total		302	100%
Community has indigenous knowledge to predict occurrence of drought induced famine	Always	67	22.2
	Often	122	40.4
	Sometimes	113	37.4
	Not at all	0	.0
Total		302	100%
When the community predicts the occurrence of drought induced famine, it occurs	Always	65	21.5
	Often	42	13.9
	Sometimes	195	64.6
	Unpredictable	0	.0
	Not at all	0	.0
Total		302	100%
Who are involved in the prediction of the occurrence of drought induced famine	Council of elders	204	67.5
	Chiefs/sub	0	.0
	Chiefs		
	Men	98	32.5
	Women	0	.0
	Others	0	.0
Total		302	100%

(Source: Author, 2014)

Results presented in Table 4.3 indicate that majority of the respondents 62.3% had good knowledge of indigenous knowledge. The rest of respondents (37.7%) had fair knowledge. On the question of whether the community has indigenous knowledge to predict occurrence of drought induced famine, 40.4% of the respondents were of the

view that the community often had indigenous knowledge to predict the occurrence while 22.2% stated that the community always predicted the occurrence of drought induced famine. Regarding the accuracy of predictions, 64.6% of the respondents indicated that when the community predicts the occurrence of drought, it sometimes occurs, 22% indicated that whenever the community predicts the occurrence of drought, it always occurs, while 13.9% reported that whenever the community predicts the occurrence of drought, it often occurs. A majority of the respondents (67.5%) indicated that prediction of the occurrence of drought induced famine was left to the council of elders, while 32.5% indicated that it was the men who were involved in the prediction of the occurrence of drought induced famine.

The implication of the results from Table 4.3 is that the community has ample indigenous knowledge in the prediction of drought induced famine, and most of the community members have an advanced level of indigenous knowledge on drought induced famine. This enables the members usually drawn from the council of elders and men to access indigenous knowledge to often predict occurrence of drought induced famine which are sometimes accurate predictions.

Respondents were further asked to indicate the forms of events and indicators used in the prediction of the occurrence of drought induced famine.

Table 4.4 Events and indicators of drought induced famine

Event	Indicator	Frequency	Percentage
1.Animal mapping	1.Emaciation and lack of food material in the stomachs of slaughtered animals	90.6	30
2.Change of climate	2.Change of wind direction	0	25
3.Prolonged drought	3.Lack of rain, shortage of irrigation water, scorching sun, calm wind and trees shading off leaves	75.5	15
4.Delayed rains	4.Calm wind, stars on the right side of the sun, small harvest	45.3	30
Total		**302**	**100**

(Source: Author, 2014)

Table 4.4 shows the results of the events and indicators mentioned; the occurrence of drought induced famine is characterized by animal mapping which is often indicated by emaciated animal and lack of food in the stomachs of slaughtered animals. Also, change of climate due to change of wind direction also point to the occurrence of drought induced famine. In addition, prolonged drought is a sign of lack of rain; shortage of irrigation water, scoring sun, calm wind and trees shading off leaves. Other events that characterize the occurrence of drought include delayed rains as indicated by calm wind, stars being positioned on the right side of the sun and low/poor harvest.

4.3.3 Community Activities and their likelihood of causing drought induced famine

Respondents were asked to indicate the forms of activities common within the community that cause drought induced famine ass shown in Table 4.5 below.

Table 4.5: Activities likely to cause drought induced famine

Activities	Frequency	Percent
Agricultural expansion	24	7.9
Agricultural expansion and Firewood harvesting	26	8.6
Agricultural expansion, Firewood harvesting and Forest fires	15	5.0
Firewood harvesting and Forest fires	15	5.0
Illegal logging and Forest fires	20	6.6
Migrant encroachment and Burning charcoal	23	7.6
Migrant encroachment, Land speculation and Agricultural expansion, Illegal logging and Forest fires	21	7.0
Migrant encroachment, Land speculation, Illegal logging and Forest fires	22	7.3
Erosion	19	6.3
Firewood harvesting	19	6.3
Forest fires	98	32.5
Total	**302**	**100**

(Source: Author, 2014)

As show in Table 4.5, most of the respondents identified a combination of activities which were responsible for causing drought induced famine among them forest fires (32.5%), agricultural expansion and firewood consumption (8.6%), agricultural expansion alone (7.9%), migrant encroachment and charcoal burning (7.6%), migrant encroachment, land speculation, illegal logging and forest fires (7.3%), erosion

(6.3%), firewood harvesting and forest fires (5.0%) and agricultural expansion, firewood consumption and forest fires (5.0%).

4.3.4 Indigenous strategies used to mitigate drought induced famine.

The study sought to establish the indigenous strategies used to mitigate drought induced famine from the study sampled for the. The indigenous strategies used to mitigate drought induced famine were operationalized as show in Table 4.6 below.

Table 4.6 Strategies used to mitigate drought induced famine

Strategy	**Frequency**	**Percentage**
Participation in land use planning activities and access to irrigation	208	68.9
Participation in land use planning activities and & access to irrigation deforestation	15	5.0
Participation in land use planning activities and access to irrigation. Improved farming systems, planting water friendly trees and cultural appease of ancestors	19	6.3
Participation in land use planning activities and access to irrigation Improved farming systems. Education on migration patterns, planting water friendly trees and afforestation	21	7.0
Participation in land use planning activities and access to irrigation. Improved farming systems and planting water friendly trees	19	63
Participation in land use planning activities and access to irrigation. Planting water friendly trees	20	6.6
Total	**302**	**100%**

(Source: Author, 2014)

Table 4.6 show that participation in land use planting activities and access to irrigation are the main strategies used by the sampled communities to mitigate drought induced famine (68.9%). Other strategies used include: a combination of participation in land use planning activities and access to irrigation, improved faming systems, education on migration patterns, planting water friendly trees and afforestation (7.0%); participation in plant use planning activities and access to irrigation, and planting water friendly trees (6.6%); participation in land use planning activities, access to irrigation, improved faming systems and planting water friendly trees (6.3%).

Results clearly in Table 4.6 indicate that the community is taking measures aimed at overcoming drought induced famine. In this regard, the community is mainly engaged in planning the land use as well as harnessing irrigation water for their crops so as to ensure food security. Besides, the community is planting trees which are expected to act as water reservoir while at the same time replacing those that may have been used only for fuel but had no conservation value.

4.3.5 Mitigation of drought induced famine

Mitigation of drought induced famine was measured by assessing among others, the frequency of occurrence of famine in the study area, the degree of severity of the cause of famine in the study area, the community's indigenous knowledge in mitigating drought induced famine, activities carried out by the community to reduce drought induced famine, indigenous knowledge in mitigating drought induced famine, activities carried out by the community to reduce drought induced famine role of indigenous knowledge in mitigating effects of drought induced famine and ability of

the community to use its indigenous strategies to mitigate drought induced famine. Results on the foregoing variables are given in subsequent sections.

4.3.5.1 Frequency of occurrence and severity of drought induced famine

Objective one of this study sought to establish the rate of occurrence of drought induced famine among communities living in Kerio Valley. Consequently, the respondents were asked to indicate the frequency of occurrence of drought induced famine and the degree of severity of drought induced famine causatives in the study area as show in Table 4.7 below.

Table 4.7 Frequency of occurrence and severity of drought induced famine

Drought induced famine causes	**Frequency of occurrence**	**f**	**%**
Frequency of occurrence of locusts	Every 5 Yrs	39	12.9
	Unpredictable	154	51.0
	None	109	36.1
Frequency of occurrence of Army worms	Unpredictable	155	51.3
	None	147	48.7
Frequency of occurrence of Drought	Every Year	133	44.0
	Every 5 Yrs	61	20.2
	Unpredictable	93	30.8
	None	15	5.0
Total Overall		**302**	**100**

(Source: Author, 2014)

Table 4.7 shows that whenever locusts occur, they are more likely to be unpredictable (51.3%). 12.9% of the respondents indicated that they occur every 5 years. Occurrence of army worms was reported to be unpredictable with 51.3% of

respondents. 48.7% indicated that army worms do not occur. 44% indicating that drought it occurs every year; 30.8% found its occurrence unpredictable, while 20.2% said that it occurs every 5 years. The above results show that droughts which mainly occur every year and in some cases every 5 years are the main causes of famine in the study area. In addition, with the exception of locusts and army worms whose occurrence as indicators of drought is unpredictable, there are not many reported incidences of other drought induced famine causes.

4.3.5.2 Severity of drought induced famine causes in the study area

Respondents were asked to rate the level of severity of the causes of famine whenever they occurs. Table 4.8 presents the distribution of Severity of drought induced famine causes in the study area.

