RISK ASSESSMENT OF THE COPING AND ADAPTATION MECHANISMS FOR PASTORALISTS TO CLIMATE CHANGE AND VARIABILITY: A CASE STUDY OF KONGELAI WARD, WEST POKOT COUNTY, KENYA.

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DECLARATION

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

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DEDICATION

This dissertation is dedicated to my father and best friend, Mr. Bernard de Philip Magal and my mother Alice Magal. You have been a great source of inspiration and your support has made me realize what God intended me to be.

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ABSTRACT

The study was undertaken in Kongelai Ward, West Pokot County, because of its vulnerability to changing and erratic rainfall pattern which has adversely affected pastoralism. The research focused on better understanding of climate change and variability on two climatic factors, rainfall and temperature, in order to provide insights on pastoralists' risk management adaptations at a micro-level. In addition, it investigated the use of Indigenous Knowledge. Pearson chi square test was conducted to test the hypothesis on whether there is an association between climate variability and change, and coping and adaptation strategies utilized by the Pokot community. Both primary and secondary data was used. Household questionnaire survey, focus group discussion and key informants interviews were used to collect primary data at household and community levels. Primary data (through questionnaires) was collected from a sample survey of 98 households taken from 5,596 households this was sampled using multi-stage sampling technique, and information obtained analyzed using inferential and descriptive statistics. Results indicated that, 94% of the farmers still use Indigenous knowledge. Coping strategies include: Sold livestock (90%), relief food (90%), cash/food-for-work (71%), Slaughter of old and weak livestock (58%), wild fruits (33%), bush products, (50%), off-farm employment (30%), and minimization of food for consumption (84%). Diversification of livelihood (92%), Livestock mobility (94%), sending children to school (56%), Strategic livestock feed (35%), Develop water sources (15%),Change in diet consumption (78%),Livestock off-take (25%),Storage of pasture (35%), were identified as some of the most commonly used adaptation strategies. Recommendations include; better planning and target interventions, Awareness creation on environment, alternative income source, support pastoralists adaptation and coping strategies, enhancement of extension services, documentation and dissemination of indigenous knowledge, and enhance pastoralists' resilience to drought and heat stresses.

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ABBREVIATION AND ACRONYMS

ASALs	Arid and Semi-Arid Lands
AU	Africa Union
AWM	Agricultural Water Management
CAHW	Community based animal health workers
CBO	Community Based Organization
CIDP	County Integrated Development Plan
ENSO	El Nin˜o-Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GHG	Greenhouse House Emissions
GoK	Government of Kenya
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-tropical Convergence Zone
KES	Kenya Shilling
MTP	Medium Term Plan
NDMA	National Drought Management Authority
NGOs	Non-Governmental Organizations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WFP	World Food Programme

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Due to multiple stresses and low adaptive capacity, studies have shown that Africa is highly vulnerable to climate change and vulnerability with projected mean warming ranging from 0.2^0C to more than 0.5^0C per decade (Sivakumar *et al*, 2005; Boko et al, 2007), Sivakumar *et al*, (2005) Christensen *et al,* (2007) reported that the warming is anticipated to be much higher in Africa than the rest of the world with its drier sub-tropical regions warming more than its moister tropics.

In relation to rainfall, Sivakumar *et al,* (2005) pointed out substantial change in rainfall in both arid and semi-arid tropics of Africa over the last 60 years resulting in noticeable changes in both frequency and intensity of extreme events eg flooding. Likelihood of increase in annual mean rainfall in East Africa has been indicated in the climate change and variability projections. According to Christensen *et al,* 2007 this seems to differ from Mediterranean and Northern Sahara regions who are likely to experience rainfall decrease while West Africa regions remains uncertain. In addition to the likelihood of the projections in arid and semi-arid lands, recurrent droughts have also resulted in water stress and greatest risk to agriculture. For effective mitigation and adaptation the challenges of climate change and variability needs to be addressed holistically including how indigenous knowledge (IK) can complement climate change monitoring, mitigation and adaptation measures.

According to (IPCC 2001, Hulme *et al,* 2002, Titus *et al,* 2009) the impacts of climate change and variability (CCV) have been documented in different research studies carried out across the entire world with anticipated impacts manifesting itself in the form of; floods, storms, prolonged droughts and increased atmospheric temperature (IPCC 2007).Impacts of the phenomenon will be experienced in economic, social and environment according to (UNDP 2007).

