THE ROLE OF DROUGHT ON AGRICULTURAL PRODUCTION;
A CASE STUDY OF FAQI DISTRICT IN
NORTH EASTERN, KENYA

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DECLARATION

I, FAISAL ABDI MUMIN, declare that these work complied and presented in this dissertation is original and entirely out of my own research and has never been submitted to any other university or institution of higher learning before for any award.

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Signature

Date: 05/06/2011
APPROVAL

This is to certify that this dissertation has been submitted for examination with my approval as the supervisor.

Signature

Mr. Orishaba R. Ammon
Supervisor
Date

10/06/2011
DEDICATION

This dissertation is dedicated to my beloved Mother Hinda Ali Mohammed for the support, care and faith in me, and for the guidance and encouragement throughout my studies.

I also dedicate this work to my dear brothers and sisters and to my friends for their time and assistance given to me.
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<td>ASAL</td>
<td>Arid and Semi-Arid Lands</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<td>ALRMP</td>
<td>Arid Lands Resource Management Project</td>
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<tr>
<td>NEMA</td>
<td>National Environment Management Authority</td>
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<td>GOK</td>
<td>Government of Kenya</td>
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<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<td>DRSRS</td>
<td>Department of Resource Surveys and Remote Sensing</td>
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<td>MoA</td>
<td>Ministry of Agriculture</td>
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<td>WFP</td>
<td>World Food Programme</td>
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<td>World Health Organization</td>
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<td>WVK</td>
<td>World Vision Kenya</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>SEA</td>
<td>Strategic Environmental Assessment</td>
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<td>KMD</td>
<td>Kenya Meteorological Department</td>
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<td>EWSs</td>
<td>Early Warning Systems</td>
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<td>ISDR</td>
<td>International Strategy for Disaster Reduction</td>
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<td>IGAD</td>
<td>Inter-Governmental Authority on Development</td>
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ABSTRACT

A case study of the role of drought on agricultural production was conducted among small-scale farmers in the Buri division of Fafi district in Northeastern Kenya, to determine how drought affects the agricultural production, causes and different types of drought that exists and what can be done to minimize the impacts of drought in the study area. Achieving these objectives would help increase the agricultural production, ensures the availability of food and water. The method that were used in data collection include; a sample of about 60 respondents being chosen and both stratified and purposive sampling techniques used in soliciting responses by means of research instruments such as questionnaire, interview guide and observation for households. Data processing and analysis were used to extract meaningful information from the raw data obtained from the field. It was identified the largest percentage of people that were affected by the burden of drought are farmers.
CHAPTER ONE

INTRODUCTION

1.0 Background of the study

Droughts have taken place around the world throughout history. Some scientists theorize that droughts brought about the migrations of early humans. From 1876-1879, severe droughts in China caused the deaths of millions of people from lack of food. Russia experienced severe droughts in 1890 and 1921. The 1921 drought in the Volga River basin caused the deaths of up to five million people.

The best-known American drought occurred on the Great Plains region during the mid-1930s. Labeled the dust bowl, the affected area covered almost 50 million acres in parts of Colorado, New Mexico and Oklahoma. During this period, dust storms destroyed crops and buried agricultural fields with drifting sand and dust (John Steinbeck 1930).

Almost the entire continent of Africa suffered from droughts in the last quarter of the twentieth century. Ethiopia, usually considered the breadbasket of Eastern Africa, was hit by a brutal in the early 1980’s. A dry year in 1981 resulted in low crop yields. Three years later, another dry year led to the deaths of nearly a million people. Drought conditions again threatened Eastern Africa in 2002. An estimated 15 million people in Ethiopia, three million in Kenya, 1.5 million in Eritrea and three million in Sudan could face starvation as a result of drought. Between 1968 and 1973, Sahel (a region in East Burkina, a country in West Africa) suffered a great drought. An estimated 50,000 and 200,000 people died as a result. In addition a region where there are few surface water reservoirs such as Sahel, the major source of precipitation is transpiration from plants. As plants become sparse in drought conditions, this source of water for precipitation is diminished. The diminished precipitation further decreases the growth of vegetation (World Health Organization 2002).

Kenya was hit by a series of droughts in 1991-92, 1996-97 and 1999-2000, and a devastating flood in 1997-98. The 1999-2000 droughts occurred against a background of long-term economic recession, where water and food requirements, and security affected almost every sector. The drought and events that followed will be remembered as probably one of the worst disasters experienced in the country in over 40 years. Failure of the long rains in March 2000
was the fifth successive dry spell over a period of two years. Consequently, the soils were left with severely inadequate moisture to sustain plant growth and resulted in the destruction of crop fields, water resources, vegetation cover, severe environmental degradation and ultimately the loss of ecosystem goods and services.

The Arid and Semi-Arid Lands (ASALs) were worst hit by this drought due to the fragile nature of this ecosystem, breakdown of traditional drought coping mechanisms and rapidly changing land use. The loss of livelihoods brought incalculable suffering to over 40 millions of people in more than 22 districts. Millions of people starved and struggled to restore their homes and regain livelihoods (UNEP 1997).

Drought can be described as the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels causing a serious hydrological imbalance that adversely affects land resource production systems. However, drought is temporary condition in which precipitation is abnormally low for a particular region. Drought may occur at any time in any part of the world and last anywhere from days to weeks to decades (ISDR 2002).

Agricultural production is the primary sector of the economy involves changing natural resources into primary products. Most products from this sector are considered raw materials for other industries. Major business in this sector includes agriculture, agribusiness, fishing, forestry and mining and quarrying industries

1.1 Statement of the problem

Drought is a widespread phenomenon in North Eastern Province of Kenya particularly in Fafi District. Low agricultural production contributes to malnutrition, which results into increase of death among children and families in the region. This is not only affecting the people but also the livestock which are vulnerable. This study attempts to close this knowledge gap. There is need to solve this problem and the solution is to provide storage facilities to the communities in the area so that they could store food and use in the future if they experience a harsh climatic conditions.

The study investigated the relationship between drought and agricultural production in the Fafi district. Drought is linked to agricultural production alone because it is the justification of
linkages, although agricultural production has other variables but drought is most important one which influences. This is what makes drought a problem and consequently forming a problem statement.

1.2 Objectives of the study

The major objective of the study was to determine the relationship between drought and agricultural production in the study area. While the specific objectives included;

i. To find out the causes and different types of drought in Fafi district in North Eastern Kenya.

ii. To find out the impacts of drought on agriculture in Fafi district in North Eastern Kenya.

iii. To recommend possible measures to mitigate the impacts of drought in Fafi district in North Eastern Kenya.

1.3 Research questions

i. What are the causes and different types of drought in Fafi district in North Eastern Kenya?

ii. What are the impacts of drought on agricultural production in Fafi district in North Eastern Kenya?

iii. What are the possible measures that can be used to minimize the effects of drought in Fafi district in North Eastern Kenya?