Table 4.8 Degree of severity of famine causes

Variable	Response	f	%
Level of severity of locusts	Not severe	115	38.1
	Severe	57	18.9
	So severe	21	7.0
	Not applicable	109	36.1
Level of severity of Army worms	Not severe	45	14.9
	Severe	69	22.8
	So severe	20	6.6
	Not applicable	168	55.6
Level of severity of Drought	Severe	218	72.2
	So severe	69	22.8
	Not applicable	15	5.0
Level of severity of other drought induced famine causes	Not severe	21	7.0
	So severe	19	6.3
	Not applicable	262	86.8
Total Overall		**302**	**100%**

(Source: Author, 2014)

Results indicated that regarding occurrence of locusts, 38.1% of the respondents found them not severe, and 36.1% said that the question was not applicable since

locusts do not occur, 18.9% indicated that they were severe, while only 7% found them so severe. In the case of army worms, 55.6% reported not applicable that they were not severe, while 6.6% said that they were so severe. With regards to drought, 72.2% reported it being severe, 22.8% indicated that it was severe; while only 5% reported that it was not applicable. Drought induced famine causes were not actually identified as indicated by the high proportion of respondents pointing to its non-applicability (86.8%).

Results imply that although locusts and army worms whenever they occur may cause famine, their effect is however not severe. Drought is the main cause of famine in the study area owing to its severity.

4.3.5.3 Usage of indigenous knowledge in mitigating drought induced famine

Research objective three sought to determine how effective indigenous knowledge is in mitigating the effects of drought induced famine. To address this objective, respondents were asked a number of questions pertaining to indigenous knowledge.

Table 4.9 Use of indigenous knowledge in mitigating drought induced famine

Variable	Response	f	%
The community uses indigenous knowledge in mitigating drought induced famine	Strongly agree	105	34.8%
	Agree	152	50.3%
	Disagree	19	6.3%
	Strongly disagree	26	8.6%
Indigenous knowledge used in mitigating effects of drought induced famine is	Very effective	91	30.1%
	Moderately effective	83	27.5%
	Just effective	128	42.4%
The community has been able to use its indigenous strategies to mitigate such famine	Always	75	24.8%
	Often	62	20.5%
	Sometimes	165	54.6%
Effectiveness of indigenous knowledge in predicting weather patterns	Very effective	19	6.3%
	Moderately effective	164	54.3%
	Just effective	61	20.2%
	Not effective	58	19.2%
Total Overall		**302**	**100%**

(Source: Author, 2014)

Results presented in Table 4.9 show that 50.3% of respondents agreed that the community utilized indigenous knowledge in mitigating drought induced famine while 34.8% strongly agree and only 14.9% tended to disagree. Regarding the level of effectiveness indigenous knowledge used in mitigating effects of drought induced famine, 42.4% said that it was just effective and 30.1% found it very effective. On whether the community has been able to use its indigenous strategies to mitigate famine, 54.6% reported that the community has sometimes been able to use its indigenous knowledge, 24.8% reported that the community has always used its indigenous knowledge while 20.5% reported that the community has often used its

indigenous knowledge although this was not effective. Results show that the community in the study area uses indigenous knowledge in mitigating drought induced famine. Indigenous knowledge used has some level of effectiveness more so in predicting weather patterns. In addition, indigenous knowledge enables the community to sometimes use indigenous based strategies to mitigate drought induced famine.

4.3.5.4 Indigenous activities undertaken to reduce drought induced famine

The researcher sought to identify some of the activities employed by the community to reduce drought induced famine as shown in Table 4.10 below.

Table 4.10 Indigenous activities used to reduce drought induced famine

Variable	Frequency	Percent
Carry out rituals	20	6.6
Perform traditional sacrifice to god	73	24.2
Perform traditional sacrifice to god and carry out rituals	81	26.8
Perform traditional sacrifice to god and perform special prayers to god	21	7.0
Perform traditional sacrifice to god; perform special prayers to god and carry out rituals	107	35.4
Total Overall	**302**	**100%**

(Source: Author, 2014)

The results from table 4.10 show that the community employs a combination of activities. Key among these are performing traditional sacrifices to god (24.2%), perform traditional sacrifice to god and carry out rituals(26.8%) and perform traditional sacrifice to god; perform special prayers to god and carry out rituals with response of (35.4%). Results clearly showed that a key activity used to reduce drought induced famine is performing traditional sacrifice to god. This activity is done in combination with other activities. The researcher sought to identify some other indigenous strategies to mitigate drought induced famine as shown in Table 4.11.

Table 4.11: Other indigenous strategies to mitigate drought induced famine

Variable	Botanical names	Main use	Availability
Exotic fruits:Kalenjin			
Morkoy	*Fiscus sycomorus*	Animal feed	Perennial
Ngechngech		Food	Unpredictable
Lom	*Syzgium*	Food,	Annual
Baryal		Animal feed	February
Montirich		Animal feed	Annual
Tilam	*Meyna tetraphylla*	Food	Once a year
Kapetwo	*Fiscus ovallis-choudae*	Food	Once a year
Tiling		Fencing	Once a year
Muonuk		Food	Once a year
Muchuk	*Berchemia discolar*	Construction	Perennial
Murkuy	*Uvaria leptoclada*	Food	Once a year
Edible insects			
Termites	*Isoptera*	Food	April/May
Kongai	*Isoptera*	Food	May
Cheliong	*Isoptera*	Food	April/May
Kipcharaya	*Orthoptera*	Food	Once a year
Chepkamet	*Orthoptera*	Food	Once a year
Ma Kimilok	*Orthoptera*	Food	Once a year
Ma Kipnya	*Orthoptera*	Food	Once a year
Kiperer	*Orthoptera*	Food	Once a year
Chemeru	*Orthoptera*	Food	May/June
Kibilet	*Hymenoptera*	Food	May
Monoch	*Hymenoptera*	Food	April
Chekecebe	*Hymenoptera*	Food	April
Non-edible trees			
Sisia	*Acacia tortilis*	Firewood	Throughout the year
Makatar	*Acacia elatior*	Firewood	Throughout the year
Labeywa		Firewood/fencing	Always
Bilic		Firewood	Throughout the year
Mymen		Firewood	Throughout the year
Tiretwo	*Diospyros scabra*	Construction	Throughout the year
Tirat	*Diospyros scabra*	Fencing	Throughout the year
Chepkereste		Animal	Always
Kerbut	*Trichilla emetica*	feed/firewood	Always
Sukuiywo		Fencing/firewood Firewood/animal feed	Perennial

(Source: Author, 2014)

Besides the activities listed in Table 4.11, the community has also resorted to use of exotic fruits, edible insects and non-edible trees as a way of reducing drought induced famine.

4.3.5.5 Non-agricultural initiatives engaged by the community to mitigate drought

When asked to identify non-agricultural initiatives used by the community to mitigate drought, most of the respondents identified a combination of non-agricultural initiatives in various main combinations among them as shown in Table 4.12 below.

Table 4.12 Non- Agricultural initiatives the community engages in to Mitigate Drought

Initiatives	**Frequency**	**Percent**
Producing and selling handcraft, selling hay/fodder, production and selling traditional brews, Carpentry business, hand outs from relatives, income generating projects and relief food	21	7.0
Producing and selling handcraft. Production and selling traditional brews, hand outs from relatives and relief food	21	7.0
Production and selling traditional brews	23	7.6
Production and selling traditional brews. Carpentry business and income generating projects	19	6.3
Production and selling traditional brews, carpentry, business and relief food	19	6.3
Production and selling traditional brews, hand outs from relatives and relief food	63	20.9
Hand outs from relatives and relief food	44	14.6
Production and selling traditional brews, carpentry, hand outs from relatives and relief food	22	7.3
Total	**302**	**100%**

(Source: Author, 2014)

The results from table 4.12 show that production and selling of traditional brews, receiving handouts from relatives and relief food (23.2%); production and selling

traditional brews and relief food (20.9%) and receiving hand outs from relatives, and relief food (14.6%), and producing and selling traditional brews, hand outs from relatives, and relief food (7%); and business handouts from relatives, income projects and relief food (7%).

The foregoing results show that the community in the study area engages in various non- agricultural initiatives in an effort to mitigate drought and drought induced famine initiatives involve production and selling of traditional brews, receiving handout from relatives, relying on relief food, and to a lesser extend production and selling of handcraft and carpentry.

4.3.6: Effects of drought induced famine on residents of Kerio valley

Research objective two sought to examine the effects of drought induced famine on the livelihoods of the communities living in Kerio valley. Consequently, respondents were asked to list effects of drought induced famine experienced by the community in the past as shown in Table 4.13 below.

Table 4.13 Effects of drought induced famine on livelihoods of residents

Variable/Response	Frequency	Percent
Hunger disaster, loss of livestock, reduced agricultural output and disappearance of water supply	85	28.1
Loss of human lives, hunger disaster and loss of livestock reduced agricultural output	26	8.6
Loss of human lives, hunger disaster, loss of livestock reduced agricultural output and disappearance of water supply	107	35.4
Loss of human lives, hunger disaster and loss of livestock reduced agricultural output	21	7.0
Loss of human lives, hunger disaster, loss of livestock reduced agricultural output and disappearance of water supply	19	6.3
Loss of human lives, Loss of livestock reduced agricultural output and disappearance of water supply	20	6.6
Reduced agricultural output	24	7.9
Total	302	100%

(Source: Author, 2014)

Results presented in Table 4.13 indicate that drought induced famine has multiple effects on the community, that include hunger, loss of livestock, reduced agricultural output, and disappearance of water supply all of which were identified by 28.1% of the respondents. It is evident that most community members relate drought induced famine in Kerio valley with loss of human lives and livestock; hunger; reduced agricultural output and lack of water.