Both natural and anthropogenic factors contribute to climate change and variability. Among the natural causes include Continental drift, mountain building, deviations in the earth's orbit, and variations in solar radiation while anthropogenic factors for instance the increase in carbon dioxide levels as a result of emissions from fossil fuel combustion and aerosols are contributed by human activities that impact on climate. In addition, other concern on the roles they play in

affecting climate, micro-climate and measures of climatic variables include change in land-use, depletion of ozone layer, agriculture and deforestation according to (Fisher *et al,* 2002; IPCC 2007).

There are a total of 268 million pastoralists in Africa who inhabit 43 percent of land mass and account between 10 to 44 percent of the Gross Domestic Product of their countries according to to African Union's policy framework for pastoralism (2010).Pastoralism has enormous potential and is manifested in poverty reduction, economic growth generation, environmental management, sustainable development enhancement, and building climate resilience which is being recognized as a vital role by 2010 African Union's policy framework. Pastoralists are experiencing rapid changes in their environment and welfare despite these positive attributes as a result of increase in a series of subsequent droughts resulting to high mortality of livestock numbers as pasture and water sources disappear. In addition to increased human population and settlement impacting traditional grazing grounds and resulting competition for dwindling water sources, pastoralists often suffer from occasional floods. All these challenges faced by pastoralists are happening under inadequately developed infrastructure characterized by poor market linkages and weak and unprepared institutions making them increased marginalized.

The subject of national and global discussions focusses on the future of pastoralism in climate change and variability forcing the scientific community to generate knowledge and share experiences and best practices offering possibilities for pastoralism and its livelihoods.

Kenya's arid and semi-arid lands (known as 'ASALs') due to their unique capacity and challenges have been neglected and suffered a long history of marginalization by both the colonial and the post-colonial administrators due to these prolonged isolation and underinvestment resulting to the lowest level of human development according to Odhiambo et al,2001.

Uniqueness of pastoral areas from the rest of the country is attributed by the mobility of livestock and people, their demography which is characterised by low population density and high population growth and their institutions which embraces customary mechanisms for the management of natural resources and security and in addition possesses invaluable indigenous knowledge. These unique characteristics are rarely included in the national policy or practice. The Policy on, (Sessional Paper No. 8 of 2012 on the National Policy for the Sustainable Development of Northern Kenya and other Arid Lands)due to its symbolism and content

established an institutional framework to oversee its interpretation and implementation and provided special attention to ASALs within government.

Due to pronounced differences among the pastoralists living in Northern Kenya and other arid lands in terms of culture, ecology, production systems, development status and comparative advantage, the Ministry of State for the development of Northern Kenya and other Arid Lands have put these differences into recognition. Previously isolated regions for instance the North requires accelerated investment for the sake of all Kenyans to have equal opportunity in the sharing of Vision 2030 promise and benefits whereby the kind of investment in North of Kenya and ASALs are spelt out.

The reference to climate change adaptation in the context of capacity building as part of the environment sector under Kenya's vision 2030 according to the (Government of Kenya – GoK, 2009),is however promising in the second Medium Term Plan (MTP 2013-2017) of vision 2030, whereby the Kenya government has given opportunity the management of climate induced disasters through strengthening people's resilience to drought and improving monitoring and response to emerging frequent drought conditions (Republic of Kenya, 2013).

Shifting of climate change and variability from solely highlighting of environmental aspects to underscore the much needed development concern at national, county and community levels should be emphasized in all guiding policy documents with great focus on the vulnerable groups

National Framework Convention on Climate Change (UNFCCC) commitments for carrying out programmes aimed at vulnerability reduction to climate change and variability including episodes of drought is being addressed by County Integrated Development Plans (CIDPs) for most of the ASALs counties including West Pokot.

CIDPs developed by ASALs have been embraced greatly on the impact of climate change and variability on lives and livelihood resources eg water, pasture and livestock resources. There is call for strengthening the County level structures and harmonization of the proposed strategies in order to promote policies that will enhance adaptive and response capacity to climate change in Kenya's ASALs.

According to ASAL Policy 2012, addressing of structural inequalities which is the backbone of household socio-economic vulnerabilities in the ASALs environments is paramount as compared to interventions and polices that only aim to increase access to water resources, early warning

systems, crop irrigation, markets and drought mitigation measures, on their own which are not adequate for enhancing adaptive capacity of the vulnerable communities.

