Links between Seasonal Climatic Variability and Poverty: A Case Study of Pastoral and Agro-pastoral Communities in Baringo District, Kenya

Yazan Ahmed Mohamed Elhadi
(B.Sc. Agricultural Economics)
University of Kordofan

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Signed..... Date..13. 09. 10.....

Elhadi, Yazan Ahmed Mohamed

This thesis has been submitted with our approval as University Supervisors

Signed..... Date..13.09.10.....

Prof. Dickson M. Nyariki

Department of Land Resource Management and Agricultural Technology (LARMAT)

University of Nairobi.

Signed..... Date..13.09.10.....

Dr. Vivian Oliver Wasonga

Department of Land Resource Management and Agricultural Technology (LARMAT)

University of Nairobi.

DEDICATION

This work is dedicated to my father Dr. Ahmed Elhadi, my mother Mazaheer and my brothers and sisters

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ACRONYMS AND ABBREVIATIONS

ACTS	African Centre for Technology Studies
AE	Adult Equivalents
AIDS	Acquired Immunodeficiency Syndrome
ASAL	Arid and Semi arid Land
CBN	Cost of Basic Needs
DESA	Department of Economic and Social Affairs
DFID	Department for International Development
FAO	Food and Agriculture Organization
FEI	Food Energy Intake
FGT	Foster-Greer and Thorbecke
HH	Household
HIV	Human immunodeficiency virus
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IDD	International Development Department
IFAD	International Fund for Agricultural Development
ITCZ	Inter-Tropical Convergence Zone
IRIN	Integrated Regional Information Network of the United Nations).
Ksh	Kenya Shillings
LM	Lower Midland
LPM	Linear Probability Model
MDG	Millennium Development Goals

MLE	Maximum Likelihood Estimation
NGOs	Non-Governmental Organizations
OFDA/ CRED	Office of U.S. Foreign Disaster Assistance/ Centre for Research on the Epidemiology of Disasters
OLS	Ordinary Least Squares
RoK	Republic of Kenya
SAE	Small Area Estimation
SAL	Sedentary Agro-Pastoral Land-use
SHG	Self-Help Group
SNL	Semi-Nomadic Pastoral Land-use
SP	Stages of Progress
SPSS	Statistical Package for the Social Sciences
TLU	Tropical Livestock Unit
WISP	World Initiative on Sustainable Pastoralism

ABSTRACT

This study was motivated by the need to ascertain whether poverty incidence, gap and severity can vary with seasonal climatic variability, and to identify determinants of poverty in sedentary agro-pastoral and semi-nomadic pastoral households. Data were collected through formal interviews using a structured questionnaire in the Njemps Flats, a semi-arid rangeland in the larger Baringo District (now Marigat and East Pokot Districts) of Kenya. A total of 200 systematically selected households were interviewed, 125 practicing sedentary agro-pastoralism and 75 semi-nomadic pastoralism.

The findings revealed that, unlike semi-nomadic pastoralists, sedentary agro-pastoralists tend to diversify their sources of income by utilizing the available resources for different economic activities. The analysis of poverty incidence, gap and severity using P-alpha equation indicated higher poverty levels in the study area during the wet and dry seasons. Poverty level was found to be higher during the dry than the wet season. The Lorenz curves demonstrated a big gap between the rich and poor in the same community on the one hand and between the semi-nomadic pastoralists and sedentary agro-pastoralists on the other hand.

The OLS parametric estimates of the determinants of poverty indicated that the number of livelihood sources, household size, distance to the nearest market, ownership of enclosures and household herd size are the most important determinants of poverty in the study area. The number of livelihood sources and ownership of enclosures were found to be positively related to per capita daily income. Households that practiced crop cultivation were better off compared to those which did not. Access to extension services and education level of household heads were found to be positively related to per capita daily income in sedentary agro-pastoral system. Distance to pasture and herd size were positively related to per capita daily income in the semi-nomadic pastoral system. In contrast to the *á priori* expectation, a negative relationship was observed between per capita daily income and household size in both sedentary agro-pastoral households and semi-nomadic ones. Binary logistic model results indicated the highest influence on poverty incidence as a result of change in relief food quantity in semi-nomadic households. In addition, access to extension services and remittances were found to be the most significant determinants of poverty incidence under semi-nomadic pastoral land use system. Under sedentary agro-pastoral land use system,

however, it was the number of livelihood sources followed by the education of the household head that had the highest effect on poverty incidence.

This study demonstrated that poverty incidence, severity and depth vary with seasonal climatic variability. Sedentary agro-pastoralists were found to be wealthier than semi-nomadic pastoralists. This was partly attributed to more diversification of economic activities among sedentary agro-pastoralists compared to the semi-nomadic pastoralists. Diversification of household livelihoods through off-farm activities can therefore be recommended as a way of reducing poverty in semi-arid rangelands. Furthermore, the study recommends family planning and birth control to reduce the number of people directly dependent on pastoral livelihood. Reversing the current trends in seasonal fluctuations in poverty status of pastoral households can therefore be achieved through provision of sustainable alternative livelihood sources. This will reduce over-reliance on livestock and land as the primary sources of livelihood.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Food security has always been a central preoccupation of mankind as households and nations try to ensure not only enough but sustained supply of food for the ever growing human populations. Despite the doubling of the global population during the past four decades, farmers have produced sufficient food to allow the average per capita food intake to grow gradually (Dixon and Gulliver, 2001). That notwithstanding, hunger persists and food reserves often fluctuate, sometimes falling to critically low levels resulting in devastating famines. The situation is exacerbated by climatic anomalies that adversely affect economic opportunities and development prospects. In the final analysis, it is the poor countries and people that tend to be particularly vulnerable to the impacts of climate variability and change (OFDA/CRED, 2003). Even though climate variability and change have many consequences especially in the marginal areas, tribal conflict over scarce resources is emerging as a major consequence of environmental change, among other factors, leading to chronic poverty and food insecurity (Ekbom and Bojo, 1999).

People in marginal areas are characterized by few resources, low income, low level of human and social capital, and limited access to markets and service institutions like credit institutions, extension and plant protection (Ogato *et al.,* 2009). Crop and livestock production are the main income sources in addition to other non-farm income sources such

as selling labour, charcoal and seasonal migration (Rutten, 1992). Household income in the drylands is characterized by seasonal fluctuations, which force people to engage in many activities like selling firewood and charcoal. The results of these are environmental degradation and rural-urban migration, and hence curtailed development (Sandford, 1983).

The most recent drought in East Africa has once again sharply exposed the layers of poverty, underdevelopment, and political marginalization in the region's arid and semi-arid lands (ASALs). Images of malnourished and thirsty children, lunar-like landscapes, and pained herders with their emaciated animals permeate the popular media, while governments, international agencies and non-governmental organizations (NGOs) launch their normal appeals for food and external assistance (IRIN, 2006). Like any natural disaster, the poor and vulnerable bear the brunt of such events, and tragically remind us that their short-term suffering is symptomatic of longer-term structural problems of chronic poverty, food insecurity and inequality (Devereux, 2006). Yet, in contrast to most disasters, droughts in East Africa frequently call for renewed efforts to transform or even abandon the area's prime livelihood system, pastoralism (Hogg, 1992).

Pastoralism has often been perceived as an outdated way of life and a production system ill-adapted to 'modern' contingencies (Meyerhoff, 1991). Poorly understood as the natural bane of governments and administrations, pastoral and agro-pastoral communities serve as a convenient scapegoat for the many social and economic problems of the ASALs that are so graphically exposed during the disasters (Sikana and Kerven, 1991).

In order to address poverty among the pastoral and agro-pastoral communities, governments, non-governmental organizations and international agencies must understand more clearly the agro-ecological, physical, economic and cultural environments within which they live as well as their livelihood systems (Campbell, 1999). In addition, it is imperative to know how these environments are affected and how they can be maintained in the face of the current climatic variability and change. Only in this way can realistic policies, investments and technical assistance programs be developed and implemented, and the latent capacity of the pastoral sector fully realized

1.2 PROBLEM STATEMENT

The concerns about poverty are at the top of the development agenda in many developing countries and are more so in arid and semi-arid areas of Africa, where environmental resource base is constantly under pressure from ecological, economic and socio-political factors. An emerging issue in the poverty debate is how to explain the notably close link between poverty and seasonal climatic variability, among other factors, that cause low crop and livestock productivity, leading to declining capital productivity followed by less marketable output and consequently poverty. Tribal armed conflict over the scarce resources in the study area compounds the problem (ICARDA/ICRISAT, 2002; Nyangena, 2001).

In the past few decades, crop and livestock production has fluctuated due to many factors, chief of them climatic variability. Faced with dwindling and uncertain productivity, many

people are pushed to look for alternative sources of income to support their livelihoods (Rutten, 1992). This has led to mass migration from the rural areas to urban centres. In most cases, what starts as a temporary measure during the dry season, when young people leave their rural communities and go into nearby towns looking for work, tends to be more or less permanent. This has resulted in loss of manpower and hence a decline in both livestock and crop production, consequently leading to the impoverishment of the pastoral households.

1.3 RESEARCH JUSTIFICATION

The rationale of this study stems from the fact that Baringo District has experienced high environmental degradation (Wasonga, 2009). This has resulted in low production and depletion of a large number of plant species and reduction of livestock herds, making most of the rural people live in highly vulnerable conditions and increasing poverty levels (IFAD, 2002). As a result, pastoral households continuously face food shortage, consequently leading to over reliance on food aid (Wasonga, 2009).

Understanding the complex relationships and causes of poverty in pastoral areas of East Africa is a necessary first step towards informed and effective policy and development interventions. While there has been considerable research in pastoral areas during the past three decades, much of it highlighting poverty as a key issue, systematic analyses of poverty in pastoral areas are limited with the exceptions of Rutten (1992) and Wasonga

(2009). A review of previous research in the ASALs reveals limited comparative studies on poverty with respect to climate variability.

This study was conducted to determine the link between seasonal climatic variability and poverty in the pastoral and agro-pastoral communities with the aim of informing policy formulation and development interventions.

1.4 RESEARCH OBJECTIVES

1.4.1 Broad Objective

The overall objective of this study was to determine the link between seasonal climatic variability and household poverty in the semi-arid areas of Kenya, using Baringo District as a case study.

1.4.2 Specific Objectives

The specific objectives of this study were to:

1. Determine poverty incidence, severity and gap between the agro-pastoral and pastoral communities in the wet and dry seasons in the study area.
2. Assess the relationship between seasonal climatic variability on the one hand and poverty incidence and severity on the other between the agro-pastoral and pastoral communities.
3. Identify the determinants of poverty between the agro-pastoral and pastoral communities in the study area.

1.5 RESEARCH HYPOTHESES

The study tested the following hypotheses:

1. There are no differences in poverty incidence and severity between the wet and dry seasons.
2. There are no differences in poverty incidence and severity between the pastoral and agro-pastoral households.
3. There are no differences in the factors that determine poverty in agro-pastoral and pastoral households.

1.6 STUDY LIMITATION

This study was conducted over one year and covered only two seasons—dry and wet. This represents only a snapshot of what is taking place. It would have been more desirable, therefore, to cover a longer period of time in order to capture events and occurrences over time. This was, however, not possible due to limited time and financial outlays allocated to this study. Furthermore, most of the data gathered in this study were based on recall information provided by the people in the study area. In addition, most of the respondents had only basic education and may have not accurately remembered everything enquired about. All these factors may have affected the accuracy of the data collected.

1.7 THESIS ORGANIZATION

This thesis is organized into five chapters. The first chapter provides background information, the statement of the problem, justification, objectives, hypotheses, and the organization of the study. The second chapter is literature review that covers poverty profile in the region, poverty analysis approaches, measurements and indicators. Also presented in Chapter Two are seasonal climatic variability in the region and its impact in Kenya, and food security at region and local levels. Chapter Three comprises the study area, research methodology and scope, and tools of data analysis. Chapter Four presents the results, and discussions. Summary conclusion and recommendations are presented in Chapter Five. Finally, references and appendices in that order are presented at the end.

CHAPTER TWO

LITERATURE REVIEW

2.1 DEFINITIONS AND CONCEPTS

During the 1995 World Summit for Social Development in Copenhagen, poverty eradication was declared as an ethical, political and economic imperative, and identified as one of the three pillars of social development. Poverty eradication has since become the overarching objective of development. This is reflected in the internationally agreed development goals, including the Millennium Development Goals (MDGs), which set the target of halving global extreme poverty by 2015 (DESA, 2010).

Poverty is multidimensional and complex in nature and manifests itself in various forms making its definition difficult (Eissa, 2009). Perceived differently by different people, some limit the term to mean a lack of material well-being and others arguing that lack of things like freedom, spiritual well-being, civil rights and nutrition must also contribute to the definition of poverty. Though often defined in absolute or relative terms for purposes of comparing groups, poor people do have their own definitions that arise from their own perceptions (RoK, 2006).

In the 1960s, measurement of poverty was based on the level of income, while in the 1970s the emphasis was on relative deprivation as measure of poverty. In the 1980s, the concept

of poverty widened to cover livelihood and gender. In 1990s, the concept of well-being and human development came to into focus. The idea of well-being became a metaphor for absence of poverty (Maxwell, 1999). It is therefore evident that poverty requires use of a number of measures and definitions to adequately understand. Absolute poverty can be narrowly defined as "the sustained lack or deficiency of basic needs required to sustain human life". Those falling below an overall or absolute poverty line constitute the poor. The poverty lines are based on the cost of purchasing a basket of basic food items representing the amount of calories sufficient for survival (a daily allowance of 2,100 calories per adult) and of essential non-food items, such as clothing, shelter and transport (RoK, 2005).

The World Bank (1997) defines poverty as the inability to attain a minimal standard of living and housing. There exist pre-determined standard levels of consumption (poverty lines) below which one is deemed poor. Seaman *et al.* (2000) defines food poverty as a condition of lacking the resources to acquire a nutritionally adequate diet. However, other than food, there are several goods and services from the natural ecosystems that are crucial for the livelihoods of the rural poor. These include fuel wood, charcoal, fruit, gums, resins, honey, timber, traditional herbal medicine, cultural values, among others. Loss of these goods and services through environmental degradation and extreme climatic events lead to loss of livelihoods, and consequently poverty.

Barrett and McPeak (2004) define chronic poverty as poverty that persists for years, if not a lifetime, while transitory poverty is plainly shorter-lived than chronic poverty. Transitory

poverty is associated with movements into and out of income poverty, while chronic poverty reflects persistent deprivation. The former type usually results from a drought, which is a normal occurrence in pastoral areas, or other disaster that knocks a household into poverty for up to a few years (Little *et al.*, 2006).

Poverty measures can be based on either economic indicators, such as income or expenditure, or on social indicators such as life expectancy, mortality of children under five years, and nutritional status. Such indicators are usually measured through household surveys (Ravallion, 1996). Monetary estimates, such as income or consumption expenditure are favoured by economists as the indicators of choice to measure the economic status of a household. Consumption expenditure estimates are generally considered more robust (World Bank, 2003). Economic measures of household wealth can be used directly (Robinson *et al.*, 2007). They are often compared to thresholds that distinguish the poor from the non-poor, so-called poverty lines, to create poverty indices, such as those among the "Foster-Greer-Thorbecke" (FGT) class of poverty indicators to assess poverty incidence, gap and severity (Foster *et al.*, 1984; Foster and Shorrocks, 1988). The most widely used is the "head count index" which is the percentage of the population living below the poverty line (Foster *et al.*, 1984).

In recent years, attempts have been made to include more explicitly the multidimensionality of poverty in its measurement and analysis (Bibi, 2005). A variety of analytical techniques have been used to investigate spatial correlates of poverty at a range of scales (Kristjanson *et al.*, 2005; Rogers *et al.*, 2006; Robinson *et al.*, 2007). In order to

develop appropriate poverty reduction strategies, it is important to understand its spatial distribution (Benson *et al.*, 2007). A better understanding of the geographical factors associated with poverty will facilitate better-targeted poverty reduction strategies that focus on modifying those factors, or empowering people to cope with them, thereby enabling households living in poor areas to improve their standards of living.