4.3.7 Policies measures for effective drought mitigation and famine reduction

The study sought to identify policies to be adopted for effective drought mitigation among the local community and other stakeholders. The study identified various policies to be adopted among as shown in Table 4.14 below.

Table 4.14 Policy measures for effective drought mitigation and famine reduction

Variables	**Frequency**	**Percentage**
Structural/physical measures strategies		
Planting appropriate crops		65
Guiding sand dams		25
Establishing engineering projects		10
Non-structural measures		
Awareness creation enhanced development		15
Public commitment and operating practices of long-term drought mitigation		85
Preparedness activities		
Re-drought activities such as risk assessments		20
Early warning systems		70
Appropriate long-term investment of financial and technical resources to promote capacity development.		10
Total		**100%**

(Source: Author, 2014)

The finding of the study showed that respondents identified several policies measures for effective drought mitigation and famine reduction**.** With regards to structural/physical measures strategies, majority (65%) of the respondent identified planting appropriate crops. Concerning non-structural measures**,** majority (85%) of the respondent identified public commitment and operating practices of long-term drought mitigation. Regarding the preparedness activities, majority (70%) of the respondent identified early warning systems.

4.4 Measures of Association between variables

In order to examine the association between indigenous knowledge and its role in the mitigation of drought induced famine, Pearson's product moment correlation was used. Pearson's correlation was deemed appropriate for analyzing this relationship so as to ascertain the levels of linear relationships among variables. This was necessary since very strong relationships between the variables would mean that multiple regression analysis would not be necessary. Mitigation of drought induced famine was measured through the responses to items on effectiveness of indigenous knowledge in mitigating drought induced famine and effectiveness of indigenous knowledge in predicting weather patterns. Indigenous knowledge was measured in terms of general indigenous knowledge held by the community, indigenous knowledge to predict famine, indigenous knowledge to mitigate famine, and proper utilization of indigenous knowledge. Table 4.15 gives a summary of the results.

Table 4.15 Pearson's Correlation results between IK indicators and Famine mitigation

Variables	General indigenous knowledge	Indigenous knowledge to predict famine	Indigenous knowledge to mitigate famine	Proper utilization of indigenous knowledge	Famine mitigation
General indigenous knowledge held	1				
Indigenous knowledge to predict famine	-.502(**)	1			
Indigenous knowledge to mitigate famine	.001	.265(**)	1		
Proper utilization of indigenous Knowledge in	.081	.111	.389(**)	1	
famine mitigation	.329(**)	-.276(**)	.166(**)	.769(**)	1

** Correlation is significant at the 0.01 level (2-tailed). *(Source: Author, 2014)*

From the results in table 4.15, it is evident that there are positive correlations between general indigenous knowledge and famine mitigation ($r=0.329$, $p<0.001$), indigenous knowledge to mitigate famine and famine mitigation ($r=0.166$, $p<0.001$), and between proper utilization of indigenous knowledge and famine mitigation ($r=0.796$, $p<0.001$). These correlations were also significant at 1% level. However, the small coefficients for general indigenous knowledge and indigenous knowledge used to mitigate famine suggest weak correlations. Results also show a negative correlation at the 1% between indigenous knowledge used to predict famine and famine mitigation ($r= -0.276$, $p<0.001$). The implication of the negative result is that high levels of indigenous knowledge used to predict famine are likely not to influence famine mitigation by community members.

4.5 Multivariate Analyses of the determinants of famine mitigation

The main objective of the study was to examine the role of indigenous knowledge and its potency in mitigating drought induced famine. In line with this, the study sought to establish which aspects of the indigenous knowledge influence mitigation of drought induced famine in the study area. Therefore, Multivariate linear regressions analysis was used to analyze multiple variables simultaneously. Multivariate analysis is geared more towards explanatory purposes. Multiple linear regressions were used to analyses the variation of drought induced famine explained by all of the independent variables. Multiple linear regressions were used to determine the best indicators of drought induced famine among the independent variables.

Since prediction of dependence techniques may not be perfect particularly when errors are correlated, therefore, Durbin-Watson statistic was used to test for the presence of serial correlation among the residuals. According to Hair *et al* (1998), the residuals are not correlated if the Durbin Watson statistic is approximately 2 and an acceptable range is 1.50- 2.50 as show in Table 4.16 below.

Table 4.16 Regression Summary Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.859(a)	.737	.734	.38820	2.080

a. Predictors: (Constant), Proper utilization of IK, General IK, IK to mitigate famine, IK to predict famine.

b. Dependent Variable: Drought induced famine mitigation

As shown in Table 4.16 which presents the regression summary results, the Durbin-Watson statistic for this regression (2.080) falls within the acceptable range. Thus, residuals were assumed to be independent. Consequently, Durbin-Watson statistic was used to test for the presence of serial correlation among the residuals which assumed to be independent.

4.5.1 Analysis of the Regression model

The regression coefficients depicted in Table 4.17 show that all the four elements of indigenous knowledge namely; general indigenous knowledge (β=0.118, p=0.001),

indigenous knowledge to predict famine (β=-0.288, p<0.001), indigenous knowledge used to mitigate famine (β= 0.077, P=0.021), and proper utilization of indigenous knowledge (β = 0.822, p<0.001) were significant predictors of mitigation of drought induced famine.

Table 4.17 Regression Coefficients Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.953	.191		4.990	.000		
	General indigenous knowledge	.183	.054	.118	3.365	.001	.720	1.389
	Indigenous knowledge to predict famine	-.285	.036	-.288	-7.941	.000	.675	1.482
	Indigenous knowledge to mitigate famine	.068	.029	.077	2.313	.021	.789	1.268
	Proper utilization of indigenous knowledge	.735	.029	.822	25.298	.000	.838	1.193

(Source: Author, 2014)

Dependent Variable: Drought induced famine mitigation

Results in Table 4.17 suggest that mitigation of drought induced famine can be represented as a function of general indigenous knowledge, indigenous knowledge to predict famine, indigenous knowledge to mitigate famine, and proper utilization of indigenous knowledge. Consequently, the specific regression model is of the form

$Y= 0.953 + 0.118X_1 – 0.288X_2+ 0.077X_3+0.822X_4$

Where X_1 = General indigenous knowledge

X_2= Indigenous knowledge used to predict famine

X_3= Indigenous knowledge used to mitigate famine

X_4= Proper utilization of indigenous knowledge.

The results further imply that when other elements of indigenous knowledge are held constant a 1% increase in general knowledge is likely to result in a 0.118 increase in mitigation of drought. Similarly, a 1% increase in the ability to predict famine is likely to lead to a 0.288 decline in the mitigation of famine and 1% increase in indigenous knowledge to used mitigate famine leads to a 0.077 increase in mitigation of famine and 1% increase in proper utilization of indigenous knowledge is likely to result in a 0.822 increase in the mitigation of drought induced famine. On the basis of the t values, proper utilization of indigenous knowledge with a t-value of 25.298 is presumed to be the main predictor of mitigation of drought induced famine in the study area.

4.5.2 Testing for the assumption of multi collineality

Multi-colliniarity occurs when a single independent variable is highly correlated with a set of other independent variables. Consequently, multi colineallity significantly affects the result of the regression analysis. Multi colineality was used to assess variable inflation factors (VIF) and should not exceed 10 if there is no multicollineality. Since none of the VIF values was beyond 10, it was concluded that multi colineality was not a problem for this regression analysis.

4.6 Results of data collected from agricultural extension officers and elders

4.6.1 Respondents knowledge about Agro bio diversity

Participating agricultural extension officers were asked pertinent questions in relation to agro-biodiversity. On the question of edible wild plants found in the study area, respondents identified several plants some of which are seasonal while others are found throughout the year. Most of them are used as food (vegetables) and some are

used for medicinal purposes. Table 4.18 presents some of the identified plants and reasons for use**.**

Table 4.18 Edible wild plants found in study area

Edible wild plants:Kalenjin	**Botanic names**	**Reason for eating**	**Availability**
Chebelei		Medicinal	Always
Kipchiken	*Bauhinia esculentum*	Vegetable	Dry season
Lisuo		Medicinal	Always
Lom	*Syzgium*	Food	Once a year
Muchukwet	*Berchemia discolar*	Food	Once a year
Tilomwo	*Meyna tetraphylla*	Medicinal	Always
Tuyunwo	*Steracarya bireae*	Vegetable	April

(Source: Author, 2014)

When asked how trees are used, respondents identified fencing, firewood and construction as the main uses of trees found in the area. Some however noted that trees were at times used for medicinal purposes as well as for feeding animals.

4.6.2 Dissemination of indigenous knowledge among the Community

When asked on how the indigenous knowledge held is disseminate among community members as shown in Table 4.19 below.