1.4 Scope of the study

This study was conducted in Fafi agricultural area. This study focused on how drought affected the agricultural production. Fafi District is located near 0°27′25″S 39°39′30″E/ 0.45694°S 39.65833°E. It has a population of 92,000 (Population Census 2009). Fafi agricultural method of farming consists of both rain fed farming system and irrigation farming system.

The context of the study mainly covered on the following variables, the role of drought as independent variable and agricultural production as a dependent variable.
The study took a period of four months starting from January 2011 to May 2011.

1.5 Significance of the Study

The study will be helpful to government agencies which are policy makers. In particular Ministry of Disaster Preparedness; Ministry of Agriculture, Animal Industry and Fisheries; and Ministry of Health. For Ministry of Disaster Preparedness it should draw its attention towards addressing impacts of drought that agriculturalists are facing.

The research is also helpful to the donor communities such as World Food Program (WFP), Food Agriculture Organization (FAO), and Oxfam Canada to provide relief to the affected people.

The study will provide a foundation for future researchers about the same problem in the area and elsewhere.

The results of the study will alert people such that they become aware of the problem of drought in the area and can thus adapt right procedures of solving the problem.

The dissertation produced out of this study is a prerequisite in partial fulfillment of the requirement for the award of Bachelor of Science in Environmental Management.
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter brings to light what has been documented about the causes, effects, different types of droughts and what can be done to mitigate them in order to achieve sustainable agricultural production. These three major objectives of the study however, have been reviewed on the regional basis starting with Sub-Saharan region, East African level and lastly on the Kenyan context. Definitions and common characteristics of drought have also been highlighted.

Definition of key terms

Hazard
A potentially damaging physical event, human activity or phenomenon with a potential to cause loss of life or injury, property damage, social and economic disruption of life, environmental degradation among other effects (ISDR 2002).

Vulnerability
Vulnerability refers to a set of conditions resulting from physical, social, economic and environmental factors, which increase the susceptibility of a community to the impact of disasters. Vulnerability also refers to the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard.

Disaster
A disaster can be defined as a serious disruption of the functioning of the society causing widespread human, material or environmental damage and losses which exceed the ability of the affected community to cope using their own resources (ISDR 2002).

Risk
Risk is the probability of harmful consequences or loss resulting from the interaction between natural hazards and vulnerable conditions of property and people (Karimganj 2008).

Mitigation
Short and long-term actions, programs or policies implemented in advance of a natural hazard or in its early stages, to reduce the degree of risk to the people, property, and productivity capacity (FEMA 2010).
Preparedness

Pre-disaster activities designed to increase the level of readiness or improve operational capabilities for responding to an emergency (Swift 1996).

Response

Actions taken immediately before, during or directly after a disaster to reduce impacts and improve recovery.

Impacts

Specific effects of hazards or disasters also referred to as consequences or outcomes (Bakker 2002).

Drought

In general, drought is defined as an extended period a season, a year, or several years of deficient rainfall relative to the statistical multi-year average for a region. This deficiency results in a water shortage for some activity, group, or environmental sector (ISDR 2002).

2.1 Causes and types of drought

The underlying cause of most droughts can be 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 results in greater evaporation rates. Drought is not only caused by natural factors but also anthropogenic activities such as deforestation, overgrazing and poor cropping methods, which reduce water retention of the soil, and improper soil conservation techniques, which lead to soil degradation.

Natural factors that causes drought

High air pressure

Drought occurs when not enough rain falls to the ground. However, water vapor condenses only if air rises into the colder regions of the atmosphere, if the air doesn’t rise, then no rain will form. When there is high air pressure, air falls instead of rising. With the air pressing down in a high pressure zone, no currents of water vapor are carried upward. As a result, no condensation occurs, and little rain falls to earth. In addition, high pressure areas push clouds and air currents downward and away, resulting in sunny, cloudless weather. It is normal for a high pressure system to pass over an area and move on, being replaced by a low pressure system. However,
when a high pressure system is stalled, the sunny weather can drag for days. If it keeps on going, the result is a drought (Alley, W. M 1984)

**Cold currents**

Currents of cold and warm water in the ocean can also stall a high pressure system. In the Pacific, a warm water current known as El Nino brings low pressure system that cause hurricanes and other violet storms to North America, while a cold water current known as La Nina brings drought. In Asia, the opposite occurs, with El Nino bringing drought and La Nina stormy weather (Bakker 2001)

**Ocean winds**

Droughts occur because water vapor is not brought by air currents to the right areas at the right times. Water that evaporates from the oceans is brought inland by wind to regions where it is needed. However, sometimes those winds are not strong enough. In the Eastern United States, moisture is carried up from the Gulf of Mexico by northward blowing winds. This moisture is then pushed by other winds until it reaches the Midwest. This water then falls to the ground, supporting the farms in that region. However, if the winds don’t blow at the right time, in the right direction, or with enough force, the moisture falls in other areas and that Midwest region suffers from drought. A similar phenomenon occurs in Southeast Asia. Usually summer winds known as monsoons carry water vapor north from the Indian Ocean inland, providing desperately needed air. Sometimes, however, instead of blowing from north to south, they blow east to west. When that happens, the vapor doesn’t leave the Indian Ocean and many people suffer from the resulting droughts (Marques S. 1982).

**Rain shadow/topography/relief**

Mountains can prevent wind from blowing moisture to needed regions. As air is moving past a mountain range, it is forced to rise in order to pass over the peaks. However, as the air rises, it becomes colder and the vapor condenses into rain or snow. The rain then falls on the side of the mountain, known as the windward side (the side that is turned toward the wind). When the air mass finally makes it over the mountain, it has lost much of its vapor. This is another reason why
many drought prone areas and deserts are found on the side of the mountain facing away from the ocean (Enger and Smith 2006).

**Bushfire**

When vegetation like trees burn they no longer are able to release any moisture into the air. The less moisture in the air means that clouds are less likely to form. With less cloud in an area, particularly in catchment area a drought could be prolonged. When a fire is in progress it reduces the humidity in the air also. This can sometimes reduce the chance of rain. The wind can also move humidity away from an area for example out to sea (Khelen Thokchom 2009).

The most obvious connection between fires and drought is that when there is less rain, the plant materials tend to dry out and even die. This allows for an increase in fuel loads. The bigger the fuel load, the larger the fires. When an environment or area has less vegetation greater winds occur. If there are fewer trees for example the winds can keep going in a straight.

Climate change causes drought, as researcher Xu Yinlong at the Chinese Academy of Agricultural Sciences explains. Xu states that climate change is responsible for the 2009 drought in China, which was the worst in 50 years. Man-made global warming may be an example of this climate change, according to reporter Jim Giles at New Scientist, who uses global warming to explain the water shortages in the western United States in 2007.

Once every one to two decades, any given region experiences a decrease in rainfall and unusually dry conditions, leading to a drought, as weather researchers at the National Oceanic and Atmospheric Administration observes. Researchers call them “cycles of drought.” These climate changes come and go naturally, as do the drought.