A widely applied approach to the analysis of poverty distribution is the small area estimation (SAE) technique for poverty mapping developed by the World Bank (Ghosh and Rao, 1994; Hentschel *et al.*, 1998). The SAE produces geographically disaggregated indicators of welfare by exploiting statistical links between survey (low household coverage with much detailed) and census (complete household coverage with limited detail) data. The detailed relationships found within the survey data, between the welfare measure and a set of predictor variables that are common to the census, are extended to the census data. Both survey and census data tend to be socio-economic in nature and the SAE approach exploits the internal correlations within such datasets. The SAE approach relates a composite welfare estimate, such as per capita expenditure, with a suite of variables that are indicators thereof, such as type of housing, type of fuel used for cooking, and source of drinking water (Francesca *et al.*, 2010).

2.2 THE DYNAMICS OF POVERTY IN KENYA

Poverty reduction has been a key government policy goal in Kenya since independence. Poverty in Kenya has many faces that can vary substantially across space, time and socio-

economic groups. Obtaining comprehensive, disaggregated, reliable and timely indicators of poverty status across these dimensions is, therefore, a prerequisite to designing an all inclusive and effective pro-poor development agenda (RoK, 2005).

Kenya's average poverty level exceeds the 50% mark. The number of the absolute poor increased from 10 million in 1994 to 13.4 million in 1997 and by the year 2000, the overall poverty situation in Kenya was 56% of a population estimated at 30 million people (Joseph, 2004). The reasons for the worsening situation are many and varied. The main causes of poverty and food insecurity in Kenya include:

- Low agricultural productivity.
- Inadequate access to productive assets (land and capital).
- Inadequate infrastructure, limited well functioning markets.
- High population pressure on land.
- Inadequate access to appropriate technologies by farmers.
- Effects of global trade and slow reform process.
- Poor planning results in available resources being directed to interventions that do not give sustainable impact.

For many livelihood activities, production and income are irregular and intermittent. For example, seasonal cycles determine times of crop harvests, livestock sales and opportunities for hiring out labour. There is also often a substantial degree of uncertainty about production and income. This is because they are affected by weather conditions, crop and animal pests and diseases, sicknesses and accidents, changing market prices and

policies and political influences (RoK, 2006). These affect taxes, subsidies, technical assistance, promotion of new technologies and security or political stability.

Poverty in Kenya is widespread. Nonetheless, the poor have been identified by region and social-economic characteristics (Mwabu *et al.*, 1999). For instance, the majority of the poor are to be found among the subsistence farmers, the illiterate, landless, female headed households; large households, widows; polygamous households; pastoralists in drought prone areas, unskilled and semi-skilled casual labourers, informal sector workers and households with limited access to markets and social amenities (Mwabu and Mullei, 2000).

The highest incidence of poverty in Kenya has been recorded in the Arid and Semi-Arid lands (ASALs) districts where the majority of the pastoralists live. Further, analysis of the 1997 welfare monitoring survey data indicated that 60% of the poor are concentrated in 17 of the 47 districts in the country (RoK, 1999). The poor are heterogeneous in characteristics, however, there are several instruments to address the multidimensional aspect of their poverty, especially in target groups. According to Yaron *et al.* (1997), these instruments include financial interventions and non-financial public interventions such as labour intensive public works projects, food subsidies, rural primary education and health care project, rural roads, electricity and water projects and support for low-income housing.

Poverty is not a static, households often move in and out of poverty from time to time. This is unsurprising in Sub-Saharan Africa, given that these economies mainly depend on land based production systems and are affected by seasonality and highly variable climatic

conditions. Changes in poverty status can be due to economic cycles and shocks, such as poor weather, loss of employment, or loss of a major income earner through death, injury, or long illness. Adding to this, institutions for income and consumption smoothing in these economies are either inadequate or are absent altogether (Kristjanson *et al.,* 2009). Some households do manage to escape poverty, while others remain in poverty for extended periods of time. Understanding what factors drive household movements in and out of poverty is extremely important for the design of poverty reduction strategies, and is still an open area for research (Suri *et al.*, 2008).

Barrett *et al.* (2001) identify four distinct rural livelihoods strategies offering markedly different returns distributions. The first two are full time farmers (depend exclusively on their own animal or crop production for income), and "farmer and farm worker" (combine own production on-farm with wage labor on others' farm). The other two strategies combine farm and non-farm earnings, differentiated by whether they undertake unskilled labor in the farm or non-farm sectors. The "farm and skilled non-farm" strategy does not include unskilled labour and tends to be associated with higher income households with relatively better educated or skilled adult members. The fourth, "mixed" strategy combines on-farm agricultural production, unskilled on-farm or off-farm wage employment, non-farm earnings from trades, and commerce and skilled (often salaried) employment.

These four livelihood diversification strategies do not offer similar returns. In comparative work across different African agro-ecologies, Barrett *et al.* (2001) found out that strategies including non-farm income stochastically dominate those based entirely on agriculture. A

study by Barrett *et al.* (2005) on income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya showed that food-for-work transfers to households in Baringo District significantly reduced liquidity constraints, enabling households to pursue more lucrative livelihood strategies in non-farm activities and higher-return agricultural production patterns.

A study by Barrett and McPeak (2004) explored the issue of asset dynamics among a poor population using data from 177 pastoralist households in six sites in the arid and semi-arid lands of northern Kenya. The study found out that the primary non-human assets held by pastoralists are their herds of livestock. The results showed a strong positive relationship between herd size, measured in tropical livestock units (TLU) and daily per capita income. Larger herds were found to generate a greater flow of milk which is the primary source of income (in kind) in the East African rangelands. The findings indicated that asset risk is central to a solid understanding of poverty dynamics in an environment such as northern Kenya where frequent droughts, violent cattle raids and human disease epidemics confront pastoralists with extraordinary risk of asset loss. The study emphasizes the crucial role of indirect efforts to induce endogenous asset accumulation by the poor through reduced exposure to downside asset risk in order to block pathways into poverty.

Barrett *et al.* (2006) study on Welfare Dynamics in Rural Kenya and Madagascar showed that much period on welfare change is stochastic and transitory, while long-term persistent poverty depends mainly on the stock and productivity of household assets. Currently, the poor emphasize the difficulty of asset accumulation and the central role of asset losses in explaining patterns of mobility. Serious human health shocks notably permanent injury or

illness and death were the most frequently cited reasons for households falling into poverty. Ill health or death of economically active household members reduced their earnings. In other cases, children had to be pulled out of school because of lack of school fees due to the high costs of treating illness or funeral expenses.

A study by Yamano and Jayne (2004) used a two-year panel data of 1,422 Kenyan households surveyed in 1997 and 2000 to measure how working-age adult mortality affects rural households' size and composition, crop production, asset levels and off-farm income. The authors used adult mortality rates from available data on a HIV negative sample to predict the proportion of deaths due to AIDS observed during 1997-2000. The study made some important findings. First, about half of the deceased working-age men were in the highest per capita income quartile in the 1997 survey while deceased working-age women were distributed more evenly throughout the other income quartiles. Secondly, the prevalence of adult mortality was highest in areas where HIV/AIDS infections were known to be high. Thirdly adult deaths negatively affected crop production, with grain crops being highly affected by female adult death and cash crops by male adult mortality. In addition, households seemed to cope with working-age adult mortality by selling particular types of assets, mainly small stock. The study showed that household off-farm income suffers greatly when a working-age adult dies and there was little indication that households are able to recover quickly from the effects of adult mortality.

Kristjanson *et al.* (2004) used a community-based methodology called the 'Stages of Progress' (SP) approach to assess household poverty dynamics for over 1,700 households

in 20 communities representing two different ethnic groups in Western Kenya. The study found that the major reason behind households' successful escapes from poverty were on-farm income diversification through cash crop production. This was asserted by 57% of the respondents. The rest (42%) of the sampled households escaped poverty by diversifying on-farm income sources, primarily through the acquisition of livestock. In addition, health-related expenses were overwhelmingly and were found to be the most critical reasons for households' declining into poverty. The majority of the poor households mentioned sickness, poor health and high healthcare expenses as principal reason for their poverty.

The resulting dependence of survivors such as orphans on other household members increases the burden of these households thus contributing to descent into poverty. If a single pathway were to be selected to control or limit households' descent into poverty in this region, healthcare provision would be chosen unhesitatingly for improvement. The study also found that the main reasons for remaining poor were low level of education, poor health and health-related expenses, funeral expenses, small land sizes, unproductive land, large family size and high levels of dependency. The main pathway out of poverty was found to be employment. This was indicated by almost 80% of the households.

Burke *et al.* (2007) found that livestock commercialization had helped households that had moved out of poverty. He concluded that policies should be focused on providing an enabling environment for commercial activities that support competitiveness of household producers, lower level of formal and informal taxes, coupled with increased investment in critical public services, such as agricultural research, extension and infrastructure.

A study by Kristjanson *et al.* (2009) on poverty dynamic conducted in 17 districts in Kenya, found that among the 4,773 households studied, 42% and 50% were poor in the year of 1995 and 2009, respectively. The study emphasized that herd diversification, investing in new and/or different types of animals or shifting to production of new animal products was important in the high potential and pastoral zones. Livestock commercialization, which is shifting from mostly home consumption to selling a significant share of the product, was relatively more important in the agro-pastoral zone and in urban areas.

2.3 POVERTY AND SEASONAL CLIMATIC VARIABILITY IN KENYA

Debates about poverty-environment connections originate from 18th century Malthusian ideas of a vicious poverty-environment spiral where the poor 'seldom think of the future' and continually degrade their natural resource base (Malthus, 1798 cited in Scott, 2006). The debate has moved on since then and it is now being acknowledged that the poor are acutely aware of any negative environmental impacts (DFID, 2001). This is attributed to larger processes of inequality and marginalization. Despite the time dedicated to the debate, the poverty-environment connection is still described as a 'big question' with which the scholarly community must engage (Gray and Moseley, 2005). There is 'little consensus as to what the rural poverty-environment relationship really is' (Cavendish, 1998).

Recent developments in climate predictions suggest that seasonal rainfall forecasts have the potential to alleviate the vulnerability of livelihoods to climate variability in the Sudano-

Sahelian region of Africa, where most rural households depend on rainfed agriculture for food and income (Hammer *et al.*, 2001). Washington and Downing (1999) postulated that "climate forecasts may indeed revolutionize resource management in Africa." Still, much remains to be learned about whether and how African farmers will understand and respond to scientifically derived forecasts and what will be the social, economic, environmental impacts of farmers' decisions that are based on climate forecasts.

Over the last three decades, pastoralists of East and Central Africa region have experienced an unusual variability in climate manifested in unpredictable rainfall and drought occurrences. Pastoralists being master adaptors to climate variability and shocks, have several coping mechanisms that mitigate the adverse impacts occasioned by these cyclical climatic patterns. The whole business of being a pastoralist is dependent on one's ability to be flexible and opportunistically exploit the range lands to his advantage and be mobile enough to minimize risks from attendant calamity (Tari, 2000).

Pastoralism is a finely-honed symbiotic relationship between local ecology, domesticated livestock and people in resource-scarce, climatically marginal and highly variable conditions. It represents a complex form of natural resource management, involving a continuous ecological balance between pastures, livestock and people (WISP 2007). When the fine balance is upset as a result of climate change and desertification, the effects on the pastoral livelihoods can be devastating. For pastoralists and agro-pastoralists, whose livelihoods and food security depend on livestock, drought conditions cause malnutrition and livestock diseases due to unavailability of sufficient and nutritious fodder. Moreover,

during droughts, raising livestock becomes expensive while stock prices drop drastically as pastoralists are under duress to dispose their livestock.

2.4 POVERTY IN THE DRYLAND OF KENYA

Pastoral societies of Africa inhabit dryland environments which exhibit wide variations in rainfall amounts from year to year. Droughts are recurrent hazards, as are outbreaks of diseases which affect livestock. These populations are confronted by extreme variability in the production environment. Survival in such areas therefore depends upon the ability of societies to adapt to strategies which mitigate the effects of recurrent drought and permit the long-term occupation of Africa's rangelands (Campbell, 1977).

About 80% of Kenya's land area is ASALs which characterized by low and erratic rainfall, resulting in marked spatial and temporal variation. ASALs area in Kenya is home to close to 10 million people, roughly 25% of the country's population (little *et al.*, 2006). Many of the more than 1.5 million who are chronically food insecure and depend on emergency relief to meet basic needs are located in these areas (Scott, 2007). The ASALs of Kenya are mostly inhabited by pastoral and agro-pastoral communities. Pastoral households are those in which at least 50% of household gross revenue (including income and consumption) comes from livestock or livestock-related activities (Swift, 1998). The pastoral areas are characterized by high incidences of poverty, lack other productive resources apart from livestock, and are relatively marginalized from the rest of the country (Hooft and

Wanyama, 2005). In addition, these areas are experiencing rapid population growth (Changole and Mango, 2003).

Poverty tends to be more prevalent in the dry areas than in the higher potential regions of the country. Finding ways to improve the food and nutrition security of household and alleviate poverty in the dry lands has, therefore, become a key policy issue (Nyariki *et al.*, 2002). Therefore, strategies to reduce the number of people directly dependent upon the primary resources of the ASALs, and improve the productivity of those resources must be sought urgently.

According to Kristjanson *et al.* (2009) agro-pastoral zones in Kenya have experienced an increase in poverty over the past 15 years. There is, however, hope as expansion of crop agriculture and increase in market orientation have proved to be promising strategies in these areas. Development interventions such as improvement of roads and access to inputs, information and services, and lowering of communication costs facilitate these alternative economic activities, and could reduce the level of poverty in the agro-pastoral areas. Pastoral areas in Kenya, on the other hand, are the poorest zones and have experienced the highest increase in poverty in the recent past. Climate related shocks remain at the fulcrum of vulnerability in pastoral and agro-pastoral areas and therefore addressing adaptation to climate variability and change could help reduce poverty in these areas.

2.5 POVERTY IN THE STUDY AREA

Poverty in Baringo District is estimated to inflict 35% of the total population. Poverty is more pronounced in the rural areas especially in the lower zones of the district where income-earnings activities are not diversified. The most vulnerable groups include squatters, the aged, orphans, handicapped, unskilled casual labourers, female household heads, small agricultural farmers and alcoholics (RoK, 2005). Causes of poverty in the district include inadequate infrastructure, HIV/AIDs, low agricultural productivity, poor marketing systems, illiteracy, large family size and high population (Changole and Mango, 2003).

The welfare in Baringo District communities is intricately tied to livestock to the point where the number of animals owned determines society's view on a household's economic status. Households lacking livestock are considered poor irrespective of other properties owned. Income from whatever source has to be utilized to purchase livestock, otherwise the household would still be considered poor. In fact, reference is made to livestock when talking about assets or wealth within the community (Changole and Mango, 2003).

Working in the Njemps Flats, Baringo District in Kenya, Wasonga (2009) reported more poor households under semi-nomadic land-use system (75%) than under sedentary agro-pastoral land-use system (69%). Similarly, sedentary agro-pastoral households had more sources of livelihood (average of 3) than the semi-nomadic pastoralists (average of 2). In the contrary, semi-nomadic pastoral households had larger herds (27.24 TLUs) and more

members (6.53 AEs) than their sedentary counterparts with an average of 18.02 TLUs and 5.70 AEs, respectively. This corroborates the findings of Farah *et al.* (2003) who reported a reduced labour availability for herding following sedenterization of pastoralists around small-scale irrigation schemes in Northern Kenya.

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 STUDY AREA

3.1.1 Location and geo-physical characteristics

This study was conducted in the semi-arid rangeland of Baringo District, Kenya. The district covers 10,949 km^2 in Rift Valley province of Kenya. The semi-arid rangelands of Baringo cover the northeastern and southeastern parts of the district. The district is divided into 14 administration divisions. Nginyang division is the largest while Sacho is the smallest in size. The district has a total of sixty five locations and one hundred and seventy sub-locations (RoK, 2005). According to the Range Management Handbook (Herlocker *et al.,* 1994), Baringo District is divided into 11 range units (areas which are roughly similar in terms of altitude, precipitation, soils and vegetation) ranging between 1,000 km^2 and 115 km^2 in size. The current study was carried out in the Njemps Flats (305 km^2) range unit which falls within agro-climatic zones IV and V, and located between latitude 00^o 30' N and longitude 36^o 00' E. the Njemps Flats is classified as lower midland (LM) livestock-millet zone, which is best suited for livestock production (RoK, 2002; Herlocker *et al.,* 1994).