Table 4.19 Dissemination of Indigenous knowledge by the Community

Means of Sharing	**Frequency**	**Percent**
Verbal communication	3	27.3
Collaboration	1	9.1
Oral spoken	7	63.6
Total	**11**	**100.0**

(Source: Author, 2014)

The finding of the study show that 63.6% of the respondents indicated that it was usually passed on by oral spoken; 27.3% indicated that it was usually through verbal communication and 9.1% indicated that indigenous knowledge was shared through collaboration.

4.6.3 Respondents knowledge about Drought trends and the consequences

The agricultural extension officers together with the council of elders were asked about the drought trend as well as the effects of drought as shown in Table 4.20 below.

Table 4.20 Aspects of Drought Manifestation

Drought conditions	Frequency	Percent
Poor weather, low rains, and dry seasons	1	9.1
Sunny weather, low rains, drought, dry seasons	10	90.9
Consequences of drought		
Declining standard of living	3	27.3
Food insecurity	1	9.1
Reduced food in households	7	63.7

(Source: Author, 2014)

The finding of the study shows that over 90% identified sunny weather, low rains, and dry seasons as the climatic conditions in times of drought. The major consequence of drought identified by respondents as shown in Table 4.20 was reduced food in

households (63.7%), followed with declining standards of living (27.3%) and finally food insecurity (9.1%).

4.6.4 Mitigation and coping strategies for drought induced famine

Members of the council of elders were asked to identify mitigation strategies used by the communities to as well as the coping strategies applied. Respondents identified several mitigation and coping strategies as shown in Table 4.21 below.

Table 4.21: Mitigation and Coping Strategies (n=11)

Variables	Frequency	Percentage
Mitigation Strategies		
food for work programme, sacrifices to induce rains	1	9.1
Relief food	5	45.5
Relief food and irrigation	1	9.1
Relief food and irrigation, drought resistant crops	2	18.2
Sacrifices to appease the spirits	1	9.1
Support from NGOs and irrigation	1	9.1
Total	**11**	**100%**
Coping Strategies		
borrowing from relatives	1	9.1
borrowing from relatives and irrigation	1	9.1
drought resistant crops	3	27.3
food preservation	1	9.1
irrigation	4	36.4
reduction in food ration	1	9.1
Total	11	100%

(Source: Author, 2014)

With regards to mitigation, the key strategy used was to seek relief food (45.5%). The second strategy involved a combination of relief food, irrigation and planting of drought resistant crops (18.2%). Other preferred combination strategies include; food for work programme and sacrifices to induce rain (9.1%) ; relief food and irrigation (9.1%); sacrifices to appease the spirits (9.1%); and support form NGOs coupled with irrigation (9.1%) . On the other hand, the main coping strategy used was irrigation

(36 .4%), followed by use of drought resistant crops (27.3%). Other coping strategies used include; borrowing from relatives (9.1%) food preservation (9.1%); and reducing food ration (9.1%).

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Based on the findings given in the preceding chapter, this section provides a summary of the findings in light of the theoretical and empirical literature with a view to crystallize the specific findings in relation to study objectives. This section discusses summary of the findings, conclusions based on the findings guided by the research objectives are given. Recommendations and suggestions for further research are then given. The following findings were made.

5.2 Discussion

The purpose of this study was to examine the role of indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley, Kenya. The study has pointed out demographic information of the respondents. Key among these characteristics include: gender, age, level of education, marital status and religious affiliation which were used for descriptive analysis of the study. On the level of education, 28.1% were of University level, 22.5% were of college level, 22.2% were of primary level and 20.2% were illiterate. Most of the respondents were affiliated to the Catholic Church (73.5%), with 12.6% being Protestants, 7.3% practicing traditional beliefs and 6.6% were Orthodox. In addition, five thematic issues were analyzed. These included: the rate of occurrence of drought induced famine in the study area, effects of drought induced famine on the livelihoods of communities living in the area, effectiveness of indigenous knowledge in mitigating the effects of drought induced famine, utilization of indigenous knowledge in reducing the effects of drought induced famine and policies to be adopted measures to enhance effective drought mitigation in the study area.

5.2.1 Rate and occurrence of drought induced famine

The study established that although the occurrence of locusts and army worms was likely to lead to famine due to their massive and destruction of crops their occurrence was often unpredictable and consequently, the main cause of famine was found to be drought which was most prevalent and tends to occur every year. It was therefore concluded that drought induced famine occurs as often as every year in the study area. These findings support other findings indicating that in such drought prone areas, famine often occurs quite frequently.

A study by Gebremedhin (1997) contends that famine is caused by a complex set of social, economic and political factors that differ depending on the place and time. These views are supported by the views of Berani and Rodier (1985) that drought is a complex phenomenon, and it is difficult to attribute its occurrence to a single cause. The findings concur with the findings of UN/ISDR (2007) that the causes of drought may be difficult to establish, due to the interrelated and complexity of the causes of drought. Although drought induced famine is a consequence of drought, it does not however, necessarily follow that famine must accompany it. According to this report, the rate of occurrence of drought induced famine in regions are not the same, some regions are more prone to drought than others, and drought induced famine is a by product of differing capacities of countries to effectively prepare for and respond to the effects of drought. These views was further supported by the findings of World Meteorological Organization (2006) that the drought is an insidious natural hazard characterized by lower than expected or lower than normal precipitation that, when extended over a season or longer period of time, is insufficient to meet the demands of human activities and the environment. Drought is a temporary aberration, unlike

aridity, which is a permanent feature of climate. Seasonal aridity, that is, a well-defined dry season, also needs to be distinguished from drought, as these terms are often confused or used interchangeably. Therefore, the differences need to be understood and properly incorporated in drought monitoring and early warning systems and preparedness plans.

5.2.2 Effects of drought induced famine on the livelihoods of Kerio Valley residents

The study sought to examine the effects of drought induced famine on the livelihoods of communities living in the study area. Results indicated that drought induced famine has a combination of effects on the community. These combinations gravitated around loss of human lives, loss of livestock, hunger, reduced agricultural output, and more importantly lack of water. These finding are consistent with findings documented by World Meteorological Organization (1984). In their report, WMO noted that drought is characterized by among others unusually low river flows, low ground water, and reservoir levels, very dry soil and reduced crop yield and even crop failure. A similar study by World Conference on Disaster Reduction (1994) revealed similar findings that famine leads to extreme lack of food security which causes widespread hunger. These views are supported by the views of UNCCD (2004) that drought can have dramatic deleterious effects on nations' economies whereby food availability and prices, employment, access to imports, government expenditures, availability of social services, and credit sources are all influenced by drought.

A similar study by UNEP (2008), UN/ISDR (2007), Edje (2004) Pimentel *et al*, (1994) and Bakenaz (2006) were further echoed that drought induced famine has a

major impact on the majority of the populations in most countries where they live in rural areas and practice rain-fed agriculture. Also, drought undermining economic development due to climatic variability in both economic and mortality terms is generally larger for predominantly agricultural economies, which are predominant in Africa.

Furthermore, similar studies carried out by Wilhite and Glantz (1985) revealed that drought-induced economic losses include those resulting from impaired dairy and beef, crop, timber, and fishery production; lack of power for industrial use; decline in agriculture-dependent industries; increased unemployment in agriculture and other drought-affected industries; strain on financial institutions (capital shortfalls, credit risks); loss of revenue to state and local governments (from reduced tax base); reduced navigability of waterways; and increased costs for transport of water and development of new sources (Wilhite and Glantz, 1985). Such effects are felt by municipalities, business and industry, agricultural enterprises, households and individuals, and governments. These was further support other studies that a country's stage of economic development (which can be measured via GDP), vulnerability to drought is also influenced by the proportion of rainfed agriculture and livestock production in the GDP, level of exports, the amount of arid land, and the levels of household self-provisioning (Benson and Clay, 1994).

5.2.3 Effectiveness of IK in mitigating the effects of drought induced famine

The study sought to determine how effective indigenous knowledge is in mitigating effects of drought induced famine among communities living in the study area. The study therefore postulated that “there is no relationship between indigenous knowledge and the mitigation of drought induced famine.” The study found that there

were significant positive correlations between general indigenous knowledge and famine mitigation (r= 0.329, P<, 0.05) and between indigenous knowledge to mitigate famine (r=0.166, p<0.05). This means that increase in general indigenous knowledge as well as in indigenous knowledge to mitigate famine is likely to lead to increased mitigation of famine. The study further found that there is a significant negative correlation between indigenous knowledge to predict famine and famine mitigation (r=0.276) p<0.05). Consequently, the implication of the negative result is that high levels of indigenous knowledge used to predict famine are likely not to influence famine mitigation by community members.

The study also found out that general indigenous knowledge (β= 0.118, p<0.05), indigenous knowledge to predict famine (β= 0.118, p<0.05) and indigenous knowledge to mitigate famine (β= 0.118, p<0.05) were significant predictors of mitigation of famine. Additionally, these elements of indigenous knowledge account for 73.7% of variation in mitigation of famine. These results of the study are consistent with the similar study conducted by of Robinson and Herbert (2001) that revealed the incorporating indigenous knowledge into drought prevention policies can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable.