**Human induced factors that cause drought**

Human population in the arid, semi-arid and dry sub-humid areas is affected by poverty, thinly scattered and with minimal means of ground communication. Information on drought impacts often reaches the authority too late when the damage is already done. Interventions are equally difficult to undertake to save lives. The survival of most people is therefore dependent on
weather patterns during the cropping seasons, cultivated area and inputs. With the rapid increase of population, these subsistence farmers continue to open more land for cultivation of crops, thus exposing the soils to weather elements, over exploitation and eventual degradation.

Extended severe droughts normally leave populations hungry and poorer having lost livestock and crops and disrupted livelihood systems. This reinforces their poverty, which means they cannot purchase and use optimal agricultural inputs in the next season so as to increase productivity. This leads to increased poverty and the opening of more land for cultivation.

Levels of poverty have been growing in most parts of the country for various reasons; low economic growth, high unemployment rates, and breakdown of cash crop in the high potential areas such as coffee farming. This partly explains why drought impacts are becoming more severe, high potential areas that were in the past mildly impacted by drought were particularly affected by the 2000 drought because of increased poverty. In the ASAL areas, livestock marketing infrastructure is inadequate. It was observed during interviews that pastoralists are now more willing to sell their herds during drought. Proper marketing infrastructure will improve their economy and enable them to cope with the impacts of drought. In Kajiado district, it was noted that cattle prices were one tenth of the normal prices during the drought and this left the pastoralists poorer than they would be if proper marketing were in place (ECA 1999).

There is considerable geographic variation in the distribution of well being in Kenya. Areas in the high potential zones exhibit significant variability of poverty levels. ASAL districts show less spatial heterogeneity in poverty levels. Poverty densities are also scattered indiscriminately across the country. An overlay of spatial data of poverty density and drought vulnerability indicates that 85% of the people in ASAL are susceptible to drought impacts. Some areas are endemic to poverty as well as drought.

Excessive farming can be hard on the landscape, resulting in drought periods when water is in short supply. For instance, in Jordan’s 2008 drought, farm irrigation drank up the country’s water supply, according to a Belfast Telegraph article. Some farmers attempt to grow plants not native to their region, requiring extra water and this contributing factor to droughts.
Deforestation also causes and worsens drought, as Nick Nuttal of the United Nations Environmental Program states. Nuttal explains that trees furnish the ground with water and give it to rivers, which feed people water during droughts. In addition, trees provide water vapor, which condenses into rainfall. Deforestation destroys these natural processes, causing rivers to run dry and rainfall to decrease, which leads to droughts.

**Different types of drought**

**Meteorological drought**

Meteorological drought refers to a reduction in rainfall over a specific period of time, for example a month, season or year. There is no agreement on what the lack of rain or the time without rain should be before it is considered a drought. Usually the area affected determines these especially in non-arid regions. Meteorological drought leads to depletion of soil moisture and this almost always has an impact on crop production (Earth Observatory 2000).

**Hydrological drought**

Hydrological drought occurs when there are critically low groundwater tables and reduced river and stream flow. Low wintertime snow accumulation in higher elevations can result in this type of drought in nearby lowlands. Hydrological droughts are distinguished by a reduction in water resources in reservoirs, lakes, rivers, underground aquifers and streams (UNEP 2000).

**Agricultural drought**

An agricultural drought is the impact of meteorological droughts and hydrological droughts on crop yields. This kind of drought is associated with extreme heat. It occurs when extended dry periods and general lack of rainfall result in a lack of moisture in the root zone of the soil. This severely damages the plants that live in the area. Agricultural droughts are related to the availability of water for crops although some crops can withstand the reduced soil moisture conditions for long periods for example sesame, cassavas and potatoes while others dry up immediately there is a reduction in soil moisture (Earth Observatory 2000).
Socioeconomic drought

Socioeconomic drought correlates the supply and demand of goods and services with the three above mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependent then drought may cause shortages in supply of these economic goods (James Lovelock 1988).

2.2 Impacts of drought on agricultural production

According to (WFP 2001) the 2000 drought was declared a national disaster by the government. In response to the government appeal, WFP spent US$ 102 million on food relief alone. In addition, WFP required more than 15,000 tons of fortified blended foods for supplementary feeding programmes in 11 of the worst-hit drought-affected districts located in pastoral, agropastoral and marginal agricultural areas of the Rift Valley, North Eastern, Eastern and Coast provinces. On its part, the Government spent in excess of KShs. 10.5 billion on relief food to combat the drought emergency during the 2000-2001 financial years. (Imbamba 2004), reported that the La Nina drought (1999-2001) cost at least KShs 220 billion compared to the El Nino floods which cost the country approximately KShs 70 billion. The year 2000 drought was the worst in 40 years.

People’s livelihoods were heavily impacted. Majority of the victims of the year 2000 drought were the rural poor people who depended on ecosystem services and natural resources for their livelihoods. When such sources of income and food were unsustainable prior to the drought, there is urgent need to find sustainable alternatives. Almost all the sectors were affected, but the worst were water resources, agriculture, livestock production and industrial. As Kenya is an agricultural based country, many victims were involved in crop cultivation, agro-pastoral activities and pastoralists livestock keeping.

Droughts have a direct impact on agricultural production. In 2000, Kenya suffered the third serious drought in ten years, with the ASAL being the worst affected. During each succeeding drought, the number of people requiring emergency assistance has drastically increased. The government estimated that 4.7 million people in 32 districts required assistance in 2000 drought. However, the World Food Programme assisted 3.3 million people affected by drought (WFP,
2001). About 25-30% of children under 5 were estimated to be severely malnourished due to food scarcity during the drought in ASAL (Save Children, 2000).

WFP further observed that even if the drought situation subsided, families still needed assistance into 2001 to enable them restore their livelihoods. In most of ASALs, agricultural production is mainly limited by the availability of soil moisture. Heavy rains often do not significantly increase soil moisture because the soil does not absorb moisture quickly, and the rain tends to run off without penetrating the soil. In addition, intense sunlight and high temperatures cause rapid evaporation of moisture from the soil (WFP 2001).

In southern Africa, agricultural production in Zimbabwe and Mozambique was reduced by the drought in 1982-83. Although 1982 was a good year for Zimbabwe, there were heavy rains early in the 1983 season, followed by drought. The 1983 harvest was down 65 percent on 1982. Money was diverted from development projects into emergency drought relief. The south and west of the country lost livestock as well as crops. Transport and agro-industries were affected by the drop in production, and water was rationed. Mozambique’s 1982-83 droughts was considered the worst in 50 years and led to many deaths (Mostafa K. Tolba 1992).

In Botswana, cattle outnumber the human population by three to one. During 1982-83, key watering places dried up completely and livestock mortality was high. Almost half the population was fed by emergency relief from overseas. Normally one child in four in Botswana is considered at risk from malnutrition, but the figure increased during the drought to one in three (Micheal D. Gwynne 1995).