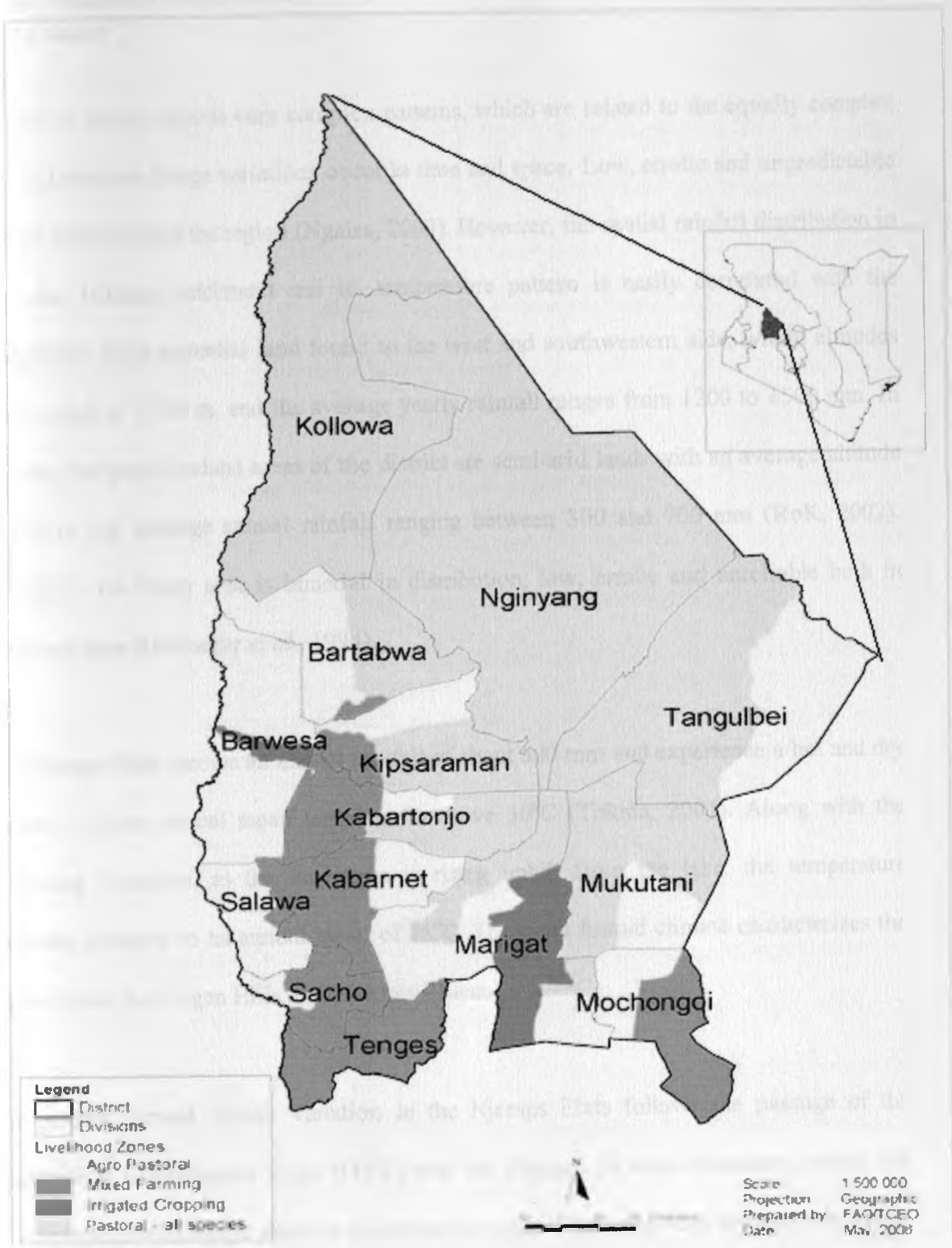

Figure 3.1: The study area

Source: Republic of Kenya (2008)

3.1.2 Climate

Rainfall in Kenya depicts very complex patterns, which are related to the equally complex physical features. Large variations occur in time and space. Low, erratic and unpredictable rainfall characterizes the region (Ngaira, 2009). However, the spatial rainfall distribution in the Lake Baringo catchment and its temperature pattern is easily correlated with the topography. High potential land found to the west and southwestern side, where altitudes reach a high of 2700 m, and the average yearly rainfall ranges from 1200 to 1500 mm. In contrast, the large lowland areas of the district are semi-arid lands with an average altitude of 900 m and average annual rainfall ranging between 300 and 700 mm (RoK, 2002). Rainfall in the study area is bimodal in distribution, low, erratic and unreliable both in space and time (Herlocker *et al.*, 1994).

The Njemps Flats receive an annual rainfall of about 500 mm and experience a hot and dry climate with an annual mean temperature above 30°C (Tokida, 2001). Along with the increasing elevation, as the landscape is rising uphill from the lake, the temperature gradually declines to an annual mean of 25°C. The more humid climate characterizes the higher zones, the Tugen Hills and Laikipia Plateau.

The general annual rainfall variation in the Njemps Flats follows the passage of the Intertropical Convergence Zone (ITCZ) and the changes in wind directions, which are accompanied by dramatic shifts in precipitation regimes between very dry and very rainy. The rainfall regime is dominated by two dry and two rainy seasons. The rainy seasons are

known as the "long rains" (March – August) and the "short rains" (October – November). However, in reality, the local patterns are more complex because of the influence of the north-south mountain ranges and Rift Valley (Davies *et al.*, 1995). The monthly rainfall distribution in the study area mainly follows the typical bimodal pattern. The short rains occur in October-November and the long ones in April-August but the long rains consist of two major peaks, one in April-May and one in July-August. The most southerly of the ITCZ occurs in January when the establishment of the northeast trade winds occurs. During December to February the western parts of the country, including the Baringo region, are dominated by very dry winds from the Sahara (Ojany and Ogendo, 1988), but stable conditions and low rainfall characterize this period in the whole country. From March to June the northeast flow weakens and low-pressure system over Lake Victoria gives rise to convergent easterly flow. This brings moist air from southern Indian Ocean (Sutherland *et al.*, 1991) producing the first rains of the year (the long rains) as the ITCZ moves northward, the ITCZ envelopes the Baringo region at the end of March or beginning of April, indicating the start of the wet season.

From June to September the southeast trade winds bring maritime air from the Indian Ocean, but despite the maritime origin of the air this is the dry season for large part of the country. In Baringo District, however, rainfall continues and intensifies in July – August once again. This second peak is caused by high, naturally unstable, winds known as the "Congo airstream" penetrating from southwest through Equatorial Africa (Sutherland *et al.*, 1991; Davies *et al.*, 1995). The "Congo airstream" can also amplify the interactions between convective thunderstorms, associated with breezes initiated by the pressure of

Lake Victoria, and westerlies to cause this peak (Camberlin, 1996). From September to November the ITCZ retreats, and as the south trade winds disappear and are replaced by strengthened easterlies carrying moisture from the ocean (Ojany and Ogendo, 1988). The convergence creates the second rainy season in October and November, known as the "short rains" in Baringo as well as in the whole country.

The temperature in the study area is much more stable than precipitation and has none of the extremes characterizing the rainfall distribution. Temperatures, however, vary and follow the annual rainfall pattern with a relatively cold duration from June to October. December to March are the hottest months. In the semi-arid lowland and up along the slopes, the daily mean temperature varies from around 15° to 35° (Wasonga, 2009).

3.1.3 Soils and water resources

The soils in the Njemps Flats are generally shallow silt loam to clay loam, with low organic matter. Soils of clay loam are generally formed on mostly old (Pliocene) volcanic rocks (Johansson and Svensson, 2002). They are relatively shallow and infertile and often very stony in steep areas. The southeastern parts of the lake are very flat and have relatively fertile soil of coarser loam and clay. The area immediately west of Lake Baringo is one of the most severely degraded semi-arid in Kenya (Sutherland *et al.*, 1991) and occasional floods take place, carrying soils as well as gravel to Lake Baringo. Soils here are associated with sedimentary lake deposits and alluviums. The sources of water in the study area are rivers Pekerra, Molo and Endao (seasonal), which drain into Lake Baringo. Other water

sources include Lake Bogoria, which unlike Lake Baringo is a salty, and Loboi, Sandai and Ng'ambo swamps.

3.1.4 Vegetation

The vegetation cover in the study area is virtually non-existent for eight to nine months of the year, with the exception of swamps (Little, 1996). The main vegetation class in the study area includes *Acacia* woodland (80%), permanent swamp and seasonally flooded grassland (15%) and shrub grassland (5%) (Herlocker *et al.*, 1994). The vegetation is dominated by *Acacia* and ephemeral herbaceous species. The perennial grass and herbaceous cover is scanty, particularly during the dry seasons and droughts. In the lowland, the vegetation is predominantly *Acacia reficiens* and *A. mellifera* bush-land with some colonization of *A. nubica*. Semi-deciduous woodland dominates riverine areas and northern parts of the Njemps Flats. Tall *A. tortilis* and *A. xanthophloea* trees are common along the riparian zones and flatter areas. Another woody species common in the study area is *Prosopis juliflora*, which is an exotic species introduced in the early 1980s through the fuel-wood afforestation extension project (Marangu *et al.*, 2008; Lenachuru, 2003). *Prosopis juliflora* is very invasive and has since spread to other parts of the region and is a problem mainly in Marigat and Ng'ambo where it has formed dense thickets thereby inhibiting undergrowth. The invasion of *P. juliflora*, however, seems higher in previously vegetated areas and in areas with high water accessibility.

3.1.5 Land-use

The main land-use practice in the study area is livestock production. Sedentary agro-pastoralism is the main land-use on the west, south and eastern part of Njemps Flats, while semi-nomadic pastoralism dominates on the northwestern and northern parts of the study area (de Groot *et al.*, 1992; Meyeroff, 1991). Livestock production provides 75% of the district's total income, with 70% of the district's population deriving its livelihood from livestock production. Although pastoralism is the main source of livelihood in the Njemps Flats, low livestock production due to range degradation and frequent drought has led to an increasing number of households engaging in some farming. Maize that is the main crop is the most productive. However, the crop is more susceptible to drought than sorghum and millet, which were the main crops in the past before colonization (Johansson and Svensson, 2002).

The Njemps Flats is one of the most affected areas in the district by government policy action of the early 20th century, which included the introduction of commercial ranches in the neighbouring highlands, mobility restriction, and introduction of irrigation schemes. These development interventions are believed to have shaped the current land-use pattern, and the processes of land degradation in the study area (Wasonga, 2009). The Njemps Flats are classified as being in a severe risk of irreversible degradation, and one in which only opportunistic use by livestock during high rainfall periods is recommended (Herlocker *et al*, 1994).

3.1.6 The people

The population of Baringo was estimated to be 264,737 with an annual growth rate of 2.65%, by the 1999 population census. The population is projected to reach 326,042 by 2008 (RoK, 2005). The semi-arid lowland of Baringo District is inhabited by three principal ethnic groups, namely the Pokot (35%), Tugen (53%) and Njemps or Il Chamus (12%) (Sutherland *et al.,* 1992). The Tugen living to the west of Lake Baringo are agro-pastoralists, cultivating crops and keeping herds of cattle, sheep and goats. They are more involved in entrepreneurial activities and the cash income than the Pokot and Il Chamus. The Il Chamus who are related to the Maasai are the sedentary agro-pastoralists, and live to the southeast and southwest around the lake. Although they practice some agriculture, they are heavily dependent on livestock. The Il Chamus who were originally hunters and gatherers transformed into agro-pastoralists, practicing irrigated agriculture in the southwest of Lake Baringo during the 19th century, and were referred to as "agricultural Maasai" (de Groot *et al.,* 1992). The Pokot who like the Tugen belong to the Kalenjin ethnic group occupy the flatter region of the northeast of the lake. They are nomadic to semi-nomadic pastoralists, herding large herds of cattle, sheep, goats and camels (Meyeroff, 1991). Land is communally held under common property regime in the Njemps Flats. However, land privatization has been going on around some trading centres occupied by the agro-pastoral communities.

3.2 METHODOLOGY

3.2.1 The semi-nomadic pastoral land-use system (SNL) site

This site included Loyamorouk and Sibilo sub-locations, and is located to the northwest of Lake Baringo. Although also inhabited by some Tugen, it is mainly a territory of the Pokot who practice a milk-based subsistence economy characterized by nomadic to semi-nomadic herding (Wasonga *et al.*, 2003). The traditional strategies and practices, including flexible and mobile responses to highly variable and often stressful environment, still comprise a significant element of the pastoral production system in this area (Wasonga, 2009). The elders exercise control over rangeland use by deciding which areas are to be opened for dry season grazing and when to open and close them. Their herds are usually split into two units, the satellite or nomadic herds (*sorok* in Pokot) and home-based (locally known as *lepon*). The latter are left at home during the grazing movements (Wasonga *et al.*, 2003).

3.2.2 The sedentary agro-pastoral land-use system (SAL) site

Sedentary agro-pastoralism is practiced mainly in Marigat Division, which is located to the southern part of Lake Baringo. This is a territory of both the Tugen and Il Chamus communities who practice both sedentary pastoralism and crop cultivation (Meyeroff, 1991). This area is considered to have undergone a lot of transformation in terms of land-use pattern and general livelihood strategies. The arrival of the European settlers in the early 20th century and subsequent establishment of commercial ranches in the neighbouring

districts of Laikipia and Nakuru, and the introduction of Perkerra irrigation scheme led to restricted mobility of Il Chamus and immigration of the Tugen into what was originally Il Chamus territory. The population density of Marigat Division increased from 4.4 persons/km^2 in 1948 to 44 persons/km^2 in 1999. The total population is estimated at 54,000 of whom the Tugen numbered about 24,000, Il Chamus 22,000 and Pokot and Turkana refugees 8,000 (Tokida, 2001). Small scale irrigated agriculture has been going on along Rivers Molo, Perkerra and Endao, and around Sandai, Loboi and N'gambo swamps, converting key grazing ranges into croplands. Marigat trading center has since grown into a large urban centre attracting settlements in the neighbourhood. Although land adjudication has not been done in the area, there is a strong tendency towards individualization of land (de Groot *et al.,* 1992). These transformations have contributed to shrinking of the grazing resource base and a number of socio-ecological changes in the area (Wasonga, 2009).

3.2.3 Data collection

3.2.3.1 Types and sources of data

Two main types of data were collected, primary and secondary data. These were both qualitative and quantitative. A questionnaire was administered by personal interviews in order to get responses with on-the-spot observations. Some respondents could not give quantitative information because it was not available. However, where it was felt there was need, qualitative data were also gathered to describe the process. Additional data were

collected from secondary sources such as previous research reports to complement the primary data.

3.2.3.2 Preparation of questionnaire

A draft questionnaire taking into account the objectives and the hypotheses was constructed before setting out to the field. The questionnaire contained dichotomous, multiple choice and open-ended questions. This was necessary because of diverse issues that were being investigated. There was an effort to make each question simple and phrased in a manner that would imply the same meaning to all that were to be interviewed, that is, questions that would carry more than one meaning were avoided (Nyariki, 2009). Leading questions were avoided as they usually suggest the answer the interviewer wants to hear, and the respondent may agree with the interviewer simply because that is the expected response.

Sequencing of questions was such that the more sensitive ones such as those inquiring about family size, age and property ownership came later. These were held back until the time when the interviewer should have struck a rapport with the interviewee. Many questions were constructed in a way that allowed adequate room to make considered choices, so as to avoid forcing answers. The possibility for no response was borne in mind. An effort was made to make the questionnaire as short as possible, including only the questions pertinent to the objectives of the study to avoid people becoming bored after answering an unending list of questions, which may also lead to incorrect answers (Nyariki, 1997).

3.2.3.3 Pilot study

The questionnaire was tested in a pilot study involving 10 households before it was used in the main study. The 10 households were selected from the study area but did not come from the main sample of 200. The main reasons for pre-testing the questionnaire were to decide on whether or not to exclude or modify some of the questions. This was done to ensure that the final questionnaire had only relevant and appropriately phrased questions to be put to the respondent. During the pre-testing exercise, informal gatherings were held to question them about mentioned operations.

3.2.3.4 Sampling procedure

The identification and training of enumerators from the local community was carried out before the actual fieldwork was undertaken. This was necessary given the language barrier and to provide assistance to speed up the process of data collection. The enumerators were trained for two days to ensure that they did not deviate from the required protocol, thereby reducing bias in the sample data collected.