It was observed in another study by Mhita (1999) that in the past, indigenous communities were well aware of the disasters that could affect them and had the knowledge and administrative structures to cope with them. At the same time, they knew that a well-conserved environment helped prevent natural disasters and enabled people to combat against natural disasters when they occurred. These views echo the

findings of Ajibade and Shokemi (2003) whose study in Nigeria showed that farmers are able to use knowledge of weather systems such as rainfall, thunderstorms, windstorms, harmattan (a dry dusty wind that blows along the north-west coast of Africa) and sunshine to prepare for future weather. This is further supported by Patt and Gwata (2002) in a study conducted in Zimbabwe where it was observed that farmers' willingness to use seasonal climate forecasts increased when the forecasts were presented in conjunction with and compared with the local indigenous climate forecasts. A study by Dea and Scoones (2003 and Gana (2003) revealed similar finding where local farmers in several parts of Africa have been known to conserve carbon in soils through the use of zero-tilling practices in cultivation, mulching, and other soil-management techniques.

The study was in consistent with United Nations Environment Programme (2008) on indigenous knowledge in disaster management in Africa. The study found that indigenous knowledge systems have enabled the various communities in those countries to live in harmony with their environments for generations, and the systems are important tools in environmental conservation and natural disaster management

5.2.4 Appropriate usage of IK in mitigating effects of drought induced famine

The fourth research objective sought to determine whether appropriate usage of indigenous knowledge reduced the effects of drought induced famine among communities living in the study area. The study found that there is a high positive and significant correlation between proper utilization of indigenous knowledge and famine mitigation ($r=0.769$, $p<0.05$). This implies that proper utilization of indigenous knowledge has the ability to reduce the effects of drought induced famine.

Besides, regression results showed that proper utilization of indigenous knowledge is a significant predictor of famine mitigation ($\beta=0.822$, $p<0.05$) and consequently, an increase in the utilization of 1K is likely to result to an increase in famine mitigation.

These results of the study support findings by a host of other studies. This study is consistence with the similar studies conducted by Ramphele (2004), Eriksen (2005) and Easton and Roland (2000) that revealed similar finding where local communities of southern Sudan rely on indigenous plants that are more tolerant to droughts and pests, providing a reserve for extended periods of economic hardship, for example, women are directly responsible for the selection of all sorghum seeds saved for planting each year.

According to the authors, such indigenous techniques have been effective in mitigating effects of drought induced famine for long periods of time and therefore their scientific value can be determined by well organized studies. These results were further echoed by Morton (2001) in a study conducted in Mongolia. According to Morton (2001) the local herders of Mongolia make used of early warning presented by remote sensing and climate forecasting. The herders make use of government funded scientifically driven weather forecasts. The authors suggest the need to integrate technological early warning with a local understanding of drought and its impacts, with field level monitoring and with appropriate local level planning and action.

5.2.5 Policy measures to be adopted for effective mitigation of drought induced famine

The study sought to identify policies to be adopted for effective drought mitigation among the local community and other stakeholders. The study identified various policies to be adopted among them structural/physical measures like planting appropriate crops, guiding sand dams and establishing engineering projects or non-structural measures such as awareness creation enhanced development, public commitment and operating practices of long-term drought mitigation and preparedness activities; pre-drought activities such as risk assessments and early warning systems and appropriate long-term investment of financial and technical resources to promote capacity development.

The foregoing results are consistent with the study of Sugule and Walker (1998) which show that the goal of mitigation and preparedness is to reduce drought vulnerability and foster drought-resilient societies. According to the authors, preparedness informs of established policies and specified plans and activities taken before an apparent threat to prepare people and enhance institutional and coping capacities, to forecast or warn of approaching dangers, and to ensure coordinated and effective response in an emergency situation. Patt and Gwata (2002) echo these views and assert that "although droughts can be disastrous to local people and livelihoods, they also create a "window of opportunity" to develop capacities that reduce risk associated with drought in the long term, including the sharing of expertise, knowledge, and lessons learned. To make the best of a poor situation, resources may even be pre-positioned to maximize the utilization of these opportunities when they occur. This view is further supported by Adano and Witsenburg (2004) who argued

that the private sector should be encouraged to foster a culture of disaster reduction, putting greater emphasis on and allocating resources to pre-drought activities such as risk assessments and early warning systems.

5.3 Conclusions

The study revealed the role of indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley, Kenya. From the findings of the study, various conclusions were made:

The study established that although the occurrence of locusts and army worms was likely to lead to famine as a result of their massive destruction of crops, their occurrence was often unpredictable and consequently, the main cause of famine in the study area was found to be drought which was very prevalent and tended to occur every year thus destroying crops, livestock and the natural resources base in general.

The study revealed that drought induced famine has a combination of effects on the community. These combinations revolve around loss of human and livestock's lives, hunger, reduced agricultural output, and more importantly lack of water for domestic and livestock use. Furthermore, due to water scarcity, irrigation farming cannot be undertaken to support, compliment or supplement rainfed agriculture

Study results indicated that there are positive correlations between general indigenous knowledge and famine mitigation, indigenous knowledge to mitigate famine and famine mitigation, and proper utilization of indigenous knowledge and famine mitigation. These correlations are also significant at the level. However, the small coefficients for general indigenous knowledge and indigenous knowledge to mitigate famine suggest weak correlations. The implication of the negative result is that high

levels of indigenous knowledge used to predict famine are likely not to influence famine mitigation by community members.

Results also showed a significant negative correlation between indigenous knowledge to predict famine and famine mitigation. This correlation was also significant at the 1% level. The implication of this negative result is that high levels of indigenous knowledge to predict famine are likely to lower actual famine mitigation since the prediction would have prepared community members.

Furthermore, the study sought to establish which of the indigenous knowledge elements influence mitigation of drought induced famine in the study area. The regression coefficients showed that all the four elements of indigenous knowledge namely; general indigenous knowledge, indigenous knowledge to predict famine, indigenous knowledge to mitigate famine and proper utilization of indigenous knowledge were significant predictors of mitigation of drought induced famine. Hence, on the basis of the t values, proper utilization of indigenous knowledge with a t-value which is presumed to be the main predictor of mitigation of drought induced famine in the study area

From the study findings, it was concluded that mitigation of drought induced famine can be represented as a function of general indigenous knowledge, indigenous knowledge to predict famine, indigenous knowledge to mitigate famine, and proper utilization of indigenous knowledge.

5.4 Recommendations

The research was restricted to communities living in Kerio valley, Kenya. The recommendations presented were based on the findings of the study and within the context of a broader policy perspective. Several aspects were noticed in the study which should be adopted by communities, stakeholders and the government in order to reduce drought induced famine among communities living in drought prone areas of Kenya. In the light of the findings, discussions and implications highlighted above, the following recommendations are made for the improvement of the management of drought induced famine in Kerio valley and thus lead to the attainment of food security. Suggestions for initiating this process are:

- Indigenous knowledge about drought prediction and occurrence and mitigation of drought induced famine should be documented urgently to avoid the information being lost as the elderly custodians of the knowledge disappear from the scene.
- Indigenous knowledge in general and specifically that on drought induced famine prediction and mitigation should be incorporated into national policy and development documents.
- There is need for laws to safeguard intellectual property rights relating to indigenous knowledge should be enacted.
- The study recommends that communities should take issues of drought induced famine seriously and participate in solution drive initiative and improve their welfare to free themselves from relief dependence cause by drought. The livelihoods approach suggested here should aims supporting existing livelihoods rather than allowing droughts to destroy them by taking action. There is need to change the thinking that development activities are separate from the

management of disasters such as droughts, and that they should be tackled differently by different actors.

- There is need to exploit available resources in order to improve livelihoods. To this end, the researcher recommends the adoption of appropriate technology rain water harvesting which is virtually lacking in the district. Appropriate rainwater harvesting techniques can enhance the provision of enough water for domestic, industrial and irrigation uses. Rain water harvesting is one of the best options available to fight drought in this region.
- Traditional and formal drought induced famine as well as coping strategies participation approaches should be integrated in institutional structures and programmes to bridge the gaps between research and extension institutions and invest more on localized research that can yield findings aimed at assisting local people to resolve problems and challenges associated with drought and its consequences on local livelihoods and resource base.
- To this end the study advocates for the adoption of an integrated approach and community participation towards planning and implementation of drought management processes. Although such planning and management approach is more complex and time consuming, it will yield significant results over the longer term in the form of cost effectiveness, sound and sustainable community investment and improved natural resources management.
- The government in collaboration with the Kenyan wildlife service, conservationists and the local community should identify all the trees and birds which have traditional value as climate indicators, and declare them protected species. In addition, the local communities need to be empowered through

capacity building and encouraged to make positive use of indigenous knowledge based practices.

- Effective drought mitigation and preparedness measures should move away from policies to practices in order to reduce the potential negative effects of drought. Furthermore, indigenous knowledge should be taught in schools and popularized among members of the public.