In eastern Africa, Ethiopia and Tanzania had good years in 1982, but production was stagnant in 1983 and fell in 1984. Kenya and Uganda showed steady growth throughout the period. Kenya even resumed food export in 1983, with an excellent tea crop, although grain production was down by about 15 percent on 1982. During drought years, which often coincide with El Nino years, the need for emergency food imports can deplete scarce foreign currency reserves. Climate can then have indirect effects on development projects as governments cut back on expenditure to compensate for the foreign exchange losses foreign exchange shortages also often
lead to scarcities of agricultural inputs such as fertilizers and pesticides. This prolongs the effects of the drought year, affecting future crop yields (IGAD 2007).

However, international market prices can sometimes offset drought-related crop losses. In 1984, the main March-May rains failed in many parts of eastern Africa, causing a severe drop in agricultural production. Kenyan tea and coffee export prices more than doubled as a result of scarcity.

Other effects are not as immediately apparent, but can cause long-term problems. The delicate balance of agriculture can be disrupted, for instance, as livestock die because changes in temperature or rainfall have reduced their food source. Soil quality can be reduced through wind and rain erosion, especially in drought-stuck areas, leading to lower crop yields and, if farming becomes impossible, to the rural population drifting towards towns and cities.

The volume of water in rivers and other reservoirs has continuously decreased over the years due to changes in land-use. Lakes continue to be degraded (NEMA, 2003) 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 is an example with reduced water volumes has directly affected the water levels in boreholes in Biyamadhal area of North Eastern province. In general the national water deficit was estimated at 704,522 m³ with some rivers completely drying up (UNEP/GOK 2000).

2.3 Possible mitigation measures of drought
After the drought, the restoration of destroyed livelihoods that depend on the damaged environment is a demanding task. The mainstream environmental concerns were prerequisite for sustainable reconstruction. In this case, the effective drought management required more concerted effort to put in place coherent mechanisms by all the players involved in monitoring and mitigation. Rehabilitation and reconstruction of the environment should be people centered gender sensitive and participatory in nature. Although the recovery process especially among the
poor rural communities is often slow, they are the greatest disadvantaged when it comes to adapting to change in physical environment and habitats.

Major projects are needed in all affected areas to restore ecosystem goods and services, for example re-afforestation of water catchments and denuded areas, improved water harvesting, upgrade of livestock farming, sustainable dry lands farming and range management. International support will likely be needed. Capacity building in techniques for rapid assessment and rehabilitation is urgently needed.

Detailed environmental assessments, including vulnerability mapping will be providing critical input for drought management and mitigation. The following gaps will be identified based on rapid assessment and field interviews with the affected communities:

i. Inadequate environmental guidelines in natural disaster plans and land use policy for sustainable and management of resources;

ii. Lack of comprehensive resource surveys, vulnerability mapping and risk assessment;

iii. Inadequate coordination between the relief agencies and participating NGOs in disaster management.

Adequate land-use policy put in place

The government should address urgently the need for land use policy to guide the planning, utilization and management of land resources especially in the fragile ecosystems. This should include strategic environmental assessment on major land use changes and destruction of ecosystems that were traditionally used in drought coping mechanisms. The areas of concern are communal lands and pristine habitats formerly used for livestock and wildlife dry season grazing, but has since been encroached into and converted to agricultural land; the destruction of water catchments and upstream dams for horticultural activities; introduction of large mechanized farms including wheat farming in the ASAL areas; overstocking of livestock and overgrazing (NEMA 2002)

In the arid and semi-arid lands, small individual parcels of land are not viable for agro-pastoral activities due to the harsh climatic conditions. The consolidation of these land units into large communal or group ranching enterprises is a better option than the smaller land units. It is
recommended that the pastoralists land tenure system be incorporated into similar land use plans in these areas. There is need for detailed studies on the relationships of factors responsible for drought severity including demographic, land use activities, water balance, land degradation and socioeconomics. This will guide appropriate policy formulation in the drought management.

Conservation of water catchments, environmental awareness and community participation will improve preparedness and sustainable resource management

The importance of watershed conservation, water resource management and implications associated with land degradation, loss of vegetation cover, alteration of hydrology and water quality cannot be overemphasized. Rural participatory and sensitization approach will encourage resource ownership and maximize the economic and social welfare benefits without compromising sustainability in resource utilization.

Rainwater harvesting strategies including those for domestic water use and agricultural activities need to be established. Affordable technology that is easily available should be encouraged. Increased damming of rivers where environmental impacts assessment has been taken into consideration is recommended. This will provide long-term sources of water for use not only domestic purposes but also for other economic benefits including hydroelectric power production and irrigation schemes. Furthermore, the rural livelihoods will be improved by the creation of employment. Both the public and private sectors must invest in water resources to avoid future water shortages as this has rippling effects in all sectors.

Environmental awareness and community participation will improve conservation activities and sustainable resource management. Basic education and environmental awareness could make a huge difference in preparedness. Ordinary people need to know climatic change indicators and mitigation measures. Indigenous people, who are closer to their natural environment, had this knowledge in their folklore. The same awareness needs to be built into the school curriculum and mass media (radio, TV and daily newspapers). The apparent sensitivity of certain animals to migrate during the dry periods or to breeds as the wet seasons approaches suggests that animal behavior also needs to be studied and documented.
Community participation should also be used to manage catchments and rehabilitate the degraded areas. This should include sensitization on proper land use practices and conservation of forests. It will also be necessary to impress upon the people the need to undertake afforestation practices in their land explaining clearly how this is vital in the recharge of water sources.

Women being the most affected by water shortages should be fully involved in management schemes. Their involvement will lead to sustainability since improving access for them will lighten their burden and allow for their development in other areas.

Public awareness campaigns on the need to use water efficiently by avoiding wasteful use and other water saving technologies should be carried out through the newly established Water Management Authority. This will not only help in revenue savings but also guarantee supply in the time of scarcity.

Long-term sustainability
Better land-use planning and management in ASAL will reduce vulnerability and environmental stress
The arid and semi-arid zones will remain vulnerable areas to drought due to the low and unreliable rainfall experienced, making such ecosystems very fragile.
Proper land use planning backed-up by adequate land use policy and community-based integrated arid lands management must be fundamental principles in the mitigation of drought impacts.

Environmental impact assessments are critical
Environmental impact assessment (EIA) of projects and Strategic Environmental Assessment (SEA) of overall plans and programmes in drought vulnerable area must be undertaken. For example, there is a potential threat to natural ecosystems from increased sub-division of large pastoral lands in the ASAL into small individual parcels based on agro-pastoral activities. Encroachment by large commercial wheat farming in Narok district has deprived the Maasai
pastoralists and wildlife of an important dry season grazing area. This has negatively impacted on livestock production and eco-tourism in general.