Though the agriculturalists practice a sedentary lifestyle, together with the pastoralists share a common tradition and pursue the environment alike and they all live in various altitudes which ranges between 400m-2400m above sea level. Together, they are commonly referred to as lowlands (plain) and mountainous people respectively. They all reside in different ecological conditions, with the former being purely pastoralists whereas the latter being agro pastoralist yet they speak in the same language.

Pastoralism is a free-range livestock production system whereas in some communities it is a source of livelihoods which is practiced in all of Africa's dryland regions, But will pastoralism continue to exist in the changing climatic episodes?

1.2 STATEMENT OF THE PROBLEM.

According to the (GoK, 2009), 13.2% out of 39 million people of Kenya population is constituted by pastoralism with livestock as an important source of livelihood and food security. Gavin et al, 2004, acknowledges that pastoralists contribute (approximately 70%) of the total marketed livestock and according to (Olukoye *et al,* 2004)these livestock are being herd in ASALs where extreme climatic events have taken place.

According to (Kandji *et al,* 2006) to cope and adapt with these changes brought by extreme climatic events in developing countries particularly Sub-Saharan region as a result of temperature increase, reduced precipitation amounts, minimal adaptive capacity, dependency on natural resources, low adoption of technology making it difficult to detect these occurrences (Kurukulasuriya *et al,*2006 and Mendelsohn *et al,*2006) ,limited infrastructure and low literacy levels, inadequate management capacities, weak institution and information(UNFCCC, 2007) and lack of national adaptation policy which is comprehensive, suitable adaptive mechanism is needed.

According to the IPCC (2007), vulnerability is defined as "the degree to which an environmental or social system is susceptible to or unable to cope with, adverse effects of climate change, including climate variability and extremes" (McCarthy *et al,* 2001).

As a result of increased vulnerability of pastoralists' livelihood in Kenya's ASALs climate change and variability has become a great problem brought about by interaction of ecological,

socio-economic and socio-political which include natural resource degradation, resource base shrinking, unfavourable policy environment, inadequate infrastructure, increased households vulnerable economies and population explosion which are key.

According to 2006 UNDP human development report additional constraints that have been brought as a result of climate change and variability include; overexploitation of land resources, population increase, desertification, and degradation of land.

To strengthening of national wide action towards adapting and mitigation of climatic changes Kenya government developed a National Climate Change Response Strategy in 2010 by involving all key stakeholders considering vulnerability of its natural resources and the society.

The strategy offers an enabling policy, legal and institutional framework with a concerted strategy and resource mobilization plan to reduce and mitigate the impacts associate with climate change and variability with a comprehensive action on resource mobilization strategies for mitigation and reduction of climate change impacts and implementation schedule at the national level. In addition the strategy recommends eight objectives in order to address climate change and variability challenges and utilizing opportunities that may arise which is a positive step in tackling mitigation and adaptation strategies. Nonetheless, policies that tackles climate change adaption with provision of guidelines for integration and inclusive into mainstream into key sectors and institution in both county and national levels is needed.

However, due to climate challenges future certainty, calls into question of the relevancy and assumptions of the past and current strategies under the future conditions (Adger *et al.* 2005). Policy making processes need to be properly designed in order for it to be flexible and capture all uncertainty and future opportunities.

Various laws and policies at national level which is entrenched in various sectorial laws and policies recognize climate change and variability though they have setback of being weak and lacks provision for climate change adaptation and include the Forest Act, the Agricultural Act, the Energy Policy, the Forest Policy and the ASALs Policy (Madzwamuse 2010).

These policies majorly focus on climate change, natural resources and environmental management and lack considering the cross-cutting aspect of climate change in the grassroots context furthermore national policy vacuum leaves county government with inadequate guidance to deal with complex climatically issues in integrated manner accordingly Literature review also

pointed out climate change and variability at the national level to be sketchy and vague in policies.

Climate change adaptation in strengthening capacity under Kenyas' environment sector under vision 2030 is promising (Government of Kenya - GoK 2009). According to the Second Medium Term Plan (MTP 2013-2017) of vision 2030, priority is given by the Kenya government by enhancing people's resilience to drought and improving monitoring and response to series of drought events in climate induced disasters (Republic of Kenya 2013). There is need however, to divert climate change from emphasizing on environmental issues to underscore development at all levels in guiding policy documents with great attention to vulnerable groups. The Pokots pastoralists rely on traditional coping strategies to adapt to the cyclic tendencies brought by the droughts with the aim of minimizing losses associated with drought and facilitating recovery thereafter. Among these strategies include ways of managing natural resources through flexibility and spread of risks including strategies like mobility/migration, communal land ownership, diversification of livestock, separation of herd and splitting, social security systems which are informal, economic alliances with non-pastoralists and diversification of livelihoods.