5.5 Suggestions for further study

Since this research focused in on indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley, further study should be carried out on other related areas to supplement its findings in the following areas:-

(i) The viability of establishing indigenous knowledge data banks to safeguard knowledge about drought, drought induced famine and other aspects of climate and local livelihood mechanism for integrating indigenous knowledge with scientific knowledge to promote the effectiveness of strategies used in mitigate drought induced famine.

(ii) How to use indigenous knowledge to improve agriculture and natural resource management in order to promote sustainable livelihoods.

(iii)Promoting research on biodiversity conservation through indigenous knowledge.

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APPENDICES

APPENDIX I : INFORMED CONSENT LETTER

Dear Respondents,

I am a PhD student at University of Eldoret. It is a requirement of the course to carry out a research project. I am soliciting for information on the topic "Indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley". I kindly request you to answer the questions below. This research is purely academic and any information provided shall be treated with confidentiality. Kindly participate and respond appropriately to the questions given below. Your contributions are highly appreciated.

Thank you very much in advance.

Yours sincerely,

FLORENCE. A. C. MURGOR
SES/ D. PHIL/18/2009

APPENDIX II: QUESTIONNAIRE FOR COMMUNITY HOUSEHOLDS

I am a PhD student at University of Eldoret. It is a requirement of the course to carry out a research project. I am soliciting for information on the topic "Indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley". This research is purely academic and any information provided shall be treated with confidentiality. Kindly participate and respond appropriately to the questions given below. Your contributions are highly appreciated. Thank you very much in advance.

Questionnaire Number……Date of interview……

SECTION A: PERSONAL DATA

1. Gender

   Male [ ] Female [ ]

2. Age

   15 – 24 [ ] 25 – 34 [ ]35 – 44 [ ]

   45 – 54 [ ] 55 – 64 [ ] 65 and Above [ ]

3. Marital status

   Single [ ] Married [ ] Widowed [ ]

   Separated [ ] Divorced [ ]

4. Education level

   Illiterate [ ] Basic education [ ] Primary [ ]

   Secondary [ ] College [ ] University [ ]

5. Religious affiliation

   Traditional Belief [ ] Orthodox [ ]

   Protestant [ ] Muslim [ ]

   Others (Specify).....

6. Family Size

   0 – 4 [ ] 5 – 9 [ ] 10 – 1 [ ]

   15 – 19 [ ] 20 – above [ ]

7. Land holding in hectares

0 – 0.4 [ ] 0.5 – 1.4 [ ]

1.5 – 2.0 [ ] 2 andabove [ ]

8. Experience years in the use of 1K in the mitigation of drought induced famine

< 5 [ ] 6 – 10 [ ]

11 – 15 [ ] >15 [ ]

9. Occupation

Casual labourer [ ] Civil servant [ ]

Farmer [ ] Pastoralist [ ]

Others (specify).....

10. Length of stay in current location in years

0 – 10 [ ] 20 – 39 [ ] 40 – 59 [ ]

60 – 79 [ ] 80 and above [ ]

11. Language spoken

Native local language [ ] Neighboring language [ ]

Exotic/foreign language [ ] other language (specify)…….

SECTION B: Rate of occurrence of drought induced famine among communities living in Kerio valley

12. What factors cause famine in this area?

Locusts [ ] Army worms [ ]

Drought [ ] Pests [ ]

Others (specify).....

13. What is the frequency of occurrence of famine in this area?

Factor	**Occurrence frequency**			
	Every year	**Every 5 yrs**	**10 years**	**Unpredictable**
Locust Army worms Drought Others				

14. Rate the cause of famine given in the table below in term of the degree of their severity in this area

(1 = Not severe; 2=. Severe; and 3 = Very severe)

Factor	**Level of severity**		
	1	2	3
Locust			
Army worms			
Drought			
Others (specify)			

15. What is the degree of indigenous knowledge of the community on drought induced famine?

Beginning [ ] Intermediate [ ]

Advanced [ ] Not sure [ ]

No knowledge [ ]

16. What forms of events predict the coming of drought induced famine? (Use table below)

Event	Indicator
1. 2. 3. 4. 5. 6.	

17. The community has indigenous knowledge to predict the occurrence of drought induced famine

Always [ ] Often [ ]

Sometimes [ ] Not at all [ ]

18. When the community predicts the occurrence of drought induced famine, it occurs.

Always [ ] Often [ ] Sometimes [ ]

Unpredictable [ ] Not at all [ ]

19. Who are involved in the prediction of the occurrence of drought induced famine?

Council of elders [ ] Chiefs/sub-chiefs [ ]

Men [ ] Women [ ]

Others

(Specify).....

20. What types of activities common within this community cause drought induced famine?

Migrant Encroachment [ ] Land speculation [ ]

Agricultural Expansion [ ] Illegal logging [ ]

Firewood consumption [ ] Forest fires [ ]

Others

(specify).....

21. What are some of the indigenous strategies used to overcome drought induced famine?

Participation in land use planning [ ] Activities and Access to irrigation [ ]

Forest Land Demarcations [ ] Improved Farming Systems [ ]

Education on Migration Patterns [ ] Planting water friendly trees [ ]

Deforestation [ ]

Others (specify).....

22. The community has indigenous knowledge in mitigating drought induced famine.

Strongly Agree [ ] Agree [ ] Disagree [ ]

Strongly Disagree [ ] Not sure [ ]

23. List the activities that the community carries out to reduce drought induced famine.

Perform traditional sacrifices to God [ ] Conduct modern prayers to God [ ]

Carry out rituals [ ] Migration to new areas [ ]

Others (specify).....

24. List the effects of drought induced famine as the community may have experienced in the past.

Loss of human lives [ ] Hunger [ ]

Loss of livestock lives [ ] Reduced agricultural output [ ]

Disappearance of water supply sources [ ]

Others

(specify).....

25. Indigenous knowledge in mitigating the above results is

Fairly effective [ ] moderately effective [ ]

Just effective [ ] Not effective [ ]

26. The community has been able to use its indigenous strategies to mitigate drought induced famine.

Always [ ] Often [ ]

Sometimes [ ] Not sure [ ]

27. To cope with drought induced famine the indigenous knowledge used by the community includes:

Mastering rainfall variability, preserve [ ]

Preserve knowledge and transfer it to subsequent generations orally [ ]

Predict rainfall and crop prospects yearly for measures to be taken to manage variability and impact on livelihood [ ]

Water Resource management for water supply throughout the year [ ]

Selection of crop patterns [ ]

Selection of cultivation practices [ ]

Diversification income generating activities [ ]

Community effort organization [ ]

28. In what ways does the community utilize its indigenous knowledge in mitigating drought induced famine?

Build storage of grains (Granaries) [ ]

Distributing grains in stress periods [ ]

Indigenous underground Cavern [ ]

Establishment of land storage structures [ ]

Storage of fodder/hay [ ]

Migration of community [ ]

Pastoralism [ ]

Grazing patterns [ ]

Short and long term preservation techniques [ ]

Food storage technology (vegetable and meat) [ ]

Preservation mechanism [ ]

Eating habits and Types of foods eaten [ ]

Any other (specify) [ ]

29. Rate the effectiveness of indigenous knowledge in mitigating drought induced famine

1 = Not effective 2= Effective 3 = Very effective

Risk mitigated	Level of effectiveness		
	1	2	3
Food security			
Water reservation			
Management of human lives			
Protection of animal lives			

30. What are some of the threats that indigenous knowledge posed to the community?

Traditional methods could not be sustainable in providing food and water

[ ] Inadequacy of Fodder for long droughts

[ ] Lack of health facilities increased loss of human and livestock lives

[ ] Oral nature of indigenous knowledge made it be confined to few people when being transferred

[ ] Technology conflicts with indigenous knowledge

[ ] Others (specify).....

31. How effective is indigenous knowledge in predicting weather patterns?

Very effective [ ] Effective [ ] Fairly effective [ ]

Not effective [ ] Unpredictable [ ]

32. (i) What type of livestock is kept in this area?(Tick appropriately)

Cattle [ ] Goats [ ] Sheep [ ]

Pigs [ ] Donkey [ ] Camel [ ]

Others (Specify).....

(ii) What crops are planted in this area? (Tick appropriately)

Maize	[ ]	Sorghum	[ ]	Groundnuts	[ ]
Millet	[ ]	Cassava	[ ]	Sweet potatoes	[ ]
Cowpeas	[ ]	Beans	[ ]	Melon	[ ]
Vegetables	[ ]	Cash crops	[ ]	Any other (specify)……	

(iii) Types of wild edible fruits available to the community

	Edible Fruits available	Period when available
1	.....	……
2.	.....	.....
3.	.....	.....
4.	.....	.....

(iv) Edible Exotic fruits available

Type of plant	Use of plant	Period when available

(v) Edible insects common in the study area

Type of insect	Use of insect	Period when available

(vi) Non – edible trees known to the community

Type of tree	Use of tree	Period when available

33. The community has experienced the following through utilization of indigenous knowledge to mitigate drought induced famine.