**Early warning systems must be put in place and capacity of environmental institutions strengthened**

There was considerable concern that much loss of life, livestock and crops could have been avoided if there had been adequate early warning system in place. It was identified that improved early warning system is a priority, as it makes better sense to consider a multi-hazards warning system, as well as a network of regional and national early warning systems proposed under the Global Earth Observation Systems. The development of these systems must be well rooted at the national and local institutions. The Arid Lands Resource Management Programme (ALRMP) has an early warning programme in 10 arid and semi arid districts based on rural economy, human welfare and the environment as indicators. This programme must be fully supported as it targets households and communities.

Ongoing efforts by the government and concerned organizations to address urgent environmental challenges posed by the drought demonstrate their strong commitment to sound environmental management. This spirit should be joined and fully supported by the international community. With continued cooperation between national and international actors, the country can establish a course towards drought mitigation and recovery, protection of its natural heritage and restoration of livelihoods.

Institutions dealing with resource survey and assessment, environmental disaster management and early warning often need direct technical assistance. However, the assistance should be combined with capacity building in priority areas. The Kenya Meteorological Department (KMD) provide daily weather forecast, seasonal weather outlook and distribution of rainfall anomalies maps; Ministry of Agriculture (MoA) provide bulletins on crop distribution and performance; and the Department of Resource Surveys and Remote Sensing (DRSRS) uses remote sensing techniques for rapid assessment and monitoring of natural resources status and environmental conditions. In addition, the linkage between early warning, crop forecasting and
food security institutions and drought mitigation programmes run by the government and NGO's including the WFP should be strengthened.

Pastoralists' livestock management strategies played a greater role in sustaining livelihoods during the drought. The system is complex and involves people and livestock moving widely in search for greener pasture and the splitting of animal herds into smaller groups. It also involves switching to keeping of smaller stocks such as sheep and goats during the dry spells and turning to cattle at the onset of the rains. In the presence of adequate early warning system, the pastoralists will be advised in time to sale their large stocks when the prices are good before the drought commences. This will ensure economic stability and restocking as the dry spell ceases.
CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction
This chapter outlines the study design, methodology that was used, sample selection of the area and population of the study, data analysis, as well as how the information will be generated by using all the above methods.

3.1 The Study Design
A case study research strategy was used to determine the relationship between drought and agricultural production. The case study research strategy was used in this project due to the fact that “the case study method allows the researcher to retain the holistic and meaningful characteristics of real-life events” (Kohlbacher 2006). The findings were anticipated therefore to provide a clear picture of the magnitude of the problem of drought and how it is impacting on agricultural production. In this study, the research design was a descriptive cross-sectional qualitative one. This research design was selected because of the time frame and the nature of the study. The following variables were investigated during the study; drought, its impacts on the agricultural production, what can be done to minimize them, and the way forward.

3.2 The Study Area
The study area was Fafi district which was a newly created district in the year 2007. Formally, it was of the greater Garissa district. Fafi district is located in North Eastern Province which is the second largest region in Kenya after Rift valley Province. Galmagala, Bura and Jarajila divisions. Fafi district has borders with three districts which include Ijara in the west, Garissa in the north and Lagdhere district in the east. It has 11 locations and 21 sub locations which comes under the central administration in the district headquarters headed by the district commission. It is overwhelmingly rural with a population of 92,000 (Population Census 2009).

Fafi lies within the Arid and Semi-Arid Land (ASAL) zone with an erratic rainfall mean of 250-350mm per year with high evaporation rates aggravated by high mean temperature of 38°c. It is unsuitable for rain fed agricultural production. Combined with hot temperatures and extreme
evaporation, this makes the district/region best suited pastoralism based on camel rearing. Livestock keeping and management is the most economic activity in Fafi district.

Climate and weather are among the most important environmental variable concerning man’s activities and survival. Weather and climate in general influence almost all environmental phenomena in several ways. Temperature and rainfall in particular, are vital indices in the assessment of the overall potential of any categorized land for agricultural and settlement development. The soil composition determines the agricultural activities in the district since in the fertile areas are mainly for crop farming while the less fertile are for livestock keeping (Fafi District Environment Profile, 2009).

3.3 Population of the Study
During the study, the major target population will be small scale farmer in Fafi district. The study population was stratified into five non-overlapping categories to enhance diversity of option. These strata were; men, women, extension workers, local leaders. Considering to the agricultural community’s population of approximately 70 people, the numbers to be used depended on the proportions in gender and the participation in pastoralism.

3.4 Sample size and Selection
The research project applied purposive sampling since case study approach to data collection was used. The research project was carried out in Bura, one of the divisions where agriculture is done in Fafi district. The study focuses on men, women, children, extension workers, and local leaders of the community who engages in agricultural activities in Bura division. It excludes other community members that were engaged in other forms of land use. A total of sixty respondents constituting 28 men, 6 women, 20 children, 4 local leaders and 2 extension workers will be purposively selected from the agricultural community’s sparse population of approximately 70 people, a percentage higher than the 40% recommended by R. V. Krejcie and D. W. Morgan (1970).

The sample size of 60 respondents was used. Yamane (1967) provides a simplified formula to calculate sample sizes. The determination of sample size in its respect according to Yamane’s formula.
\[
\begin{align*}
\frac{n}{1 + n(e)^2} &= \frac{N}{1 + N(e)^2} \\
\text{where } n \text{ is the sample size, } N \text{ is the target population and } e \text{ stands for error.}
\end{align*}
\]

\[n = \frac{70}{1 + 70(0.05)^2} = \frac{70}{1 + 70(0.0025)} = \frac{70}{1 + 0.175} = \frac{70}{1.175} = 59.57 \approx 60 \text{ respondents}\]

3.5 Data Collection Methods

Questionnaires were employed by the researcher during the study. A logically design set of questions were used to answer the research questions in relation to the set study objectives. The questions were both open and close-ended in nature. They were designed on the following variables; causes of drought, its impacts, control measures and the way forward. The questionnaire was used in away that the researcher read the questions while filling in the respondents’ answer. The method was used partly because some respondents were unable to read or write, or both. Cases of non-response did not arise as the questionnaires were self-administered.

The second method that was used to backup the study findings was photography. It helped in providing rich details about the physical appearance of pastures, water sources, livestock, soil moisture, pasture weeds, the landscape and soil profile among others. All these greatly aid the reader (user) of the report to appreciate what is really on the ground.
Observation was widely used specifically in the viewing on the ground. For example agricultural activities like; how livestock are grazing, the pasture weeds, and pasture species, soil moisture indicators, and water quality and quantity as well as livestock condition. The method helped the researcher to discover the relationship of drought and agricultural production. Furthermore, direct observation helped in acquiring sufficient information, which could not have been captured while using other methods like questionnaire due to insufficient knowledge of the respondents on some technical issues.

Documents were reviewed to ascertain information on drought and agricultural production. The problem being a global one, a world, regional and local perspective view was considered while basing on these documents for well found discussions and conclusions. Libraries and internet searches were used to obtain this information.