Because of the inherent difficulties in accessing most parts of the study area, chief of them rough terrain and scattered homesteads, simple random sampling data collection technique proved difficult. Stratified random sampling procedure was therefore used to collect the data. The goal of stratified sampling was to achieve desired representation from the different subgroups in the population (Mugenda and Mugenda, 1999). The method involves

dividing the population into two or more subpopulations using given criteria, and then a simple random sample is taken from each subpopulation. The study area was divided into two strata based on land-use system, namely, sedentary agro-pastoral land-use system (SAL) and semi-nomadic pastoral land-use system (SNL). The two strata were considered to be two distinct food economies. A "food economy" is defined by Seaman *et al.* (2000) as all the households in a geographical area where most households obtain their food and cash income by roughly the same combination of means.

3.2.3.5 Actual study

This study was conducted between the months of January and February, 2010. A baseline survey was carried out in January, 2010 to identify the target sample size namely, sedentary agro-pastoralists and semi-nomadic pastoralists. The final sample size of 200 households (HH) was systematically selected, 125 from sedentary agro-pastoralists and 75 from semi-nomadic pastoralists. This was done by taking into account the statistical requirement to have a minimum size of 30, the possibility of non-response and limited financial outlays and time. Further, the terrain in the study area is difficult and the infrastructure is poor. Taking all these factors together, larger samples would have reduced the resources and as a result the quality of data collected would have suffered. The reason behind taking unequal sample size from the two groups is that the ratio between agro-pastoralist and pastoralists is one and half to one respectively.

3.2.4 Data analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), a package that is mostly used for analysis of socio-economic data. Data collected through personal interviews were subjected to descriptive analysis. The information on general trends in social and economic status of the two groups (pastoralists and agro-pastoralists) was summarized in terms of means, modes, frequency tables, charts and graphs.

3.2.5 Poverty measurement

The problem of determining an appropriate poverty line, and thus identifying those who are classified as poor, has always been one of the principal methodological issues in the analysis of poverty. Various procedures have been developed, based on alternative concepts of poverty. But a feature common to all proposed methods is a significant degree of arbitrariness in the value assigned to the poverty standard. This is evident even in approaches based on subsistence needs since "there is no one level of food intake required for subsistence, but rather a broad range where physical efficiency declines with a falling intake of calories and proteins" (Foster and Anthony, 1988). However, this study used the food energy intake and the cost of basic needs approaches to establish the food poverty line.

This study used the P-alpha equation of Foster-Greer and Thorbecke (FGT) to assess poverty incidence, gap and severity. Poverty analyses were done to compare the status within and between agro-pastoral and pastoral communities. P-alpha can take three forms, to measure the poverty incidence, gap index and severity. The first is the head count index (P_0), which is the percentage of the population in families living below the poverty line. The second measure is the poverty-gap index (P_1), defined by the mean distance below the poverty line (expressed as a proportion of the poverty line), where the mean is obtained from the entire population and considers the non-poor as having zero poverty gap. The third measure is the squared poverty-gap index (P_2), defined as the mean of the squared proportionate poverty gaps (Jolliffe, 2003). The following P-alpha equation was used to estimate poverty:

$$PG_\alpha = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^\alpha$$

Where z is the poverty line, q is the number of households or persons below poverty line, N is the sample population, y_i is the income of the i^{th} household, and α is the FGT parameter, which takes the values 0, 1 and 2, depending on the degree of concern about poverty.

3.2.5.1 Poverty line

1. Food energy intake (FEI)

The FEI method constitutes two procedures. One of them, and the simpler one, involves using a sub-sample of households whose total income or expenditure is equal or close to the recommended calorie level to derive a simple average to serve as poverty line. The other approach involves fitting a regression of the cost of a basket of commodities consumed by each household (food expenditure, E) on the calorie equivalent implied by the basket (calorie consumption, C). The estimated coefficients are then applied to the calorie requirements to derive the poverty line (Ravallion and Sen, 1996). The study used the first procedure to determine the poverty line.

2. The cost of basic needs (CBN) method

This approach considers poverty as lack of command over basic consumption needs, and the poverty line as the cost of those needs. The modified CBN method suggested by Ravallion and Bidani (1994) relies on the FEI method. First, the basic food basket is set, using the nutritional requirements. The composition would need to reflect local foods and the observed diets of the poor. Then the bundle at local prices is cost to get the food poverty line component of the CBN poverty line.

The food (extreme) poverty line is established through the following steps:

a) Calculation of the different amount of food items consumed by the household per day (in kilograms).
b) Calculation of total calories consumed by the household.
c) Calculation of family size in man and woman equivalents.
d) Calculation of calories consumed by household members per day.
e) Determination of poor and non-poor based on number of calories consumed per day and amount of calories required as recommended by FAO, estimated to be 2100 kilocalories for light physical activity. Some people require more and other people require less than that.
f) Calculation of average consumed calories from different items by poor and share of each item in the amount consumed.
g) Calculation of required amount from different foodstuff using FAO recommended number of calories.
h) Calculation of the cost of the required calories to rest on food poverty line.

To establish the poverty line in this study, non-food costs (health, education, water, clothes, social contribution and other costs) and food costs were calculated to arrive at the poverty line in the study. Using the poverty line, the study separated the poor and the non-poor to arrive at the proportion of population who live under poverty line or poverty incidence in each group.

3.2.5.2 Poverty incidence (head-count index) (PG_0)

The head-count ratio captures the extent to which an individual household's or person's income falls below the poverty line and is given by the following equation:

$$P_0 = \frac{1}{N} q = \frac{q}{N} = H$$

Where P is the FGT parameter, q is the number of households/persons below poverty line, N is the sample population and H is the head-count ratio. This index measures the incidence of poverty (Nyariki and Wiggins, 1997).

3.2.5.3 Poverty gap index (PG_1)

This measure captures the acuteness of poverty since it measures the total shortfall of the income of the poor from the poverty line. In other words, it measures the total amount of income necessary to remove that poverty (Jolliffe, 2003). It is calculated using the following formula:

$$PG_1 = \frac{1}{N} \sum_{i=1}^{q} \left(\frac{z - y_i}{z} \right)$$

The head-count ratio is multiplied by the income gap between the average poor person and the value of poverty line. This index measures the depth of poverty and is referred to as "income gap" or "poverty gap" measure.

3.2.5.4 Poverty severity (square poverty gap)

The income gap squared index (P^2 or FGT) allows for more concern about the poorest of the poor by attaching greater weight to the poverty of the poorest than to that of those just below the line. This is done by squaring the income gap to capture the severity of poverty. In other words, this measures the severity of poverty even more accurately (Eissa, 2009). The FGT is given by the following formula:

$$PG_2 = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^2$$

This index satisfies the Sen-Transfer axiom, which requires that when income is transferred from a poor to a poorer person, measured poverty decreases.

3.2.6 Income inequality measurement.

To measure the degree of inequality of income distribution between the agro-pastoral and pastoral households, inequality measurement can be diagrammatically represented e.g.

Pen's parade, Lorenz curves or complete orderings by statistical indexes, normative indexes or Partial orderings through Lorenz curves and stochastic dominance (World Bank, 1997). These studies used both the diagrammatic presentation (Lorenz curve) and complete ordering (statistical indexes) to measure and analyze the income inequality between households in the different groups and seasons. The measures used are Lorenz curve and Gini-index.

3.2.6.1 Lorenz curve

In the Lorenz curve, the cumulative proportion of population is presented on the horizontal axis and the corresponding cumulative proportion of income on the vertical axis. When income is equally distributed among the population the Lorenz curve corresponds to the diagonal line or 45 degree line reflecting the line of perfect equality otherwise the Lorenz curve is a convex curve and the degree of convexity is higher when inequality is higher (Eissa, 2009).

3.2.6.2 Gini index (concentration index)

The Gini index value corresponds to the area between the 45-degree line and the Lorenz curve. Developed by an Italian statistician Corrado Gini in the 1910s, Gini coefficient is commonly used to indicate income inequality in a society. The coefficient is a number which has a value between zero and one. As the value of the coefficient rises, so does the degree of income inequality in a society (Census and Statistics Department of the Hong

Kong Government, 1992). The Gini index is given by:

$$G = 1 + \left(\frac{1}{q}\right) - \left(\frac{2}{q^2 z}\right)\sum_{i=1}^{q}(q+1-i)y_i$$

Where G is the Gini coefficient of income distribution (income distribution among households), q is the number of poor households (those falling below the poverty line), z is the mean income of the poor households and y_i is the income of the ith household. Using this measure, when the value of G is 0 there is perfect equality, otherwise value 1 implies mean perfect inequality (Nyariki and Wiggins, 1997).

3.2.6.3 Sen's poverty measure

This measure was introduced by Sen (1976). Sen formulated two desirable properties of poverty indices: the monotonicity axiom, which requires a rise in the overall poverty level if the income of a poor person is reduced; and the transfer axiom, which demands an increase in poverty whenever, a pure transfer is made from a poor person to someone with more income. The head-count ratio, H (the fraction of the population in poverty) fails to meet either of these requirements. The transfer axiom is also seen to be violated by the income gap ratio, indicating the average proportional income shortfall of the poor from the poverty line (Shorrocks, 1995). The Sen's index can be represented by (Nyariki and Wiggins, 1997):

$$S = h\left[1 - \frac{z}{p}(1 - G)\right]$$

Where S is Sen's measure, h is the head-count ratio, z is the mean income of the poor household, p is the value of the poverty line and G is the Gini coefficient of income distribution.

3.2.7 Selection and description of the hypothesized variables

This study adopts a conceptual framework developed by Reardon and Vosti (1995). The assumption is that a household's objective is to maximize food security and other livelihood objectives subject to a set of natural resources, human capital and on-farm and off-farm physical and financial capital, as well as a set of external conditioning factors. All the activities brought together are expected to have environmental consequences, which on the other hand alter the household's access to resources and capital (Wasonga, 2009). Poverty is considered to be the product of the deprivation of basic resources for production and the reason behind that is that livelihood security and poverty in the rangeland are a function of pastoral coping strategies among other variables that determine access to factors of production and assets.

This study assumes a set of factors that influence poverty status of pastoral households. Some of these variables are inherent in the production system, such as, herd size, distance to pasture, distance to the water point and distance to nearest market. Other variables are

external for example extension services, remittances and food relief. The variables are discussed in details below.

1. Per capita daily income

The per capita daily income based on adult equivalents was used as a depended variable in this study. The first step in the computation of per capita daily income involved the determination of annual household income. The annual household income was obtained by aggregation of yearly sales of farm produce, livestock, livestock products, value of produced goods consumed at home, wage of employed household head, and remittances from members of households employed elsewhere. To obtain a household's daily income, the annual household income was divided by the number of days in a year (365). This was further divided by the total household adult equivalents to arrive at per capita daily income. The level of a household's income is a major determinant of food security (Nyariki *et al.*, 2002), livelihood security and therefore a measure of poverty level. Households with high per capita income are expected to be food secure than those with low income levels. The per capita daily income was used to determine whether a household is living below or above the poverty line. Poverty line is the level of income below which one is considered poor— it is the poverty threshold, the minimum level of income deemed necessary to achieve an adequate standard of living in a given country (RoK, 2000).

2. Seasonal climatic variability

The seasonal climatic variability is one of the critical factors that influence economic activities in pastoral areas in Kenya. Agro-pastoralists and pastoralists depend to large extent on the natural environment for their livelihoods. Seasonal climate variability is, therefore, one of the key determinants of the poverty incidence and severity. During the wet season, when the rain is adequate and other climate factors are favourable, households can maximize their income from cultivation of crops and/or livestock. In the dry season, however, climatic conditions do not favour both crop and livestock production, thereby making households prone to transient poverty (Hussain *et al.*, 2002). It is, therefore, expected that the percentages of poor households is likely to be higher during the dry season than the wet season. Seasonality was a dummy variable where a value of 1 was allocated to dry season and 0 to wet season.

3. Gender of household head

Under normal circumstances, the head of household in all pastoral communities in Kenya is a male. The bundles of resources which are vital for a household's food security are controlled by men who are not yet ready to share ownership with women (Samba, 2010). Such rights are not readily transferable to women even in cases where they are rendered heads of households when their husbands are employed elsewhere or dead (Wasonga, 2009). This implies that women headed households may be disadvantaged with regard to access to natural resources and decisions important in pursuance of sustainable livelihoods.

It is hypothesized in this study that female headed households are likely to be poorer than the male headed households. Gender of household head was a dummy variable where a value of 1 was allocated to male headed households and 0 to female headed households.

4. Age of household head

The age of a household head in years is expected to determine a household's access to and ownership of livelihood assets and means of production. This in turn determines the amount of wealth at a household's disposal and therefore poverty level. A household headed by a young person (less than 30 years) is therefore expected to be poorer than that headed by an older person (30 — 60). However, beyond the age of 60 years, the reverse may be true as assets are shared out among siblings and wealth creation declines (Wasonga, 2009). The age of the household head was a categorical variable and was assigned a value of 1 if less than 30 years, 2 if aged between 30-60 years, and 3 if over 60 years.

5. Education of household head

The level of education attained by the head of a household is expected to influence access to information, decision making, income and consequently livelihood security of a household. Poverty of a household, whether transient or chronic, is therefore expected to decrease as level of education of its head increases. This is because educated household heads are likely to have higher income earning potential and more alternative income

earning opportunities. According to Wasonga (2009), education provides an opportunity for pastoral households to diversify their livelihood portfolios especially through employment as a source of wage and remittances. The level of education of a household head was assigned a value of 1 if never attended school, 2 if attained primary education, 3 for secondary education, and 4 if attained secondary education.

6. Distance to pasture

Herd movement is a critical strategy in African dry lands for the efficient management of heterogeneous forage availability and highly variable precipitation (Boker and Hoffman, 2006). However, forage availability determines the direction and distance of the opportunistic movements by the African pastoralists to make use of different ecological niches (Niamir, 1994). The assumption in this study is that the distance travelled in search of pasture is an indicator of forage availability, a reflection of range condition and productivity and therefore livestock productivity. Secure livelihoods can only be attained when resources needed for production are accessible. This leads to the hypothesis that the longer the distance to pasture, the lower the productivity, and therefore the poorer the households. Daily distance travelled by a herder and his livestock in search of pasture was measured in kilometers.

7. Distance to water source

In addition to high incidence of poverty, water resources in ASALs are scarce and erratic in availability (Sussan and Arriens, 2003). Water is crucial for livestock production, and therefore its availability influences livestock productivity and consequently the household welfare of pastoral households. It was hypothesized in this study that the longer the distance to water, the lower the productivity and therefore the poorer the households. Daily distance traveled by a herder and livestock in search of water was measured in kilometers

8. Herd size

In most pastoral communities, wealth and well being are measured in terms of the number of livestock owned. It is assumed in this study that the level of poverty of a pastoral household is a function of its herd size, among other variables. This, however, depends on the extent to which a pastoral household relies on livestock for its basic needs. Although different herd sizes have varying labour requirements (Dahl and Hjort, 1979), the number of persons supported by a herd is assumed to be proportional to its size. Herd size was measured in terms of Tropical Livestock Units (TLUs) per household where one TLU was taken as an equivalent of a mature live animal weighing 250 kg (KARI, 1996). The TLUs were derived using average weights of the different sex and age categories of cattle, sheep and goats estimated from previous studies (Wasonga, 2009). In this study a bull is equivalent to 1.29 TLU, a cow = 1 TLU, a calf = 0.4 TLU and a sheep or goat = 0.11 TLU. Conversion of livestock holdings into TLU equivalents was for the purpose of

standardizing different animal kinds and classes into a universal unit to allow comparisons between households and strata.

9. Household size

The size of a family is assumed to be directly proportional to its demand for food and income to secure other necessities. This study considers the size of a household as the sum total of a pastoralist, his spouse, offsprings and dependants present at the time of interview. The number of persons comprising a household was converted to adult equivalents, based on the gender and the age, the men where categories in several groups. as indicated in Table 3.1.

Table 3. 1: Adult equivalent used in the study

Age interval	Adult Equivalent	
	Males	Females
0 - 1	0.35	0.35
1 - 3	0.48	0.48
4 - 6	0.63	0.63
7 - 10	0.89	0.89
11 - 14	1	0.81
15 - 18	1.04	o.76
19 - 22	1.07	0.78
23 - 50	1	0.74
51 - 75	o.89	0.67
Above 75	0.76	0.56

Source: adopted from Eissa (2009).