Reduced loss of human and livestock lives [ ]

Good food security management system [ ]

Reduced of water supply insecurity [ ]

Others

(specify).....

34. Non- agricultural initiatives the local community engages in to mitigate drought induced famine

Selling firewood

Producing and selling handcraft [ ] Selling hay/fodder [ ]

Production and selling traditional brews [ ] Carpentry [ ]

Loan acquisition for business initiatives [ ] Handouts from relatives [ ]

Seeking full time employment [ ] Income generating projects [ ]

Relief food [ ] Any other (specify)……

35. Any other coping strategies adopted by the local people/community

Begging for food from neighbors [ ] Asking for food from relatives [ ]

Working for neighbors in exchange for food [ ] Indulge in making traditional beer [ ]

Migration to areas with less severe drought [ ] Lease land from high rainfall areas [ ]

Any other (specify)……..

36. Classify the following activities according to who perform them (men, women Boys and girls)

Activity	Adults		Children	
Digging by hand Ploughing by tractor Planting by plough Planting by planter Planting by broadcasting Planting by hand Weeding by hand Weeding by draft Fertilizer application Harvesting Winnowing Tending cattle Milking Tending poultry Fetching water Fetching firewood Cooking Watering vegetables	Men	Women	Boy	Girl

APPENDIX III: INTERVIEW SCHEDULE FOR EXTENSION OFFICERS AND COUNCIL OF ELDERS

I am a PhD student at University of Eldoret. It is a requirement of the course to carry out a research project. I am soliciting for information on the topic "Indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley". This research is purely academic and any information provided shall be treated with confidentiality. Kindly participate and respond appropriately to the questions given below. Your contributions are highly appreciated. Thank you very much in advance.

Date of interview: .....Community name: .....

1. PERSONAL INFORMATION

Demographic Characteristic

Area.....

Occupation.....

Age..... Place of Residence.....

2. Characteristic of Agriculture----------

Number of fields ----------

Reasons for change in cultivated area----------

Distance of field from home----------

Number of livestock kept----------

Number of livestock last year----------

Reasons for change in livestock ----------

Number of small stock kept ----------

Changes and reasons for change of stock kept ----------

3. Crop husbandry (Use table below)

Area	Crop	Yield	Use of fertilizer	Pest/Disease control

3b.AGRO – BIODIVERSITY

i. Are there any edible wild plants in this area?

ii. If yes, what name.....

iii. Are there any reasons for eating it or any nutritional value attach to the fruits……

iv. When the fruits are available who collects them.....

v. Are there any fruits from other parts that are grown here? ----------

vi. How do you use trees/forests----------?

vii. Do you have the practice of tree planting? ----------

viii. Have you noticed any of the following?

Increased harvesting of wild fruits and vegetables YES [ ] NO [ ]

Any extinct varieties YES [ ] NO [ ]

Increased sale of firewood YES [ ] NO [ ]

Depletion of game species YES [ ] NO [ ]

Extinction of livestock breeds YES [ ] NO [ ]

3 C. ANIMAL HUSBANDRY (Livestock available)

Cattle, ----------

Donkey----------

Mules----------

Goats----------

Camel----------

Pigs etc. ----------

4. Indigenous knowledge for mitigating drought induced famine

Crops to grow in the area, who possesses such knowledge

Seeds, which and how to find the seeds on how to plough and use of oxen on weeding.

Stalk borer control

Scarring birds and rodents

Harvesting and avoiding crop losses

Building cribs and other food storages

Intercropping

Crop rotation and conservation

Weather hazards and control

Local breads

Soil conservation and fertility

4 B How is this indigenous knowledge shared in the community----------?

Who owns it?

Men and women [ ] Women alone [ ]

Children [ ] Men alone [ ]

All the above [ ]

5. What is the Drought Condition in this place?

Weather conditions ……..

Rain……..

Weather hazards……..

Seasons…….

Any change over the last 3 years YES [ ] NO [ ]

If yeas what are the changes……..

Have you experienced drought induced famine? YES [ ] NO [ ]

If so which years…….

What is the nature? ……..Probe on:

Rain failure throughout the year [ ]

Rains come later in the year [ ]

Which months……

And for how long……..

What are the causes of this drought induced famine?.....

5 B. What are the consequences of drought on the following?

Agro biodiversity ……

Farming systems …….

Indigenous knowledge (IK) ……

Household……

6. Food Security

Do you have food available during the two seasons? Dry, wet……

What food is available throughout the year?

What is the source available food?

Are there any changes observed overtime with household food security……

If so what are the changes that which livelihood is affected……

What are the causes of the changes? Probe on: drought, illnesses……..?

Any institution available in the community that support households affected by the above…….……?

What kind of support is given and to what extent probe on: food for work, drought relief NGO programme (specify) .....?

Who gets the food aid?.....

How do you get news about food aid?.....?

7. What kind of help do you prefer?

Sources of income [ ] Sale of produce [ ]

Sale of livestock [ ] Sale of assets [ ]

Earning [ ] Loans [ ]

Remittances [ ]

7B. Who controls income at household level……?

What are the Constraints faced by specific group in diversifying their sources of income?

8. Income expenditure on

Food …….

Farm inputs……

Capital items……..

School fees…….....

Services……..

Others (specify).....

9. Mitigation strategies use to reduce drought induced famine

.....

10. Coping strategies for drought induced famine

.....

.....

11. Rate the Intensity and frequency of drought experienced in this area. Provide your response in relation to the extent to which you agree to the statements (Keys VS= very severe, S = Severe, M = Moderate, L = Light and N/G= Normal/good).

VS = very severe [ ] S = Severe [ ] M = Moderate [ ]

L = Light [ ] N/G= Normal/good [ ]

APPENDIX IV: QUESTIONNAIRE FOR GOVERNMENT OFFICIALS, MINISTRIES, NGOs AND CBOs STAFF

I am a PhD student at University of Eldoret. It is a requirement of the course to carry out a research project. I am soliciting for information on the topic "Indigenous knowledge and its potency in mitigating drought induced famine among communities living in Kerio valley". This research is purely academic and any information provided shall be treated with confidentiality. Kindly participate and respond appropriately to the questions given below. Your contributions are highly appreciated. Thank you very much in advance.

SECTION A: PERSONAL INFORMATION

1. Gender

Male [ ] Female [ ]

2. Age

18 – 24 [ ] 25 – 34 [ ]35 – 44 [ ]

45 – 54 [ ] 55 – 64 [ ] 65 and Above [ ]

3. Marital status

Single [ ] Married [ ] Widowed [ ]

Separated [ ] Divorced [ ]

4. Education level

No formal education [ ] Basic education [ ] Primary [ ]

Secondary [ ] College [ ] University [ ]

Others (Specify).....

5. Occupation

Casual labourer [ ] Civil servant [ ] Self employed/ Jua kali [ ]

Farmer [ ] Pastoralist [ ]

Others (specify).....

6. How long have been working in this organization?

Below 20 years [ ] 20 – 25 years [ ]

26 – 40 years [ ] 41 years and above [ ]

SECTION B: KNOWLEDGE OF DROUGHT INDUCED FAMINE

9. What are the causes of drought induced famine in this area?
   1. ……..
   2. ……
   3. ……..
10. What role(s) does your institution play in mitigating drought induced famine in this area?

1.……

2.……

3.……

4.……

11. What are indicators to show that local community activities contribute to drought induced famine?

Activities	**Indicators**
Migrant encroachment	
Military personnel	
Land speculation	
Agricultural expansion	
Illegal logging	
Firewood harvesting	

12. How does the institution mitigate these risks?

Education on Environmental hazard Patterns [ ] Control of encroachments [ ]

Installation of boundary posts and signage [ ] Stop illicit forest activities [ ]

Others (Specify) _____

13. What are other activities do the government / NGOs/ CBOs engage the locals in to support to their indigenous knowledge so as to mitigate drought induced famine?
    1. ……
    2. ……
    3. ……
    4. ……

14. How effective are the support mechanisms listed in question 13 above?

Very effective [ ]
Moderately effective [ ]
Fairly effective [ ]
Not effective [ ]
Non- of the above [ ]

15. What are the roles of your organization toward mitigation of drought induced famine?

Creation of awareness of danger of forest destruction [ ]
Training local people on proper farming mechanisms [ ]
Campaigns to introduce drought resistant crops [ ]
Organizing tree planting campaign [ ]
Establishing food storage mechanisms [ ]
Promoting water harvesting and management systems [ ]
Others (Specify) _____

16. How is indigenous knowledge being utilized in mitigating drought induced famine in this area?

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

17. Effects of drought induced famine

Loss of human lives [ ] Reduction agricultural output [ ] Hunger [ ] Reduction food supply [ ] Reduction agricultural output [ ] Loss of livestock [ ]
Disappearance of water supply sources [ ]
Others (specify).....