3.6 Data analysis
Qualitative data was collected and analyzed using tabulation. The approach was descriptive and diverse because quantification was not considered essential grasping the basic issues in the research project. The synthesis of the qualitative data complied through the research was used to create a general profile of drought on agricultural production. The data was rearranged into the arrays, placing the evidence in a matrix of categories, creating flowcharts or data display. The main analytic strategy was based on the original objective and research questions of the study to identify some causal links that could be analyzed. The research project employed an explanatory study.

3.7 Ethical consideration
The research was carried out with full knowledge and authority of farmers, assurance of the confidentially were exhibited in the critical process of collecting and coding data, better still objectivity as principle of research was paramount to control of bias and distortion.
CHAPTER FOUR
RESEARCH FINDINGS AND DISCUSSIONS

4.0 Introduction

This chapter presents data presentation analysis and discussions of findings. It mainly summarizes key issues from the theoretical and empirical literature, compares and contrasts findings systematically and possible relationships in the process of fulfilling the overall objectives of the study. The analysis was done in accordance with the research objectives and variables of the study. The variables understudies were drought on agricultural production. Therefore, the researcher used various tools to analyze the data collected including, pie charts and percentages, frequency distribution tables. A descriptive analysis has also been given to enable easy understanding of the information given by various respondents.

4.1 Background of the respondents

Findings regarding demographics in the study area are shown on Table 1.1 below. These include information about farmer’s marital status, educational background and types of farming activities practiced. Results of the survey on Table 1.1 show that over 48.3 percent of the farmers were married, 21.7 percent were single, 10 percent were divorced and 16.7 percent were either widows or widowers while only 3.3 percent was separated. Some of the married farmers whose spouses were not engaged in agricultural sector claimed income from spouses who were engaged in non-agricultural sector helped to ease drought effects at the household level in meeting household needs.

Table 1.1: Marital Status

<table>
<thead>
<tr>
<th>Marital status of the respondents</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>29</td>
<td>48.3</td>
</tr>
<tr>
<td>Single</td>
<td>13</td>
<td>21.7</td>
</tr>
<tr>
<td>Divorce</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Widow/er</td>
<td>10</td>
<td>16.7</td>
</tr>
<tr>
<td>Separated</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Data collected from the field by the researcher.
Table 1.2: Level of Education

<table>
<thead>
<tr>
<th>Highest level of education</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No education</td>
<td>25</td>
<td>41.7</td>
</tr>
<tr>
<td>Pre-school</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Completed primary</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td>Did not complete high school</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Secondary/high school</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Matric</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td>Diploma</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Degree</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Data collected from the field by the researcher.

Data on education from Table 1.2 indicate that 41.7 percent of the farmers surveyed had no formal education, while a larger percentage of 58.3 had a formal education which varied from primary to university education. Judging by the percentage of interviewed farmers with no formal education, this implies that many farmers might not be able to read or write, which tends to limit their access to required information during drought, such situation requires an exhaustive preparation from designated government and non-governmental organizations to bring about awareness about any impending disaster.
Table 1.3: Types of farming/occupations

<table>
<thead>
<tr>
<th>Types of farming</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock farming</td>
<td>23</td>
<td>38.3</td>
</tr>
<tr>
<td>Crop farming</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Mixed farming</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Data collected from the field by the researcher.

Out of the 60 respondents, 38.3 percent were livestock farmers, 50 percent were crop farmers because crops mature faster than livestock while 11.7 percent of them practiced mixed farming due to shortage of land.

Table 1.4: Ages of respondents

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30</td>
<td>4</td>
<td>6.7</td>
</tr>
<tr>
<td>31-40</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td>41-50</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>51-60</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>61-70</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>71-80</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Data collected from the field by the researcher.

The respondents consisted of 33 per cent of females and 67 per cent of males. Table 1.4 shows age composition of the sample. The majority (58 per cent) of the respondents were middle-aged (41-60 years). A small proportion (20 per cent) consisted of young adults (21-40 years) and the elderly (61-80 years) made up one quarter of the sample. Two-third of the respondents (between one and three) and one third had five or more dependents.
The respondents owned five types of livestock as shown in Table 1.5. They predominantly rear small livestock (72 per cent) in form of cattle and goats because they have ready market for sale. There are smaller proportions of large livestock such as camel (20 per cent) and donkey (7 per cent) because of the long gestation period. Very few sheep are kept by the respondents because they cannot tolerate the harsh climatic conditions in the area.

<table>
<thead>
<tr>
<th>Respondents assets</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>Goats</td>
<td>19</td>
<td>32</td>
</tr>
<tr>
<td>Camel</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Donkey</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Sheep</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Field study.

In the response to a question on a size of their land planted with crops in 2006/07 season, half of the respondents revealed that they cultivated only a small part of their fields (one to two hectares) because the other parts of the land have been degraded by drought making them unsuitable for cultivation. About two fifths of the respondents tended between two and a half to four hectares because their land was productive and one respondent did not farm at all because this one could not avoid irrigation facilities. The results of the question about the quantity of

<table>
<thead>
<tr>
<th>Size of cultivated area (ha)</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td>2.5</td>
<td>11</td>
<td>18.3</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>16.7</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Field study.
their harvest during the 2006/07 season and how long they thought the food they had produced would last them are shown in Table 1.7. One third of the respondents produced a fairly good harvest of between 8 to 21 bags of grain and had a secure food supply until the next harvest in the 2007/08 season due to adopting soil and water conservation measures which improved the soil.

Table 1.7: Size of harvest and household food situation

<table>
<thead>
<tr>
<th>SIZE OF CULTIVATED AREA IN (ha)</th>
<th>SIZE OF GRAIN HARVEST (NO OF 90-KG BAGS)</th>
<th>DURATION OF FOOD SUPPLY (MONTHLY)</th>
<th>NO OF MEALS PER DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAIZE</td>
<td>SORGHUM</td>
<td>PEARL MILLET</td>
</tr>
<tr>
<td>2.5</td>
<td>0.5</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>2.5</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.5</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>No fields</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>22.5</td>
<td>21</td>
<td>10</td>
<td>26.5</td>
</tr>
</tbody>
</table>
Another third experienced a poor harvest of one to two bags of grain. Their food stocks would run out within the next two months due to high soil temperatures that led to the drying up of most crops. About one quarter experienced a total failure of crops because it failed to rain thus resulting into no crop growth and one respondent had no fields. Two thirds of the respondents were experiencing either transitory or chronic food insecurity due to failure of their crops. For those with a small harvest the food would run out in a few months because of the large families to feed. The majority of the respondents (58 per cent) had two meals a day and a surprisingly significant proportion (42 per cent) had three meals a day.

4. 2 Causes and different types of drought

The first objective of the study was causes of drought and its types, therefore the researcher sought to find out what are the major factors that caused and intensified drought, as the results shown there were several factors that were associated each other. However, to identify the root causes of drought several questions were administered to measure this objective.