The concept of AE assumes that life-cycle stages have an important influence on the needs of members or individuals of the same household. Other studies have used different conversions rates (Nyariki *et al.*, 2002). This discrepancy is due to the fact that the concept of AE is based on the differences in nutrition requirements according to age and sometimes sex, and this is expected to vary with the environment and the kind and level of activity in which one is involved (Wasonga, 2009)

10. Relief food

Relief food is food that a household acquires from sources outside their main livelihood activities, normally from the government, the United Nations Organizations, non-governmental organizations (NGOs) or religious organizations. Dependency on relief food indicates poverty, a decline in human support capacity of the land and non-functioning pastoral mitigation strategies. Reliance on relief food was considered a dummy variable where the value of 1 was assigned to household that received relief food and 0 to those that did not receive relief food.

11. Remittances

Employment outside the pastoral sector is one important way of diversifying sources of livelihood in pastoral areas. It is important to note that although some pastoralists are currently living off-pastoral sector for various reasons such as employment, by tradition, most of them remit part of their wages to their families back home. This favourably alters

such households' resource base. Wage transfers received from employed members is assumed to ease the dependency on livestock, crops cultivation and land resource base and reduce poverty (Wasonga, 2009). Household receiving remittances are therefore expected to be less dependent on livestock for their needs, and more secure in food and other needs than their counterparts that do not receive remittances. This variable was given value of 1 if household received wage transfers from its member employed elsewhere and 0 if they did not receive remittances.

12. Number of livelihood sources

The pastoral communities in arid and semiarid Africa primarily raise livestock to produce milk for household consumption. These livestock also provide a means for wealth accumulation, meat production, and cultural expression (Desta and Coppock, 2004). However, due to high risk and uncertainty that characterize pastoral production systems, pastoralists normally rely on fall-back livelihoods to cushion them from natural shocks such as droughts (Herlocker, 1999). Cultivation of crops, for example, is one of the major strategies used by the pastoralists to supplement milk and meat during bad seasons (Sikana and Kerven, 1991). Other alternative livelihoods include honey production, trading and charcoal burning, among others. Expanding livelihood portfolios in ways that encourage local growth linkages is usually meant to augment subsistence from livestock. Therefore, households that have alternative livelihoods are expected to be richer and more food secure than their counterparts that depend on livestock or/and crop cultivation alone.

13. Social networks

Pastoralists traditionally use their livestock to make social bonds within and beyond their territories. These social ties form the basis of risk spreading, and post drought herd rebuilding. Nyariki and Ngugi (2002), referring to the pastoral social networks as the "economy of affection", pointed out that the social alliances built through livestock transfers to friends and relatives as loans serve as post drought insurance. Besides the positive effects of spreading grazing pressure, strong social linkages such as self-help groups are expected to enhance livelihood security, and therefore reduce poverty in a given household. This variable was given value of 1 if household head have a social network and 0 if he is not.

14. Extension services

Extension services cover information delivery and training in new technology (Moris 1991). These services are usually provided by the government, NGOs and traditional institutions. The extension services are expected to influence critical decisions concerning production, sale and the whole process of income generation activities, and consequently livelihood security of households. Households' members who had chance to be trained or receive information are less likely to be poor compared to those do not have access to such information. This is because those who plan their activities according to the extension information have higher chances of making the right decisions at the right time, and therefore reducing risk and uncertainties associated with production. Extension service

was considered a dummy variable where the value of 1 was assigned to household that received on farm information and 0 to those that did not receive information.

15. Distance to the nearest market

The rising impoverishment of pastoral communities has been linked to the settlement of pastoralists around water resources, trading centres and other social services and amenities. The argument is that due to diminishing grazing land and restricted mobility, pastoralists tend to settle and when they do so, they degrade the range thereby compromising range productivity. Consequently, land degradation leads to poor livestock productivity, insecure pastoral livelihoods and ultimately impoverishment (Wasonga, 2009). Generally, trading centers are expected to provide market outlet for both livestock and their products as well as other produce, thereby influencing households income status. Distance to the nearest trading center was measured in kilometers.

3.2.8 Model specification

3.2.8.1 Ordinary Least Squares (OLS) regression

An Ordinary Least Squares (OLS) regression technique was used to determine the relationship between poverty and the hypothesized explanatory variables. In order to eliminate multicollinearity, a correlation analysis was conducted to identify variables, which were significantly correlated (correlation coefficient, $r \geq 0.5$) priori to performing a

multiple linear regression. Pairs of variable with highly significant correlation coefficients were scrutinized and either of them dropped depending on their influence (t-value) on the regressand. Variables with higher t-values (more influence on the dependent variable) were retained for the Ordinary Least Squares (OLS) regressions (Wasonga, 2009). A general equation for a multiple linear regression (OLS) given k variables (a regressand and (k-1) regressors) is specified as:

$$Y_i = \beta_1 + \beta_2 X_{1i} + \beta_3 X_{2i} + ... + \beta_k X_{ki} + \mu_i.$$

Where Y is the dependent variable, $X_1,...,X_k$ is a set of explanatory variables, i denotes ith household, μ is the error or disturbance term associated with the model, and $\beta_1,...,\beta_k$ are coefficients representing parameters estimators of the variables in the model.

A series of multiple regressions were conducted using per capita daily income as the regressand until the best fit of the model was attained. The criteria for determining the variables that best defined the estimated model (goodness of fit) was based on the coefficient of determination (R^2); adjusted R^2, F statistic, significance of explanatory variable (t-value), the sign or direction of influence of the independent variables, and the number of significant explanatory variables in the model.

3.2.8.2 Logit model

Poverty incidence, the phenomenon we seek to model, is considered discrete rather than continuous in nature. In this case, the dependent variable is binary. These are cases where the dependent variable can be characterised as binary, taking the value of 0 or 1. The dependent variable thus takes the value of 1 if the household is not poor and 0 if the household is poor. The regressand in this model is poverty incidence (whether a household is poor or not).

Binary regression is the most suitable method for analyzing discrete binary data in which the dependent variable evokes a yes or no response (Farah *et al.*, 2003). These are techniques for estimating the probability of an event (such as poverty incidence) that can take one of two values (poor or not poor). The basic difference between Logit and Probit models is that Logit assumes a cumulative logistic distribution, while Probit model assumes cumulative normal distribution. The logit model was chosen because the properties of estimation procedures are more desirable than those associated with the choice of a uniform distribution (Pindyck and Rubinfeld, 1991). The study used the Logit model also because the Logit model is computationally easier than the Probit to evaluate the poverty incidence. In the logit regression model, parameters are determined through maximum likelihood estimation (MLE) procedure. The probability that a household is poor can be specified as:

$$P_1 = F(\alpha + \beta x_i) = \frac{1}{1 + e^{-(\alpha + \beta x_i)}} \quad (1)$$

Where P_1 is the probability that the ith household will be poor given x_i, where x is a vector of explanatory variables and e is the natural logarithm. Equation (1) can be rewritten as:

$$P_1 = \left[1 + e^{-(\alpha + \beta x_i)}\right] = 1 \quad (2)$$

Where $\alpha + \beta xi = \log\left[\frac{P_1}{1 - P_1}\right]$ and $\frac{P_1}{1 - P_1}$ is the likelihood ratio, whose log gives the odds that a household is poor.

The model estimated for SNL is specified as:

$$Log\left[\frac{P_1}{1 = P_1}\right] = \alpha + \beta_0 WDUC_i + \beta_1 DIM_i + \beta_2 HHS_i + \beta_3 DIP_i + \beta_4 RF_i + \beta_5 ES_i + \beta_6 TLU_i + \beta_7 REM_i$$

The model estimated for SAL is specified as:

$$Log\left[\frac{P_1}{1 = P_1}\right] = \alpha + \beta_0 EDUC_i + \beta_1 HHS_i + \beta_2 REM_i + \beta_3 TLU_i + \beta_4 LIV_i + \beta_5 DIM_i + \beta_6 AGE_i + \beta_7 RF_i$$

Where i denotes i^{th} household (1, ..,125 for SAL and 1,...,75 for SNL); LIV is the number of livelihood sources; DIP is distance to pasture, DIM is distance to the nearest market,

AGE is age of the household head; EDUC is education of the head of the household; ES is extension services; HHS is household size; RF is relief food; REM is remittances; TLU is herd size and α and $\beta_1,\ldots,\beta_k$ are coefficients representing parameters estimators of the variables in the model.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This chapter presents the study findings and their interpretation. It comprises the general descriptive statistics and the analysis of poverty status.

4.1 GENERAL DESCRIPTIVE STATISTICS

4.1.1 Household characteristics

A household was defined as 'all people who live under one roof and are subject to decisions made by the household head.' A household head was defined as one who owns and controls the major resources in a household, makes important decisions in a household and provides the basic needs for the household members. Table 4.1 indicated that, the average household size was 8 persons, 7 and 8 in agro-pastoral and the semi-nomadic pastoral households, respectively..

Table 4.1: Mean household size

Variables	Total (N=200)		Agro-pastoralists (N=125)		Semi-nomadic pastoralists (N=75)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Family size	7.6	3.04	6.6	1.82	7.6	3.04
Number of males	4.0	1.89	3.2	1.22	4	1.89
Number of females	3.6	1.72	3.4	1.34	3.6	1.72

The household heads under the sedentary agro-pastoral land use system were found to be more educated, (34.4%, 12.8% and 15.2% having attained primary, secondary and post-secondary education respectively) than those under semi-nomadic pastoral land use system (24%, 14.7% and 10.7% having attained primary, secondary and post-secondary education, respectively). Results show that the majority (average of 79%) of respondents were in the category of 30-60 years. The respondents under 30 years were 16% and 12% in both sedentary agro-pastoral and semi-nomadic pastoral land-use systems, respectively. Respondents over 60 years were 16.8% and 16% in SAL and SNL, respectively (Table 4.2).

Table 4.2: Education level and age of household head

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequency	%	Frequency	%	Frequency	%
None	85	42.5	47	37.6	38	50.7
Primary	61	30.5	43	34.4	18	24.0
Secondary	27	13 5	16	12.8	11	14.7
Post secondary	27	13.5	19	15.2	8	10.7
Under 30 years	30	15	21	16.8	9	12
Between 30-6 years	137	68	83	66.4	54	72
Over 60 years	33	16.5	21	16.8	12	16

4.1.2 Land tenure system and enclosures ownership

The land tenure system was found to be predominantly under clan/family ownership in both the SAL (88.8%) and the SNL (93.3%). Other land tenure regimes included group

ranch system (4%), titled private land (5.6% in SAL and 1.3% in SNL). The study showed that the proportion of respondents with enclosures under the sedentary agro-pastoral land use system was higher (66.4%) than in the semi-nomadic pastoral land used system (22.7%). Results also indicate that under SNL the enclosures are mainly used to reserve pasture to ensure supply throughout the year. Under SAL, 69.1% of the households used enclosures for cultivation of crops, while 17.9% of them used the enclosures for growing both crops and grass (Table 4.3).

Table 4.3: Enclosures ownership and type

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequency	%	Frequency	%	Frequency	%
Own enclosure	100	50	83	66.4	17	22.7
Do not own enclosure	100	50	42	33.6	58	77.3
Pasture/grass	27	27.0	10	12.0	17	100
Crop	58	58.0	58	69.1	0	0
Pasture and crop	15	15.0	15	17.9	0	0

4.1.3 Livelihood and income sources

Livelihood sources in the two land use systems (SAL and SNL) during the wet season are presented in Table 4.4. The results show that livestock contributed Ksh.12068.4 (24.9%) and Ksh. 21660.7 (62%) of total household income in the SAL and SNL, respectively. Crop cultivation contributed Ksh.19813.4 (40.8%) and Ksh 646.7 (1.9%) of total household income in the SAL and SNL, respectively. Off-farm income sources during the wet season

included bee-keeping (2.6% and 15%), charcoal burning (3.3% and 4%), trade/business (15.3% and 13.2%) and wage employment (13.1% and 3%) in the SAL and SNL respectively.

Table 4.4: Household average income in wet season (Ksh.)

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Income (Ksh.)	%	Income (Ksh.)	%	Income (Ksh.)	%
Livestock	15665.5	36.2	12068.4	24.9	21660.7	62.6
Crop cultivation	12625.9	29.2	19813.4	40.8	646.7	1.9
Bee-keeping	1246.2	2.9	1220.3	2.6	5289.3	15.3
Charcoal burning	1528.2	3.5	1617.9	3.3	1378.7	4.0
Trade/business	6351	14.7	7416.0	15.3	4574.7	13.2
Wage employment	5879.2	13.6	6376.0	13.1	1039.9	3.0
Total	43296	100.0	48512	100.0	34590	100.0

Table 4.5 presents sources of income in the two land use systems. Livestock contributed Ksh. 6346.4 (21.9%) and Ksh.12664.7 (45.9%) of the total household income in the sedentary agro-pastoral land use system and the semi-nomadic pastoral land use system, respectively. Crop production contributed Ksh.2405 (8.4%) in the sedentary agro-pastoral land use system.

The dry season is usually associated with water stress which leads to a decrease in income from crop cultivation and livestock. Therefore, households under the two systems engage in non-farm activities to sustain their livelihood. Off-farm income sources during the dry season included bee keeping, charcoal burning, trade/business, and wage employment.

Table 4.5: Household average income in dry season (Ksh.)

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Income (Ksh.)	%	Income (Ksh.)	%	Income (Ksh.)	%
Livestock	8715.8	30.6	6346.4	21.9	12664.7	45.9
Croup cultivation	2405.1	8.4	3556.0	12.2	486.7	1.8
Bee-keeping	861.8	3.0	548.5	1.9	4384.0	15.9
Charcoal burning	4544.5	15.9	5531.6	19.0	2899.3	10.5
Trade/business	6310.0	22.1	6558.4	22.6	5896.9	21.4
Wage employment	5657.3	19.9	6500	22.4	1252.7	4.5
Total	28494.5	100.0	29040.9	100.0	27584.3	100.0

These results imply that Livestock production is the major source of income in a semi-nomadic pastoral land use system despite the water stress and scarcity of pastures. Wage employment was, however, found to be the major source of income during the dry season. This was followed by trade/business, charcoal burning and bee keeping as alternative sources of income and food for the pastoral households in the study area. Off-farm activities in the dry season are a very important source of livelihood for the semi-nomadic pastoralists, especially during prolonged dry season or droughts, when livestock productivity is suppressed by lack of water and pasture.

4.1.4 Migration

Migration is a traditional pastoral strategy used to track forage and water as well as escape from natural shocks including diseases, drought and tribal conflict. Table 4.6 shows that migration is more prevalent (68%) under semi-nomadic pastoral land use system than in

the sedentary agro-pastoral land use system (33%). The main reason for migration is to track water and pasture (90.9% under SAL and 100% in SNL). These results imply that migration is a critical strategy under the semi-nomadic pastoral system, especially during periods of water stress as is the case during prolonged dry seasons and droughts. Therefore, without moving livestock to track water and pasture, the livelihood of households might not be sustained. Thus, more households might fall under the poverty line. Consequently, more households under the semi-nomadic system might be in need of food relief.

Table 4.6: Migration and the reason behind migration of household

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequency	%	Frequency	%	Frequency	%
Migrate	84	42.0	33	26.4	51	68.0
Do not migrate	116	58.0	92	73.6	24	32.0
Search for water and grass	81	96 4	30	90.9	51	100
Due to business	1	1.2	1	3.0	0	0
Due to flood	2	2.4	2	6.1	0	0

4.1.5 Remittances

Wage employment is a source of cash income that supplements subsistence and income from livestock. Households with one or more of their household member in formal employment have a lower poverty level, compared with those without any member in the wage-earning employment. Table 4.7 indicated that 64% and 34.7% of the sedentary agro-pastoral households and semi-nomadic households had some of their members wage-

earning employed. More (64%) sedentary agro-pastoral household received remittances than their semi-nomadic counterparts (26.7%).

Table 4.7: Household members employment and remittances

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequenc y	%	Frequency	%	Frequency	%
Empioyed	106	53.0	80	64.0	26	34.7
Not employed	94	47.0	45	36.0	49	65.3
Receive remittances	100	50.0	80	64.0	20	26.7
Do not receive remittances	100	50.0	45	36.0	55	73.3

4.1.6 Access to extension services and information

In this study, 96.8% of the agro-pastoralists received on farm extension and climate forecast, compared with 29.3% of the semi-nomadic pastoralists. This implies that agro-pastoral households therefore have the advantage of making right and timely decisions that translates into higher production than their semi-nomadic counterparts.