18. What activities is your agency engaged in to ensure protection of indigenous knowledge in reducing famine?

Introduction of appropriate policies and good governance [ ]
Identification of risks associated with drought [ ]

Impact assessment and early warning [ ]

Drought awareness and knowledge management [ ]

Reduction of factors promoting drought risks [ ]

Strengthening preparedness for drought and tracking progress [ ]

19. What adaptation measures are necessary for the community to adopt to mitigate drought induced famine?

Expand efforts to promote rain water [ ]

Adopting harvesting and improved soil management techniques to reduce soil erosion [ ]

Increase soil water's holding capacity through soil erosion control [ ]

Improved weed management [ ]

Adopt cultivation of drought tolerance crops [ ]

20. What are some of the responses to drought emergencies in this area?

1. ……
2. ……
3. ……
4. ……
5. ……..

21. List the forms of coordination and communication between your office and the local community

1. ……..
2. ……..
3. ……..
4. ……..

22. Which are some of the indicators used to send early warning to determine the occurrence of drought

1. …….
2. ……..
3. ……..
4. …….

23. What are the ways used to help maintain the livelihoods of drought affected population

1. Diversify ways of income generation [ ]
2. Adopt a transitions to different livelihood [ ]
3. Offer alternative solutions besides current ones [ ]

4. Others (Specify) _____

24. Ways for collaboration on drought management practices with the government and NGO/ CBO agents.
    1. ……..
    2. ……..
    3. …….
    4. ……..

25. What are the enabling conditions that you aim to achieve to promote development in this area

    Understand local livelihoods and vulnerability [ ]

    Promotion of community driven implementation [ ]

    Promote community organization [ ]

    Enhancement strong participation of gender equity [ ]

    Local training and capacity building [ ]

    Bring together traditional and scientific drought mitigation strategies [ ]

    Supportive policy environment [ ]

26. Measures taken to curb drought related activities

    Soil and water conservation [ ] Planting cover crops plantation [ ]

    Agro forestry [ ] Integrated pest management [ ]

    Zero grazing [ ]

    Others (Specify) _____

27. Comment on IK in mitigating drought induced famine

    People in Hazard prone areas have acquired considerable knowledge and technical expertise for risk management [ ]

    Indigenous knowledge and coping strategies are often overlooked and undervalued by agencies [ ]

    Coping strategies are very diverse [ ]

    All forms of knowledge – indigenous and external are important [ ]

Indigenous knowledge is affected by changes in economy and society [ ]

28. Government and NGO/ CBO aim to:

Empower communities to forecast, prepare for manage and mitigate drought [ ]

Mobilize and learn social infrastructure for drought mitigation and climate management [ ]

Improved and sustained farm productivity and livelihood opportunities among the vulnerable in drought period [ ]

Enhance information and knowledge flows among stakeholders on drought mitigation [ ]

Informed policies on drought mitigation [ ]

Minimize adverse economic, environmental and social effects of drought among the vulnerable [ ]

APPENDIX V: FOCUS GROUP DISCUSSION GUIDE

1. How do you define climate variability and drought in this community? Probe for: what is meant by normal excess, low rainfall in a season, failure of crops, death/disease of animals, prices of stable foods).
2. How do you forecast drought in this community? (probe indicators like drying in occurrence of certain plants species, occurrence of rare animal species, wind directions/ strength, movement of birds/animals, sighting of stars, stars arrangement, temperature sun or moon positions. Timing of occurrence of these indicators – how many weeks before the normally expected start of rains).
3. Do farmers remember past times when there was an event of drought induced famine that they were forewarned, were there indigenous indicators? If they cannot remember exactly, ask them to compare with ages of their children or colleagues named after such events and estimate the years.
4. Do these indicators show the intensity of the drought induced famine? (Intensity of animal/plant species occurring relative to strength of winds, temperature etc).
5. How is the information of these indicators communicated within the community? Are there any mitigating and coping strategies taken to mitigate or reverse the consequences of the drought induced famine both at individual and community level? What are these? (Find who is the custodian of information in the village, rainmakers etc. once the information is given, what do they normally do?
6. Do you have any knowledge/explanation as to why a particular indicator should occur/happen only when a particular climate abnormally is about to happen?
7. What are the strengths and weaknesses of indigenous knowledge in the mitigation of drought induced famine? Probe on techniques of managing such famine and limitations of such techniques.

APPENDIX VI: OBSERVATION SHEET

WHAT TO OBSERVE?

1. **Land use**

Farming methods practiced

Crops planted

Planting seasons

Size of land usage per household

Amount of harvest

Number of household members

Forest/trees usage and plants types

2. **Type of animals/ livestock**

Other activities other than farming undertaken in the area

Vegetation cover

Types and nature of animals

Any available shrines for performing rituals to induce rainfall

Sacrifices to induce rainfall

3. **Presence of elders (Rainmakers)**

Climate forecasting person

Methods of communicating forecasted information

Mitigation measures, if and when drought is forecast to occur...

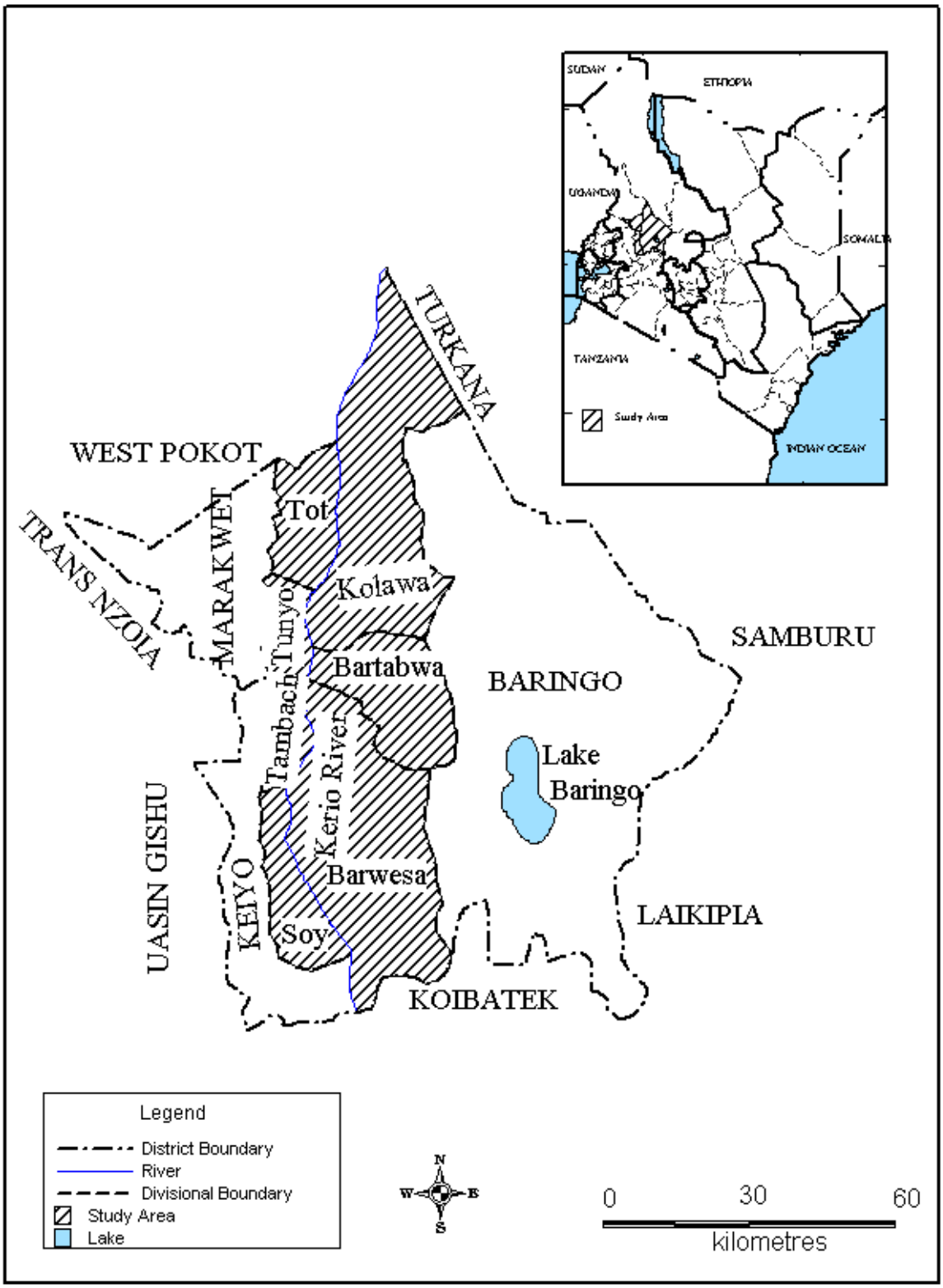
Any systems for assisting each other in case of drought induced famine

Any exchange and reciprocity systems resorted to in drought induced famine periods

Any storage facilities for food reservation

Any dams, wells, boreholes made to store water as well as other facilities used to harvest and store water.

APPENDIX VII: MAP SHOWING LOCATION OF THE STUDY AREA



(Source: Moi university cartography department, 2011)

APPENDIX I: PICTURES FROM THE STUDY AREA SHOWING STRESS FROM WATER SCARCITY

(Source: Author, 2012)