Currently these strategies are inadequate given the occurrence of frequent droughts, social and economic changes which are rapid and worsening climatic conditions.

According to (Nassef *et al,* 2009; Ericksen *et al,* 2013) new challenges are being brought by increasing frequency of changes in climatic conditions which constraints some of the adaptation mechanisms though pastoralists have been employing indigenous knowledge leading to dependency syndrome to permanent relief interventions and unsustainable social protection schemes by governments and humanitarian agencies as a result of increased vulnerability to their livelihoods.

The reduction in adaptive capacities by pastoralists is associated with climate change and variability who have considerable experience and knowledge in handling these challenges which is expected to increase with frequent climatic changes.

According to (Sherbinin *et al,* 2013) identification of likely climate change impacts and dissemination of the information by researchers, advocacy groups and NGOs in a visual format to communicate issues and interpret in an easier manner than text have been done by maps which depicts climate change "hotspots" .In addition, mainstreaming of impact studies in attempt

to inform adaptation policy have been employed in developing countries, for instance in the development of National Adaptation Programmes of Action (NAPAs).However, Focus on biophysical processes by modelling studies which simulate the impacts of climate change and variability on agricultural productivity have often excluded considerations of adaptation or adaptive capacity which is paramount in determination of future climate change (Cinner *et al*,2013.; Huchery *et al*, 2013.; Darling *et al*,2013; Humphries *et al*, 2013; Graham *et al*,2013.; Hicks *et al*,2013.; Marshall *et al*,2013; McClanahan *et al*,2013), leading to criticism for leading to human-less projections of environmental change according to (Fraser *et al*,2011.; Dougill,*et al*, 2011; Hubacek *et al*,2011.; Quinn *et al*, 2011; Sendzimir *et al*, 2011; Termansen *et al*, 2011).

This research seeks to assess the risk of failure to incorporate adaptation and coping mechanisms used by the Pokot pastoralists to climate change and variability.

1.3 OBJECTIVES

1.3.1 GENERAL OBJECTIVE.

The study aims to assess mechanisms pastoralists use to cope and adapt to climate change and variability.

1.3.2 SPECIFIC OBJECTIVES

i. To document the indigenous knowledge used by the Pokot community to cope with climate change and climate variability.
ii. To determine perception and reliability of the adaptation and the coping mechanisms used by the Pokot community.
iii. To assess the adaptation and coping strategies that pastoralists adopt to mitigate the impacts of climate change and variability.

1.4 RESEARCH QUESTIONS.

1. What kind of indigenous knowledge does the Pokot community in the study area use to cope with climate change and variability?

2. What is the perception and reliability of adaptation and coping mechanisms used by the Pokot community?

3. What kind of adaptation and coping strategies does the Pokot community adopt to mitigate the impacts of climate change and variability?

1.5 HYPOTHESIS

H_o-Pokot pastoralists have not developed strategies of coping with Climate change and variability.

H_1-Alternative

1.6 JUSTIFICATION OF THE STUDY.

Due to increased drought events as in the year 2008 and 2009, and thereafter in 2010 and 2011 calls for need of integrated examination of coping mechanism and model combined as adaptation strategies for long term resilience to drought. According to (Smith *et al*, 2001, and Polifosova *et al*, 2001; Paavola *et al*, 2008; Headey *et al*, 2013, and Ecker *et al*, 2013) violent conflicts have provided compelling justification for effective adaptation mechanisms in the Horn of Africa whereby studies have shown increased vulnerability in the wake of climate change. Therefore this study is justified because of the following reasons;

- Climate change and variability affects crops and livestock production and the impacts are felt more on pastoralists since they occupy the fragile arid and semi-arid lands where occurrence of drought is rampant.
- Ecologically sensitive environment with poor soil quality, poor infrastructure, and weak governance and normally responds drastically to changes in the climate are being depended upon which render the pastoral communities even more susceptible to climate changes (Bante *et al*,2008., and Abagalla *et al*,2008).
- According to (Akegbejo et al, 2009) currently constrained research and extension can be enhanced with low cost solutions with indigenous knowledge.
- IK can be used to highlight other form of knowledge since it is a different form of knowledge in the model it can used to highlight unnoticed aspects in of climate monitoring, which have gone unnoticed, or given inadequate attention in 'western' science.
- Recognition of pastoralists local innovativeness offers an entry point for bottom-up approach for enhancing adaptation and coping mechanisms than only climate change and variability.