Table 4.8 shows that the main source of information for the agro-pastoralists are the radio (46.3%) followed by the informal sources (30.6%), extension officers (19.8%) and the newspaper (3.3%). In the semi-nomadic pastoral land use system, the major resource for information is the informal sources (40.9%), extension officers (31.8%). The radio was ranked third (27.3%). The elders and the chiefs were found to be the main source of informal information under the semi-nomadic pastoral land use system.

Table 4.8: Extension services and information

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequency	%	Frequency	%	Frequency	%
Access services	143	71.5	121	96.8	22	29.3
Do not access services	57	28.5	4	3.2	53	70.7
Informal sources	46	32.2	37	30.6	9	40.9
Radio	62	43.3	56	46.3	6	27.3
Extension officers	31	21.7	24	19.8	7	31.8
Newspaper	4	2.8	4	3.3	0	0

4.1.7 Membership in self-help groups (SHGs)

This study shows that 69.6% of the agro-pastoralists and 22.7% of the semi-nomadic pastoralists were members of self-help groups (Table 4.9). These self-help groups help the members to share extension information, technology and any other facilities that promote their livelihood. Such collective actions help households to alleviate poverty (Mwanthi, 2009). Moreover, those belonging to a self-help group are likely to benefit from the group through economies of cooperation.

Table 4.9: Membership to self-help group (SHGs)

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequency	%	Frequency	%	Frequency	%
Belong to SHG	104	62.0	87	69.6	17	22.7
Do not belong to SGH	96	48.0	38	30.4	58	77.3

4.1.8 Household herd composition and size in the study area

This study found, that semi-nomadic households keep more goats (48%) than sheep (23%), and cattle (20%) (Figure 4.1). Other livestock species kept under SNL include chicken (5%) donkey (3%) and camel (1%) in order of importance. Herd composition shows a similar pattern (Figure 4.2) under SAL, where goats constituted 53%, sheep 21%, cattle 14% and chicken 12% of the average household herd.

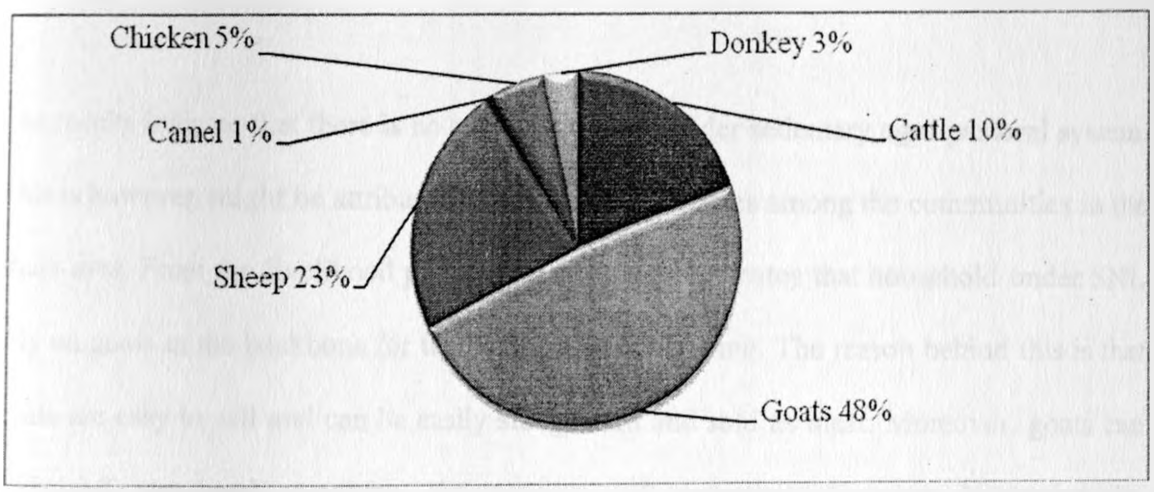

Figure 4.1: Herd compositions under the semi-nomadic pastoral system

The goats seem to be favoured by the households because they are drought tolerant and have higher fecundity than cattle or sheep. These results are consistent with those of Wasonga (2009) who found that the herd composition under SNL and SAL consisted of a higher number of sheep and goats compared to cattle.

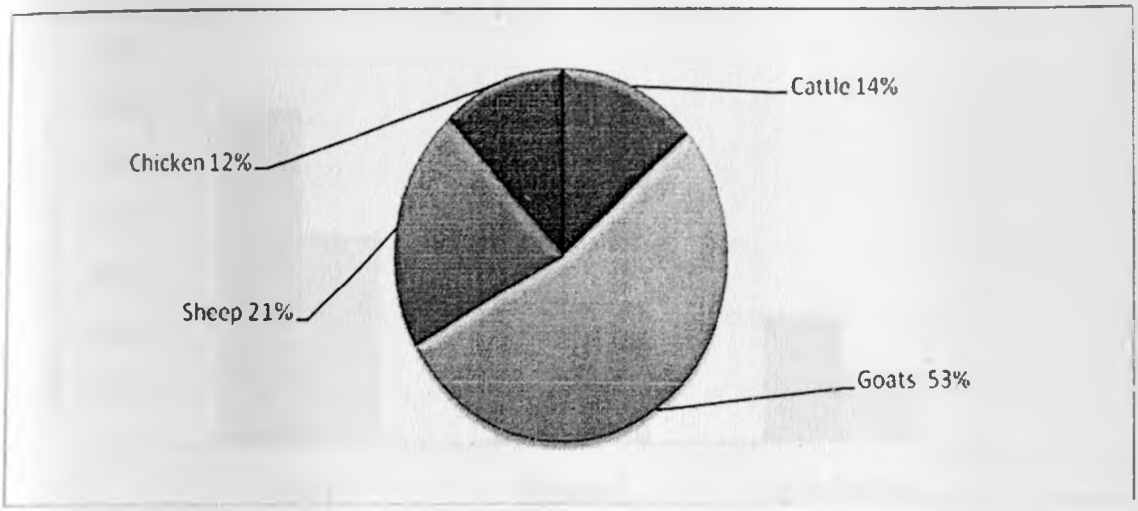

Figure 4.2: Herd compositions under the agro-pastoral system

The results indicate that there is no camel or donkey under sedentary agro-pastoral system. This is however, might be attributable to cultural differences among the communities in the study area. From the livelihood perspective, the result indicates that household under SNL rely on goats as the backbone for their subsistence economic. The reason behind this is that goats are easy to sell and can be easily slaughtered and sold as meat. Moreover, goats can withstand very harsh conditions thus survive well throughout the year. Increasing the numbers of donkeys under SNL is a strong indication of scarcity of water.

Figure 4.3 shows the numbers of livestock owned by households under both the semi-nomadic pastoral land use system and agro-pastoral land use system. Under SNL, the household herd size decreased from 2698.58 TLUs during the wet season to 2436.33 TLUs during the dry season. Herd size under SAL showed similar trend, decreasing from 2210 TLUs during the wet season to 1253 TLUs during the dry season.

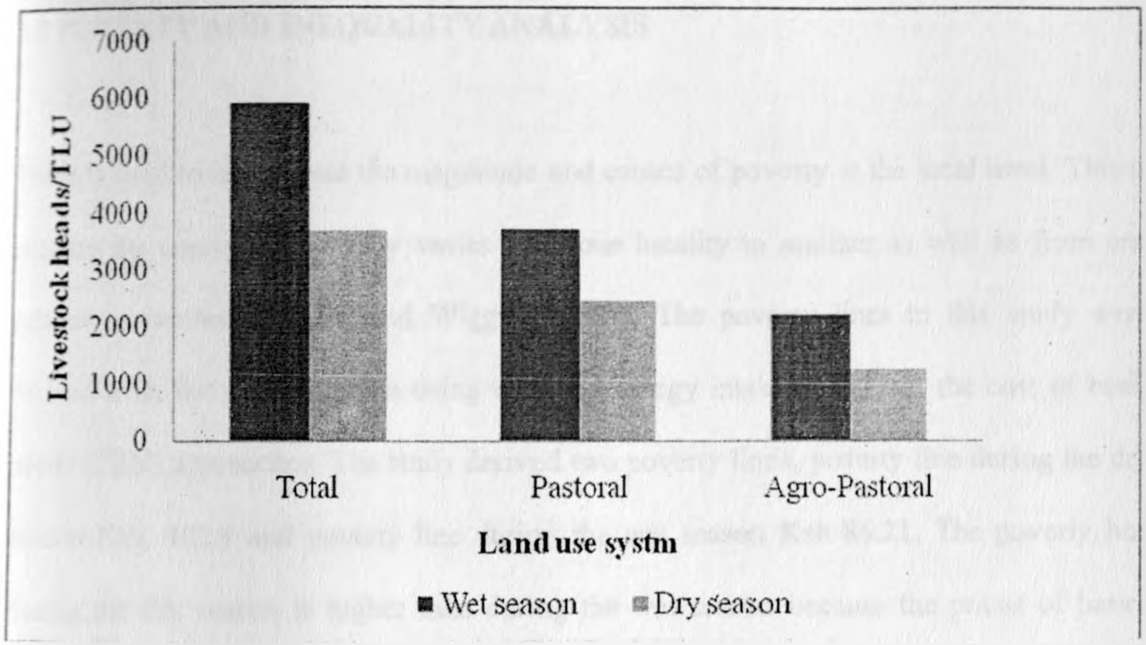

Figure 4.3: Household herd size in the study area

4.1.9 Relief food

The results show that only 16.8% of sedentary agro-pastoralists received relief food during the wet season compared to 80% during the dry season (Table 4.10). Similarly, in the semi-nomadic pastoral land use system, 10.7% of the households received relief food during the wet season in contrast to 86.7% during dry season.

Table 4.10: Relief food during the wet season and dry season

Variables	Total (N=200)		Agro-pastoralist (N=125)		Semi-nomadic pastoralists (N=75)	
	Frequency	%	Frequency	%	Frequency	%
Wet season	29	14.5	21	16.8	8	10.7
Dry season	165	82	100	80	65	86.7

4.2 POVERTY AND INEQUALITY ANALYSIS

There is need to understand the magnitude and causes of poverty at the local level. This is because the concept of poverty varies from one locality to another as well as from one culture to another (Nyariki and Wiggins, 1997). The poverty lines in this study were derived from the collected data using the food energy intake (FEI) and the cost of basic needs (CBN) approaches. The study derived two poverty lines, poverty line during the dry season Ksh. 102.9 and poverty line during the wet season Ksh 86.21. The poverty line during the dry season is higher than during the wet season because the prices of basics goods rise during the dry season compared to the wet season.

4.2.1 Poverty and inequality in the study area

The overall poverty assessment in the study area was based on per capita daily income. The results of this study show that poverty in the study area was very high in both wet (77.5%) and dry (89.5) seasons. Table 4.11 shows that, 12% of the people in the study area fell below the poverty line (Ksh. 102.9) in the dry season. This could be attributed to water stress that adversely affects both livestock and crop production and therefore household income generation during the dry season.

Table 4.11: Influence of seasons on household poverty in the study area

Season	Poor		Not poor	
	Frequency	%	Frequency	%
Wet (N=200)	155	77.5	45	22.5
Dry (N=200)	179	89.5	21	10.5

Poverty incidence was found to increase from 55% during the wet season to 61.5% in the dry season. The result show poverty gap 23% in the wet and 29.1% in the dry season, poverty severity was 13% during the wet season and 17.2% during the dry season (Table 4.12). These findings show that there were lower incidence, depth and severity of poverty during the wet season than during the dry season. The reason behind this is that households are fully dependent on rain-fed livelihoods to generate their basic needs, among other factors.

Table 4.12: Poverty and income inequality in the study area

Seasons	Poverty line (Ksh.)	Poverty incidence (%)	Poverty gap (%)	Poverty severity (%)	Gini coefficient	Sen's measure (%)
Wet (N=200)	86.21	55	23	13	0.43	36.6
Dry (N=200)	102.9	61.5	29.1	17.2	0.44	37.3

Income inequality was measured using the Gini index (coefficient of concentration). Figure 4.4 illustrates the distribution of poverty in the study area and the two seasons using the Lorenz curves. The Lorenz curves show that the gap between the expected and observed income distribution during the wet and dry seasons to be different. The gap is bigger during the dry season compared to the wet season. The Gini coefficient was lower (0.43) during the wet season than during the dry season (0.44). Similarly, Sen's measure was 36.6%

during the wet season but increased to 37.3% during the dry season. These results indicate that the income inequality and welfare among households is higher during the dry season than wet season. The slight increase in Sen's measurement in the dry season implies that the situation of those below the poverty line actually worsens.

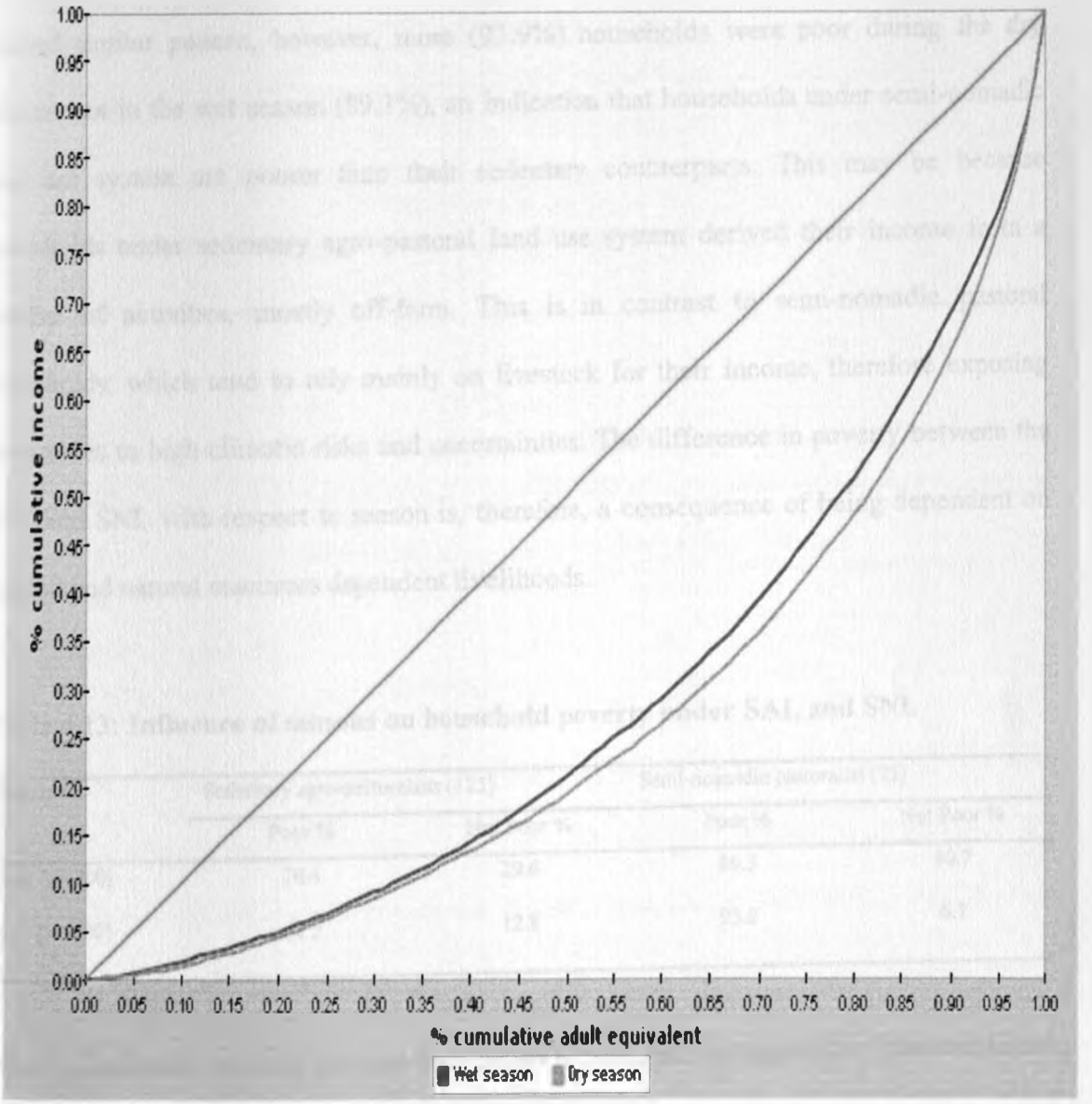

Figure 4.4: Lorenz curves for the study area during the wet and dry seasons

4.2.2 Poverty and income inequality under SAL and SNL

Table 4.13 presents that 70.4% of agro-pastoral households were poor (households with per capita daily income less than Ksh. 86.21) during the wet season. This number increased slightly to 87.2% during the dry season, suggesting a non-significant difference in poverty incidence between the two seasons under SAL. The number of poor households under SNL showed similar pattern, however, more (93.9%) households were poor during the dry season than in the wet season (89.3%), an indication that households under semi-nomadic land use system are poorer than their sedentary counterparts. This may be because households under sedentary agro-pastoral land use system derived their income from a number of activities, mostly off-farm. This is in contrast to semi-nomadic pastoral households, which tend to rely mainly on livestock for their income, therefore exposing themselves to high climatic risks and uncertainties. The difference in poverty between the SAL and SNL with respect to season is, therefore, a consequence of being dependent on rainfall and natural resources dependent livelihoods.