**Deforestation**

Deforestation was noted by the researcher to be one of the causes of drought taking place in Bura division of Fafi district. This activity involves cutting of trees and shrubs using pangas, slashers, hoes and axes. Sometimes clearance of land is done using fire to destroy the overgrown grass and shrubs. After burning the remaining shrubs are then cleared using pangas and axes. These shrubs and trees are pilled up in heaps and they are used as firewood. Others are burnt to discourage them from re-germinating. This practice of agriculture is common in Bura division. Consequently, these areas devoid of vegetation are exposed to direct excessive temperature from the sun thus leading to loss moisture for the soil and consequently loss of productivity. Therefore the researcher noted that vegetation clearance which is an agricultural practice has a role in causing drought.
During the discussion, the sixty respondents observed that drought occurs as a result of seven (7) major factors of; deforestation suggested by 40% of the respondents because it reduces the availability of precipitation hence resulting into drought, while 17% related it to excessive farming because much water is being used for irrigation purposes leading to hydrological drought, 13% to bushfire due to hunting and clearing of land for agricultural purposes, 12% to climate change because of changing rainfall pattern, 7% to oceanic winds because water vapor is not brought by air currents to the right areas at the right times, 6% to rain shadow due to the dry winds which reduces the moisture of rain pairing clouds and the remaining 5% said it was as a result of high air pressure.

Table 1.8: Causes of drought

<table>
<thead>
<tr>
<th>Causes of drought</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deforestation</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>Excessive farming</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Bushfire</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Climate change</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Oceanic winds</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Rain shadow</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>High air pressure</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*Source: Field study.*
Table 1.9: Types of drought

<table>
<thead>
<tr>
<th>Types of drought</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural drought</td>
<td>23</td>
<td>38.3</td>
</tr>
<tr>
<td>Metrological drought</td>
<td>11</td>
<td>18.3</td>
</tr>
<tr>
<td>Hydrological drought</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Socio-economic drought</td>
<td>8</td>
<td>13.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Field Study.

All 60 respondents answered a question of types of drought that exists in the area of the study. Whereby the most of the respondents related agricultural drought with 38.3% because farmers are vulnerable to the adverse effects of drought, followed by hydrological drought with 30% because it results into severe shortages of water, 18.3% of the respondents related it to metrological drought because it leads to depletion of soil moisture and this almost always has an impact on crop production, the rest 13.4% of the respondents related it to the socioeconomic drought because drought affects them in a less magnitude.

4.3 Impacts of drought on agriculture

When drought strikes, it does not only affect the farming activities, it also affects farmers’ livelihood including their household. As a result of such effects, farmers are left with no choice other than to respond to disturbances which change the status quo at the household economic level. This section deals with effect of drought on farmers and their household. During periods of natural disasters like drought, there is large numbers of migration due to the harsh climatic conditions.
Plate 1.1: Cattle carcass in Bura Division of Fafi district during the drought

Source: Field study.

Plate 1.2: A dry riverbed in a semi-arid area (Bura)

Source: Field study.
The diverse impacts of drought can be broadly categorized as economic, social and environmental (Glantz, Betsill and Crandall 1997; Nagarajan 2003; Paul 1998). They are further referred to as direct or indirect and first order or second order to depict the sequence in which they occur (Paul 1998). Van der Linden, Dekkers and Hommes (1995) use the terms primary and secondary impacts. In a country where agriculture dominates the economy, one of the direct or first order impacts of drought is reduced food production. Secondary effects occur because certain sectors of the economy have forward or backward linkages with agriculture or with those sectors that use large quantities of water in their production processes (Benson and Clay 1998; Van der Linden, Dekkers and Hommes 1995). Second order impacts include increased unemployment and lower incomes. Increased unemployment is caused by reduced employment opportunities in the agricultural sector. Because of crop failure and animal losses, there will be a reduced surplus produce for sale.

Adapted from Paul (1998: 359)
Table 1.10: Impacts of drought on agriculture

<table>
<thead>
<tr>
<th>Impacts of drought</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of clean water for human and animal consumption</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td>Crop Failure</td>
<td>13</td>
<td>21.6</td>
</tr>
<tr>
<td>Animal Mortality</td>
<td>16</td>
<td>26.7</td>
</tr>
<tr>
<td>Partial or total loss of source of livelihood</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td>Disease outbreak</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Migration</td>
<td>10</td>
<td>16.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Field study.

According to the Table 1.8 some respondents revealed that the major impact of drought included; animal mortality (26.7%) due to lack of pasture and water for animals, crop failure (21.6%) because of loss of soil moisture, migration (16.7%) because of loss of land for agricultural activities, partial or total loss of source of livelihood (13.3%) because of no food to eat, lack of clean water for animal and human consumption (11.7%) due to scarcity of water and lastly diseases outbreak (10%) because of water shortage.

The study revealed that animal mortality and crop failure were among the biggest impacts of drought in the area of the study. Other impacts of drought that the researcher observed were school drop outs and food insecurity.

4.4 Possible measures used to minimize the impacts of drought

In this section, attempt made by farmers to reduce the drought impacts on their agriculture were considered. It reflects coping mechanisms exhibited by agricultural farmers to ensure sustainability of agriculture during periods of water and grass shortages.
Table 1.11: Coping with drought in Fafi district

<table>
<thead>
<tr>
<th>Coping mechanisms of drought</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenced water sources</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Not fenced water sources</td>
<td>55</td>
<td>91.7</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field study.

As shown in Table 1.11 above, only 8.3 percent of the respondents fenced to protect their water sources during the drought period because they were financially stable to undertake the cost of fencing the water sources, such water sources include harvested water stored in tanks at farmers' homes as well as tap water sources. 91 percent of the respondent did not fence their water sources, which indicates that farmers in the study area did not have control over water sources which may hinder their coping ability, such water sources are rivers and dams available to the entire community.

Table 1.12: Coping with drought of livestock in Fafi district

<table>
<thead>
<tr>
<th>Coping mechanism of drought</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provided supplementary feeds</td>
<td>16</td>
<td>26.7</td>
</tr>
<tr>
<td>Not provided supplementary feeds</td>
<td>44</td>
<td>73.3</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field study.

As shown Table 1.12 out of the livestock or mixed farmers interviewed, 26.7 percent provided supplementary feeds for their livestock during normal times; 73.3 percent did not supply their animals with supplements. It would have been expected that all the farmers would provide supplement for their animals for lack of adequate grazing, but this was not the case because many farmers claimed lack of adequate finances.
World Vision Kenya operated a supplementary feeding program for agricultural farmers in the district. It universally targeted all cultivators and non-cultivators that are found in the study area. World Vision also assisted the community with other projects such as the establishment of boreholes, to improve crop irrigation and provision of seedlings.
CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction
This chapter summarizes the findings of this research, conclusions and appropriate recommendations were also made.

5.1 FINDINGS AND CONCLUSIONS
The findings of this study have shown that farmers perceived drought as reduction in soil water table level for crop growth and development, inadequate grazing land as a result of delay in rainfall and/or inadequate precipitation. Various perceptions of farmers was also believed to have led to crop failure, malnutrition of farmers and livestock alike, forcing them to manage and cope with drought consequences with limited or inadequate resources.