Table 4.13: Influence of seasons on household poverty under SAL and SNL

Seasons	Sedentary agro-pastoralists (125)		Semi-nomadic pastoralist (75)	
	Poor %	Not Poor %	Poor %	Not Poor %
Wet (N=200)	70.4	29.6	89.3	10.7
Dry (N=200)	87.2	12.8	93.9	6.7

Poverty incidence, severity and gap were found to be higher during the dry than wet season under SAL (Table 4.14). Although agro-pastoralists are known to pursue more than one

livelihood activity, in some instances, these alternatives may not be productive and sustainable enough to cushion them from the effects of dry conditions.

Table 4.14: Poverty and income inequality among SAL

Season	Poverty line (Ksh.)	Poverty incidence (%)	Poverty gap (%)	Poverty severity (%)	Gini coefficient	Sen's measure (%)
Wet (N=200)	86.21	70.4	37.5	24.5	0.48	47.3
Dry (N=200)	102.9	87.1	59.5	44.6	0.49	69.6

The results presented in Table 4.15 show similar trends to those observed under sedentary agro- pastoral land use system, that poverty incidence, gap and severity were higher during the dry than the wet season.

Table 4.15: Poverty and income inequality among SNL

Seasons	Poverty line in (Ksh.)	Poverty Incidence (%)	Poverty gap (%)	Poverty severity (%)	Gini coefficient	Sen's measure (%)
Wet (N=200)	86.21	88.3	49.7	32.6	0.37	61.4
Dry (N=200)	102.9	89.0	61.9	46.5	45.7	70.8

The findings of this study reveal that, semi-nomadic pastoralists are poorer than sedentary agro-pastoralists. The reason behind that is that the institutional capacity is generally low under the semi-nomadic pastoral land use system. This can be attributed to poor services and infrastructure among other factors in the SNL than in the SAL. Households under SAL normally have better access to extension services and education compared to households under the semi-nomadic pastoral land use system. Another reason is that household under sedentary agro-pastoral land use system are most likely to be found near the urban centres

which allows them access to the market and other social services and amenities. These factors affect productivity and therefore household income. Figure 4.5 Lorenz curves, shows the distribution of income between SAL and SNL. Lorenz curves indicated big gap between expected and observed income distribution between the two groups. The gap is bigger under the semi-nomadic compared to the agro-pastoral households. This implies that the income inequality among households under the sedentary agro-pastoral land use system is lower than under the semi-nomadic pastoral system.

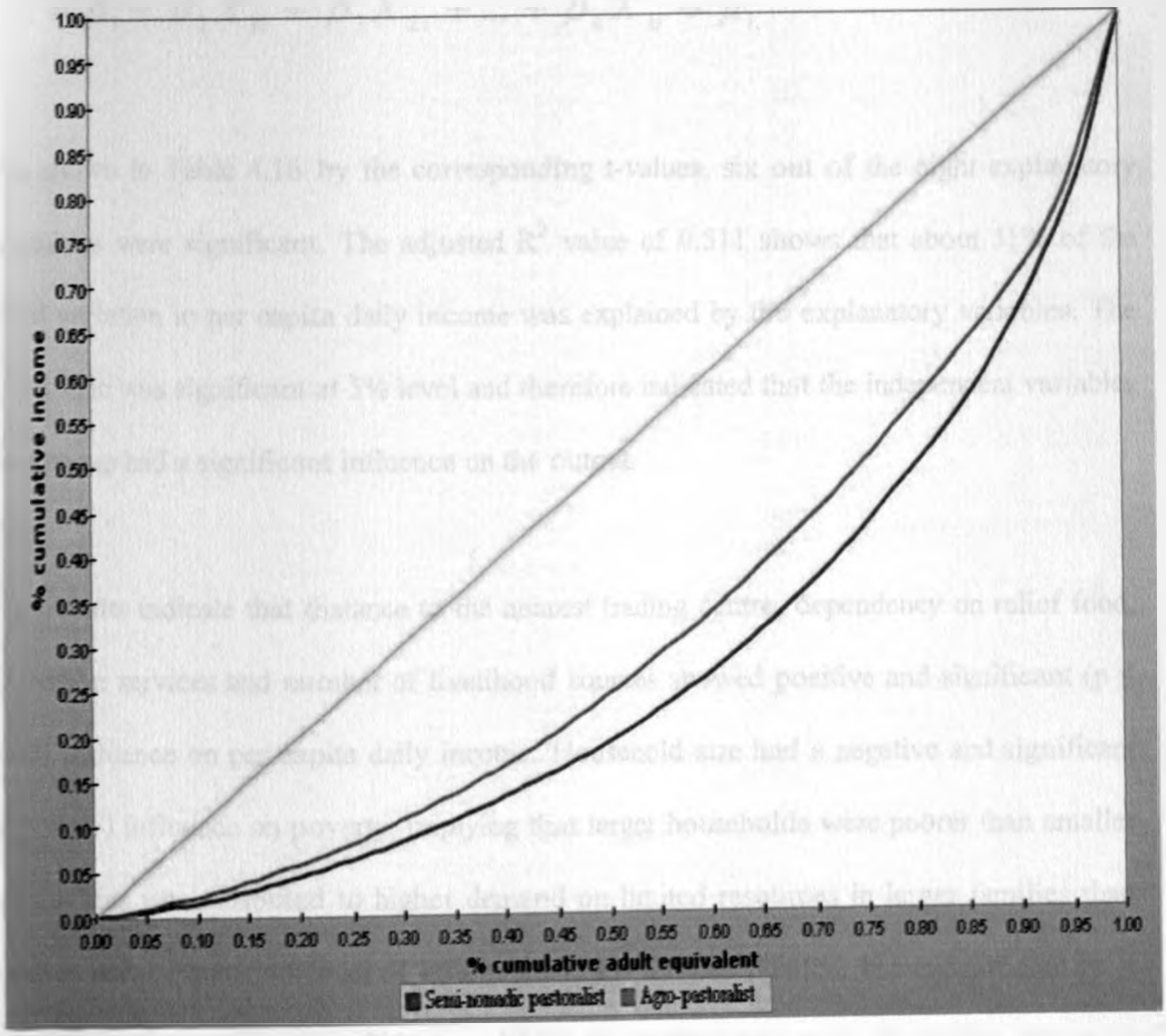

Figure 4.5: Lorenz curves for the Agro-pastoral and semi-nomadic households

4.3 RESULTS OF REGRESSION ANALYSES

4.3.1 OLS and binary logistic regression models for SAL

Table 4.16 presents OLS regression results for the sedentary agro-pastoral land use system. The regression was adopted to estimate the effects of the explanatory factors on poverty as represented by per capita daily income. The OLS regression model can be expressed as:

$$Y_i = \beta_1 + \beta_2 X_{1i} + \beta_3 X_{2i} + \ldots + \beta_k X_{ki} + \mu_i.$$

As shown in Table 4.16 by the corresponding t-values, six out of the eight explanatory variables were significant. The adjusted R^2 value of 0.511 shows that about 51% of the total variation in per capita daily income was explained by the explanatory variables. The F-statistic was significant at 5% level and therefore indicated that the independent variables as a group had a significant influence on the output.

The results indicate that distance to the nearest trading centre, dependency on relief food, extension services and number of livelihood sources showed positive and significant ($p \leq 0.05$) influence on per capita daily income. Household size had a negative and significant ($p \leq 0.05$) influence on poverty, implying that larger households were poorer than smaller ones. This was attributed to higher demand on limited resources in larger families than smaller ones. Education level of household head, showed positive but insignificant ($p \leq 0.05$) influence on poverty. This may likely be attributed to lack of herding labour in

households whose heads are educated. Educated household heads are likely to send their children to school therefore denying their households the much needed herding labour. This often than not result in small household herd sizes and limited mobility, low productivity and therefore impoverishment of such households.

Table 4.16: Factors influencing poverty in SAL: OLS estimation

Model	β	SE	t
Constant	-153.931	52.213	-2.948**
Education of household head	9.551	5.126	1.863*
Household size	-14.091	3.188	-4.419**
Distance to nearest market	2.828	.617	4.583**
Relief food	54.983	13.264	4.145**
Extension services	207.032	34.609	5.982**
Number of livelihood sources	13.074	10.888	2.065**
Enclosures ownership	22.429	10.863	1.201
Remittances	-7.947	10.515	-.756

Significant at 5%; *Significant at 10%; $R^2 = 0.543$; Adj. $R^2 = 0.511$; F = 17.68; N = 125

The OLS regression results indicate that under the sedentary agro-pastoral land use system, the number of alternative sources of livelihood plays a significant role in determining a household's poverty as represented by per capita daily income and therefore whether a household is poor or not. The higher the number of livelihood sources of a given household, the higher the per capita income, and therefore the lower the poverty level (Mango *et al.*, 2004; Ngugi and Nyariki, 2005; Wasonga, 2009).

Access to extension services showed positive and significant ($p \leq 0.05$) influence on the per capita daily income. This suggests that households with access to technical advice and information tend to realize higher production and therefore more income than those that do not access extension services. Education of household head had a positive and significant ($p \leq 0.10$) influence on poverty status of a household, this implies that education become important as pastoralists settle thereby making education necessary for creating non-pastoral opportunities and diversification of economy in general. The results indicate that households that receive remittances are poorer than those do not receive financial supports. This suggests that it is mostly the poor households that rely on employed relatives for such transfers.

Distance to the nearest market showed positive and significant influence on the per capita daily income. This may be because agro-pastoralists often settle around these centres and therefore easily access the markets to sell their produce and other services that enhance production and therefore income. Moreover, the proximity to trading centres can encourage small businesses which can increase the households' per capita daily income. These results are, however, contrary to the findings of Muyanga (2008) that despite the confounding interactions between distance to markets and poverty components, the relationships between the two are not statistically significant in the rural areas of Kenya. The current study shows that the nearer a household is to a trading centre, the higher the per capita daily income and thus the lower the poverty.

The model shows that relief food has positive and significant ($p \leq 0.05$) influence on poverty, suggesting that households that depend on relief food are better off than those which do not receive food aid. This may be so because they spare their limited resources to acquire other basic needs other than food. This result is, however, contrary to the finding of Wasonga (2009) that households that rely on relief food are poorer than those that do not rely on food aid. He argued that it is mostly the households with limited food and income that would rely on relief food for their survival. Although ownership of enclosures showed insignificant ($p \leq 0.05$) influence, it was found to be positively related to per capita daily income.

Table 4.17 presents the results of a logistic regression analysis for the sedentary agro-pastoral land use system. In this model the poverty incident was used as a regressand. The model parameter estimates were jointly significantly different from zero as shown by the Chi-square statistic, which was significant at 5%. The significance of individual variables was tested by the Wald statistic. The result presented in Table 4.17 shows that the number of livelihood sources has the highest influence on poverty level and the education level of the household head is the second most influential determinant of poverty level under SAL. The logistic regression can be expressed as:

$$Log\left[\frac{P_i}{1=P_i}\right]=\alpha+\beta_0 EDUC_i+\beta_1 HHS_i+\beta_2 REM_i+\beta_3 TLU_i+\beta_4 LIV_i+\beta_5 DIM_i+\beta_6 AGE_i+\beta_7 RF_i$$

Table 4.17: Factors influencing poverty in SAL: Logit estimation

Model	β	SE	Wald	Exp (β)
Constant	1.537	2.506	.376	4.649
Education of household head	.867	.347	6.253**	2.379
Household size	-.720	.227	10.032**	.487
Remittances	-2.578	1.041	6.133**	.076
Relief food	-1.232	.761	2.618	.292
Herd size of household	.036	.013	7.697**	1.037
Number of livelihood sources	1.076	.312	11.911**	2.933
Distance to nearest market	.116	.044	6.933**	1.122
Age of household head	.530	.656	.652	1.699

Significant at 5%; *Significant at 10%; Chi-square = 85.878; -2log-likelihood = 65.981; N = 125

The results indicate that the level of education attained by a household head, number of livelihood sources, herd size and distance to the nearest market had positive and significant ($p \leq 0.05$) influence on poverty incidence, as represented by poverty index. Household size and remittances had a significant ($p \leq 0.05$) but negative effect on household poverty incidence. These results imply that households that keep more livestock are not likely to be poor. Contrary to OLS model relief food had a negative but insignificant effect on poverty incidence under sedentary agro-pastoral land use system.

Comparing the two regression models used in poverty estimation under SAL, the binary logistic model gives a better estimation as evident in more significant ($p \leq 0.05$) variables than the OLS regression model.

4.3.2 OLS and binary logistic regression models for SNL

The OLS results for the sedentary agro-pastoral land use system are presented in Table 4.18. As shown by the corresponding t-values, six out of the eight explanatory variables, were significant. The adjusted R^2 value indicates that 49.1% of the total variation was explained by the variables. The F-statistic was significant at 5% level and therefore indicating that the variables as a group were significant. The regression results show that up to 50% of the variation in poverty is unexplained. This may be because of the missing of important variables such as policy and health which could not be included due either to unavailability of data or their significant collinearity with other explanatory variables.

Table 4.18: Factors influencing poverty in *SNL*: OLS estimation

Model	β	SE	t
Constant	-29.588	31.122	-.951
Herd size of household	.175	.049	3.570**
Age of household head	5.439	7.511	.724
Distance to pasture	11.415	4.709	2.424**
Household size	-2.713	1.366	-1.986**
Number of livelihood sources	11.689	3.542	3.300**
Enclosures ownership	15.472	7.355	2.103**
Remittances	-6.910	7.467	-.925
Relief food	27.916	9.993	2.794**
Distance to nearest market	-6.829	7.878	-.867

Significant at 5%; *Significant at 10%; $R^2 = 0.553$; Adj. $R^2 = 0.491$; F = 8.942; N = 75

Herd size showed positive and significant ($p \leq 0.05$) influence on the poverty, implying that household with large herds are likely to be richer than those with small herds. Distance to pasture, ownership of enclosures and relief food all showed positive and significant ($p \leq 0.05$) influence on the poverty. Household size had a negative and significant ($p \leq 0.05$) influence on the poverty incidence, implying that larger household were poorer than the smaller ones. This was attributed to higher demand on limited resources in larger family than the smaller ones. Although distance to the nearest market and remittance showed negative influence on poverty, their effect were insignificant ($p \leq 0.05$).

The number of livelihood sources was found to be positively and significantly related to per capita daily income, suggesting that the more the sources of livelihood, the lower the probability of a household being poor. The level of diversification of livelihoods determines a household's level of output, per capita income and ability to cope with the inherent natural shocks. Naturally, households with a variety of income sources are less likely to be poor.

Table 4.19 presents the results of a logistic regression analysis for the semi-nomadic pastoral land use system. In this model, the poverty incidence was used as regressand. The model parameter estimates were jointly significantly different from zero as shown by the Chi-square statistic, which was significant at 5%. The significance of individual variable was tested by the Wald statistic. This model shows that relief food had the most significant

influence on poverty incidence under SNL, followed by access to extension services and remittances.

$$Log\left[\frac{P_1}{1=P_1}\right]=\alpha+\beta_0 WDUC_i+\beta_1 DIM_i+\beta_2 HHS_i+\beta_3 DIP_i+\beta_4 RF_i+\beta_5 ES_i+\beta_6 TLU_i+\beta_7 REM_i$$

Table 4.19: Factors influencing poverty in SNL: Logit estimation

Model	β	SE	Wald	Exp (β)
Constant	-1.197	2.283	.275	.302
Education of household head	.445	.458	.947	1.561
Household size	-.662	.221	9.008**	.516
Distance to nearest market	-2.028	1.000	4.114**	.132
Distance pasture	-.189	.110	2 991	.827
Relief food	2.762	1.064	6.738**	15.839
Extension services	1.393	.892	2.438	4.028
Herd size of household	.033	.012	7.571**	1.033
Remittances	1.301	1.136	1.311	3.674

Significant at 5%; *Significant at 10%; Chi-square = 31.437; -2log-likelihood = 64.04; N = 75

The results indicate positive and significant influence of relief food and household herd size on poverty. Relief food, however, had more influence on the poverty than herd size. Other variables that showed significant ($p \leq 0.05$) influence but had negative impact on poverty were the household size and distance to nearest market. Implying that the nearer a household is to a trading center, the higher the per capita daily income and thus the lower the poverty.

4.3.3 DISCUSSIONS

Table 4.20 presents OLS results for the sedentary agro-pastoral land use system and semi-nomadic pastoral land use system. The OLS regression goodness of fit for sedentary agro-pastoralists is slightly poorer compared to that for the semi-nomadic pastoralists because of fewer variables and relatively less significant variables under SAL model.

The OLS regressions results for SAL and SNL exhibit a few similarities and differences. Similarities are observed in the effect of number of livelihood sources and relief food on poverty. Household size had the same influence on poverty under both land use systems. Similarly, remittances showed negative and insignificant ($p \leq 0.05$) impact on poverty under both systems. Some of the differences observed between the two land-use systems is significant ($p \leq 0.05$) and positive relationship between distance to nearest market, education of household head and access to extension services and poverty under SAL.

The regression results of this study indicate that under both the sedentary agro-pastoral and semi-nomadic land-use systems, the number of alternative sources of livelihood plays a significant role in determining a household's per capita daily income and therefore poverty status. This implies that alternatives to livestock production such as crop cultivation, bee-keeping, charcoal burning, livestock trading among others, are particularly important during dry spells in pastoral areas. Although these alternatives mainly serve as fall-back livelihood activities, most of them are practiced alongside livestock production to augment subsistence from livestock and provide income for purchase of other basic needs.

Table 4.20: Factors influencing poverty under SAL and SNL: OLS estimation

Variables	Sedentary agro-pastoralists		Semi-nomadic pastoralist	
	β	t-value	β	t-value
Education of household head	9.551	1.863*	-	-
Household size	-14.091	-4.419**	-2.713	-1.986**
Distance to nearest market	2.828	4.583**	-6.829	-.867
Relief food	54.983	4.145**	27.916	2.794**
Extension services	207.032	5.982**	-	-
Number of livelihood sources	13.074	2.065**	11.689	3.300**
Enclosures ownership	22.429	1.201	15.472	2.103**
Remittances	-7.947	-.756	-6.910	-.925
Herd size	-	-	.175	3.570**
Age of the household head	-	-	5.439	.724
Distance to pasture	-	-	11.415	2.424**

**Significant at 5%; *Significant at 10%; $R^2 = 0.543$; (0.553); Adj. $R^2 = 0.511$ (0.491);
The values in brackets represent the OLS model for SAL and the others represent the OLS model for SNL.

Under sedentary agro-pastoral land use system, access to extension services is the most important variable that determines poverty. Household that accesses extension services and climate forecast are unlikely to be poor. This is because access to extension services and climate forecast helps households to make right decisions at the right time, thereby reducing risks and losses in crop and livestock production. However, under the semi-nomadic pastoral land use system, herd size is an important variable. A household with small herd size is poor compared with a household with large herd. This is because livestock is the main source of livelihood, and large herds also serve as insurance against losses due to droughts and diseases.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

This study analysed poverty in relation to seasonal climatic variability among pastoral and agro-pastoral communities in a semi-arid area of Kenya. This study was conducted in the larger Baringo District. The study was done in two selected locations Marigat (Marigat District) and Loruk (East Pokot District). Data were collected through formal interviews using a structured questionnaire. Besides analyses poverty and income inequality parameters estimated and comparisons done between wet and dry seasons. Models were used to determine factors that influence poverty.

The results of this study indicate that households under sedentary agro-pastoral land use system have higher access to extension service and education compared to households under the semi-nomadic pastoral land use system. The results also reveal that most of the agro-pastoralists are members of self-help groups, which only few nomadic pastoralists are member of such association. Self-help groups help members to secure livelihoods through collective actions and information.

The poverty analyses reveal a higher poverty level in the study area. The findings indicated that there were differences in poverty incidence, gap and severity between the dry and wet

seasons, the dry season being associated with higher poverty level than the wet season. The income inequality showed the same trend as poverty. Lorenz curves showed big gap between the rich and poor within and between the agro-pastoral and pastoral communities. Poverty level was found to be higher among the semi-nomadic pastoralists than the sedentary agro-pastoralists.

Regression analysis showed several variables that influence poverty in the study area. Under the sedentary agro-pastoral land use system, distance to the nearest centre, dependency on relief food, extension services, number of livelihood sources and number of livelihood sources showed positive and significant ($p \leq 0.05$) influence on poverty as represented by per capita daily income. Household size had a negative and significant ($p \leq 0.05$) influence on the poverty, implying that larger household were poorer than the smaller ones.

Under semi-nomadic pastoral land use system, herd size showed a positive and significant ($p \leq 0.05$) influence on the poverty, suggesting that household with large herds are rich than their counterpart with smaller herds. Distance to pasture, ownership of enclosures and relief food showed positive and significant influence on the poverty. Household size had a negative and significant ($p \leq 0.05$) influence on the poverty incidence.

5.2 CONCLUSIONS

Households in the dry-lands diversify their sources of income to reduce the risk of production failure by spreading the risk across different activities. Livelihood through diversification, they utilize the available resources especially labour for cultivation of crops, charcoal burning and wage employment to increase their incomes, food security and ultimately reduce poverty. The high dependency on relief food under semi-nomadic pastoralists than in sedentary agro-pastoralists is mainly attributed to no or fewer alternative sources of livelihood in the former than the latter. It can be concluded that households with fewer alternative livelihood options are likely to fall into poverty.

The lower household per capita daily income in the dry season than the wet season, is mostly the consequence of over reliance on natural resource based livelihoods that are subject to seasonal climate variability. In this study, the sedentary agro-pastoralists are more involved in off-farm activities, than the semi-nomadic pastoralists. This makes them less prone to transient poverty especially during dry seasons. The off-farm activities are therefore critical in alleviating income and food poverty during the dry season, and it can be one of the successful ways of escaping poverty in the long-run.

The findings of this study show that the livestock is the backbone of the economy in the study area. Under both land use systems livestock plays a major role in providing both food and income to households. It can, therefore, be concluded that households with larger herd

size are richer than those with smaller ones. Suggesting that maintenance of optimum herd sizes could provide pathway out of poverty in the semi-arid areas.

Access to extension services plays a significant role in determining a household per capita daily income under sedentary agro-pastoral land use system. This is because access to extension services and climate information, helps households to make timely and right decisions, and therefore reduces risks of production failures. Under both land use systems there is a positive relation between poverty and household size, implies that larger families are more likely to fall into poverty than the smaller ones.

5.3 RECOMMENDATIONS

The main recommendations derived from the findings and conclusions of this study include the following:

- There is need to promote diversification of household economic activities in the pastoral areas through off farms activities such as bee keeping and crop production. In the long-run, and coupled with education and skills, diversification into formal employment is appropriate. Any efforts that aim at reducing or eradicating poverty in the study area must consider seasonal variability as well as focus on infrastructure improvement to enable households access markets for their produce.
- It is necessary to provide and improve access to extension services and climate information. This will ensure that households make timely decisions and therefore increase their production and income.

- The positive relationship between poverty and large families calls for need to sensitize pastoralists and agro-pastoralists on family planning. Birth control need to be promoted to assist in reducing household sizes and high dependency burden in the long-run. Ultimately, reducing the number of people directly dependent on pastoralism provides a significant way forward.
- There is need for improvement and transformation approaches to the pastoral production system aimed at adapting pastoralism to the prevailing social and ecological conditions. This implies that efforts must be directed towards facilitating their absorption into crop agriculture, rural or urban employment and any other viable alternative livelihoods.

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APPENDIX

Appendix I: Questionnaire to assess the link between seasonal climatic variability and poverty: A case study of pastoral and Agro-pastoral community in the larger Baringo District, Kenya.

1.1 Date of interview: ...../...../... ..... Questionnaire serial number: ...../...../.....
1.2 Name of enumerator: .....
1.3 Name of respondent: ..... Sex: (1) Male (0) Female
1.4 Location:..... Sub-location
.....Village.....
1.5 Livelihood : (1)Sedentary Agro-pastoralist (0) Semi-nomadic pastoralist
1.6 Age: (1) Under 30 years (2) Between 30 – 60 years (3) Over 60 years
1.7 Relationship of respondent to the household head? (1). Self (2). Spouse (3). Son (4). Daughter (5). Employee (6). Relative

2.0 Household head's information

2.1 Sex: (1) Male (0) Female

2.2 Age: (1) Under 30 years (2) Between 30 – 60 years (3) Over 60 years

2.3 Education: (1) None (2) Primary (3) Secondary (4) Post Secondary

2.4 Household Size/Composition No. of male..... No. of female.....

2.5 General information on household members

Member (husband, wife/s child)	Sex	Age	Education level	Occupation

Codes for education: (1) None (2) Primary (3) Secondary (4) Post-secondary

Codes for occupation: (1) Employed (2) Livestock production (3) Crops production (4) Trade business (5) Other (specify)

2.6 How much did you get from the following activities in last wet and dry seasons?

Source of income	Last wet season		Last dry season	
	Rank (1, 2, 3, 4, 5, 6.)	Amount (Ksh.) per season	Rank (1, 2, 3, 4, 5, 6.)	Amount (Ksh.) per season
Livestock				
Crop cultivation				
Bee- keeping				
Charcoal burning				
Trade/ Business				
Formal employment				
Other (specify)				

2.7 Land tenure system: (1) Group ranch (2) Clan/family ownership (3) Titled private land

(5) Squatter (6) Scheme settlement (7) other (specify)..... .....

2.8 Do you have an enclosure (*Shamba*)? (1)Yes (0) No. If yes.

(i) What type of enclosure? (1) Pasture/Grass (2) Crop (3) other (specify)..... .....

(ii) What is the size of your enclosure? . ...Acres.....

2.9 Do you ever migrate?(1) Yes (0) No. If yes: (i) how many times in a year? .....

(ii)What is the main reason behind your migration? .....

3.0 How many animals did you keep in last wet and dry seasons? Please fill the table below:

Species/Class	Total number for last wet season	Total number for last dry season
Cattle		
Calves		
Goats		
Kids		
Sheep		
Lambs		
Camel		
Chicken		
Donkey		

3.1 How many animals did you.....last wet season?

Species	Sold		Bought		Slaughtered	Given out as gift	Received as gift	Lost/ Died
	No.	Per animal price (Ksh.)	No.	Per animal price (Ksh.)				
Cattle								
Goats								
Sheep								
Camel								
Chicken								
Donkey								
Total								

3.2 How many animals have you.....last dry season?

Species	Sold		Bought		Slaughtered	Given out as gift	Received as gift	Lost/ Died
	No.	Per animal price (Ksh.)	No.	Per animal price (Ksh.)				
Cattle								
Goats								
Sheep								
Camel								
Chicken								
Donkey								
Total								

3.3 How much milk did you get from..... During the last wet and dry? Fill the table below:

	Last wet season		Last dry season	
	No. of animals on milk	Liters/day	No. of animals on milk	Liters/day
Cattle				
Goats				
Camel				

3.4 What do you do with the milk? Please fill the table below:

	Liters of milk consumed at home per day	Sold	
		Liters/day	Unit price (Ksh./liter)
Last wet season			
Last dry season			

3.5 If you herd your animals, how far from home do you move on daily basis looking for pasture?

	Distance to pasture (Km)	Distance to water (Km)
Last wet season		
Last dry season		

4.0 Crops

4.1 Do you usually grow crop or grass? (1) Yes (0) No

4.2 If yes: fill the tables below:

During the last wet season

Crops/grasses	Input (Ksh.)	Output/Kg	Home consumption (Kg)	Sale (Kg)	Price/Kg/sac etc

4.3 During the last dry season:

Crops/grasses	Input (Ksh.)	Output/Kg	Home consumption (Kg)	Sale (Kg)	Price/Kg/sac etc

4.4 How much.....did you consume per day? Please fill the table below:

During last wet season				During last dry season	
Food item	Qty (Kg/litre/Ksh. etc.)	Price (Ksh./Kg /litre)	Food item	Qty (Kg/litre/Ksh. etc.)	Price (Ksh./Kg /litre)
Milk			Milk		
Meat			Meat		
Maize & Beans			Maize & Beans		
Ugali			Ugali		
Vegetables			Vegetables		
Ages			Ages		
Tomatoes			Tomatoes		
Oil			Oil		
Rice			Rice		
Banana			Banana		
Potatoes			Potatoes		
Nuts			Nuts		
Watermelon			Watermelon		
Fruits			Fruits		
Honey			Honey		
Wild fruits			Wild fruits		
Others (specify)			Others (specify)		

4.6 How much did you spend on the following items?

Items	Cost (Ksh.) during last season	Cost (Ksh.) during previous season
Food		
Clothing		
Healthcare		
Water		
Security		
Other cost		

4.7 How much did you spend on the following items?

- School fees per year.....
- Electricity per month.....
- Taxes per year..... .....

4.8 Is any member of your family employed elsewhere? (1) Yes (0) No. If yes,

(i) How many are employed? .....

(ii) What is the type of the employment? .....

(iii) Do you receive any remittance from them? (0) yes (1) No. If yes: how much? .....

(iv) If not in cash explain? ....

5.0 Food security:

5.1 Did you have enough food during the last wet season? (1) Yes (0) No

5.2 Did you have enough food during the last dry season? (1) Yes (0) No

5.3 Did you receive any relief aid during the last wet season? (1) Yes (0) No

5.4 Did you receive any relief aid during the last dry season? (1) Yes (0) No

5.5 Did you ever skip a meal during the last dry season because you did not have enough food? (1) Yes (0) No

5.6 Did you ever skip a meal during the last wet season because you did not have enough food? (1) Yes (0) No

5.7 What do you normally do to make sure you have enough food to sustain your family throughout the year?

....

....

....

5.8 Is there any collective action that you and other people take to ensure you would be able to have enough food for your respective households for the year?

Explain.....

....

... .

5.9 Rank all things you do in times of food shortage (Ranking should be done starting from the beginning of the food shortage to when it became the most severe) Check-list in the table below:

Items	Rank (1,2,3,4,5,6,7,8,9,10.)	
	Beginning of food shortage	Peak of food shortage
Buy food on credit		
Food borrowing		
Borrowing cereal		
Reduction of the meal size		
Reduction of the number of meals		
Skipping some of the meals		
Working for the wealthier people		
Ask help from relative & friend		
Request of support from migrants		
Migration		
Sale of goods		
Sale of household assets		
Send children to live with relative		
Others specify.....		

6.0 **Infrastructure**

6.1 Do you have access to following services?

(i) Do you have access to **Health care services** (1) Yes (0) No

(ii) If yes: how far is the nearest health centre in km? .....

(iii) Do you have access to **Education?** (1) Yes (0) No

(iv) If yes: how far is the nearest school in km? .....

(v) Do you have access to **Market**? (1) Yes (0) No

(vi) If yes: how far is the nearest market during the wet season? ..... Km

(vii) If yes, how far is the nearest market during the dry season? .....

7.0 Community network:

7.1 Do you belong to formal community group? (1)Yes (0) No

8.0 Institutional capacity:

8.1 Do you receive information from extension on issues of crops or livestock? (1) Yes (0) No

8.2 Where do you receive information on weather dynamics (1) Traditional sources (2) Radio (3) Television (4) Newspapers (5) Neighbours (6) Others (specify).

8.3 Rank these sources of information in order of reliability? .....

8.4 Do you plan your strategies according to the weather forecast that you receive from these sources? (1) Yes (0) No

8.5 If yes has it been beneficial? .....

8.6 If no why don't you use the information? .....