Drought effects on farmers in the study area among others include:

i. Lack of clean water for human and animal consumption
ii. Crop failure
iii. Animal mortality
iv. Partial or total loss of source of livelihood

In trying to cope with above listed effects of drought and others in the study area, the following coping mechanisms were identified:

i. Sale of assets
ii. Use of mini or hand irrigation systems
iii. Purchase of supplementary feeds for livestock
iv. Change of crop cultivation patterns
v. Traveling long distance in search of grazing
vi. Seeking alternative sources of income

Findings of the present study are generally consistent with results of past studies on drought coping mechanisms, but on the contrary, migration, seeking alternative sources of food such as...
wild fruits and animals, sales of assets such as land, farming equipments and personal effects was not experienced in the study areas.

Although some of the farmers tried various ways to manage and cope with different changes and effects brought by drought as stated in chapter 4, most farmers were unable to cope effectively with the drought mainly because there was lack of information about drought occurrence and drought management as well as lack of resources, in view of these, the current research findings has been accepted.

5.2 RECOMMENDATIONS

5.2.1 Recommendation in terms of Early Warning System

According to 2002/03 annual reports of National Department of Agriculture, only a handful of extension workers have been trained in terms of weather data interpretation to help with early warning system during drought as at that period, it was still evident that not so many extension workers were working in this regard, this was reflected in the percentage of farmers that were aware of drought incidence before its onset in the study area, there is need to intensify such projects.

Among other stake holders such as manufacturers of agricultural equipments, utilities and various inputs, farmers are one of the most important end users of early warning systems. As such, information about anticipated weather or climate changes should be communicated to them on time so as to be able to strategize ahead of such impending disasters in order to reduce their level of vulnerability to such disasters. In the light of this, all available medium of communication and awareness should be employed to convey information about any form of disaster.

5.2.2 Recommendation in terms of farmers’ preparedness

Most farmers claimed that they were not prepared for drought because of lack of information about impending disasters, while others claimed that they did not know what to do to prepare even if they have access to such information. This research made it known that with farmers’ financial status, level of education and lack of valuable information, it is impossible for them to
manage and cope with drought without external help or assistance from governments and agencies at all levels. Making available useful information about an impending drought may not be enough; there is also the need to go a step further by providing information about how to cope with such disaster.

Considering the fact that most rural farmers in Kenya does not have control over various production factors such as arable land, grazing land and their homes because most of them are cultivating on communal lands which does not belong to any individual as well as their homes which are mostly government owned houses and as such could not pledge, sell or even use them as collateral in other to seek for financial assistance while trying to cope with drought. It would be recommended that farmers are advised and equally trained from time to time on how to cope and manage with drought and its associated effects or problems; these should include preparedness, public education and collaboration.

5.2.3 Recommendation on general issues
During the drought periods or other agricultural disasters, farmers tend to migrate to nearby towns and cities in search of alternative source of income. At such times, government could bring about developmental activities which include rural community building such as road construction, bridge construction, drilling of bore-holes, building community centres where there is none; this would in a way provide a temporary employment and income to farmers to ease the effect of disasters at that particular point in time.

Lastly, farmers should be encouraged to store hay at all times, protect vegetation cover, trained and educated on certain farming ethics with regards to drought as well as rational use of water. Also the use of various tested drought resistant plants and other agricultural inputs should be introduced to rural communities prone to drought so as to gain and improve their confidence level on such inputs over time.

5.3 Areas of further research
The researcher identified the following as possible areas to carry out further research in the field of drought and agricultural production.
i. Drought coping mechanism.

ii. The impacts of Kenya's drought policy on rural community.
REFERENCES


Earth Observatory, Drought The Creeping Disaster November 2000, New York, USA
http://earthobservatory.nasa.gov/Library/DroughtFacts/


Federal Environmental Protection Agency of Ethiopia, 2006. Ethiopia’s input to the Africa review report on drought and desertification.


APPENDIX I
RESEARCH QUESTIONNAIRE

I am Faisal Abdi Mumin, pursuing a degree of Bachelor of Science in Environmental Management of Kampala International University. Am carrying out research on the role of Drought n Agricultural Production in Fafi district. I will be grateful if the highest level of cooperation is exhibited by you my dear respondent. The information you provide will be confidential.

RESEARCH TOPIC
THE ROLE OF DROUGHT ON AGRICULTURAL PRODUCTION IN FAFI DISTRICT IN NORTHERN EASTERN KENYA

(Tick in the boxes for each question and fill in the spaces provided)

RESPONDENTS BACKGROUND

1. Sex: Male □ Female □

2. Age interval: 15-25 □ 26-35 □ 36-45 □ 46-55 □ 56+ □

3. What is your level of education?
   Primary □ O’level □ Vocational □ University □

4. What is your occupation?
   Peasant □ Employed □ Others □

5. Marital Status:
   Married □ Single □ Widow □ Widower □
6. How many are you in this home?
Parents [ ] Children [ ] Others [ ]

SECTION A

CAUSES AND DIFFERENT TYPES OF DROUGHT

7. What are the major causes of drought in this community?

8. What do you understand by drought?

9. Have you ever-experienced drought incidence since you started farming?
1 = Yes
2 = No

10. When did it last rain here?

11. What was the size of harvest for each the different grain crops?

12. Were you aware of drought incidence before its onset?
1 = Yes.
2 = No

13. Which kind of drought did you experience?
SECTION B
EFFECTS OF DROUGHT ON AGRICULTURE

14. Did you have to change your cropping system during the drought period?
1 = Yes
2 = No

15. How did the water shortage affect your crops?
1 = Little
2 = Very
3 = Very much
4 = Not at all

16. Did you have to move from your household village because of drought?
1 = Yes
2 = No

17. Did you have access to clean water for domestic purposes during these periods?
1 = Yes
2 = No

18. How would you rate your access to clean water?
1 = Good
2 = Very Good
3 = Fairly Good
4 = Bad
5 = Worse

19. Did you have access to good foods during drought?
1 = Yes
2 = No

20. To what extent did drought affects on livestock?

21. What kind of crops did you plant when there is drought?

22. What happens to the water sources when there is a drought?
SECTION C

MEASURE THAT HAS BEEN DONE TO MINIMIZE THE IMPACTS OF DROUGHT

23. Where you prepared for drought incidence before its onset?
   1 = Yes
   2 = No

24. What kind of preparation did you put in place?

25. Did you seek new source of food, like wild fruits and animals during drought period?
   1 = Yes
   2 = No

26. How did you find out about the organisation you received help from?
   1 = Friends and families
   2 = Farmers' union
   3 = Community associations
   4 = News media
   5 = Others

27. Was these help or aid timely?
   1 = Yes
   2 = No

28. Did the aid or assistance from agencies you mentioned meet the need you hope it would meet?
   1 = Yes
   2 = No

29. Did you provide any supplementary feeds for your animals during the drought period?
   1 = Yes
   2 = No

Thank you for your time and information.