- The study was undertaken in Kongelai Ward because of its vulnerability to unpredicted rainfall pattern which has adversely affected pastoralism due to variations in climatic conditions affecting coping and adaptation strategies. The model helps to visualize that a large part of Kongelai Ward receives erratic and unreliable rainfall with most of the areas having high rate of evaporation.
- Thus the model in the case study is important in showing the possibility of Pokot community's' future in relation to adaptation strategy to climate change and variability

1.7 SCOPE AND LIMITS OF THE STUDY

Interaction of different factors including ecological, socio-economic and socio-political factors have led to vulnerability of pastoral livelihoods to impacts of climate change and variability which constrains their livelihoods and ecosystem structure.

This case study is important by analyzing different factors that leads to their vulnerability and their responses in attempt to reduce vulnerability. The study will show new emerging coping and adaptation models and changes in vulnerability. Among the variables that will be addressed in the study include; climate change, indigenous knowledge, adaptation and coping strategies of the Pokot pastoralists. Furthermore, it will also consider some of the implications of the findings, including the cultural consequence.

The research covers West Pokot County in NW Kenya and located in Rift Valley region and boarders Uganda in Western boundary, Turkana County to the North, Trans Nzoia County to the South, Elgeyo Marakwet County in South East and Baringo County to the East. The County lies within Longitudes 34^0 47'and 35^0 49'East and Latitude 1^0 and 2^0 North. The County covers an area of approximately 9,169.4 km^2 stretching a distance of 132 km from North to South.

The county is characterized by a variety of topographic features. On the Northern and North Eastern parts are the dry plains, with an altitude of less than 900 m above sea level. On the Southeastern part are Cherangani Hills with an altitude of 3,370 m above sea level. Landscapes associated with this range of altitude include spectacular escarpments of more than700 m. The high altitude areas have high agricultural potentials while medium altitude areas lie between 1,500 m and 2,100 m above sea level and receive low rainfall in addition to being predominantly pastoral land. The low altitude areas include Alale, Kacheliba, Kongelai, Masol and parts of Sigor. These areas are prone to soil erosion due to flash floods.

The main forests in the county are found in Cherangani Hills. The gazetted forest, which forms part of the Cherangani Hills in Lelan, covers an area of 20,857 ha. The un-gazetted forest covers 15,719 ha and consists of rain forests blocks scattered all over the county. These are natural forests dominated by tree species like cedar (*Juniperous procera*) and bamboo (*Aredinaria alpina*). Plantation forests cover an area of 662 ha of which approximately 34 ha are indigenous and the rest exotic.

The main rivers in the county are Suam, Kerio, Weiwei and Muruny. Cherangani Hills are the main source of Muruny and Weiwei rivers, while Mt Elgon is the main source of river Suam. River Muruny, Kerio and Weiwei drain northwards into Lake Turkana, while other small rivers join and drain into River Nzoia which in turn drains into Lake Victoria. River Suam drains into Turkwel dam that generates hydro-electric power.

The county receives bimodal type of rainfall with long rains fall between April and August while the short rains fall between October and February. Great variation in total rainfall amount received is experienced with lowlands receive 600 mm per annum while the highlands receive 1,600 mm per annum suitable for crops. Variations in temperature is experienced with lowlands experiencing temperatures of up to 30^0 C unfavorable for crops and the highlands experiencing moderate temperatures of 15^0 C which is suitable for crop production.

As mentioned before, more than 60 percent of Pokot County is occupied by arid and semi-arid lowland occupied by Pokot pastoralists, it is indicated in the report, that pastoralists have come under increasing pressure and their traditional coping and adaptation strategies have become insufficient to sustain their mode of livelihoods.

Kongelai Ward was chosen since it falls within the county lowlands where fluctuations in climate are experienced. The region also experiences a lot of structural challenges mainly due to poor infrastructure development that affects access to basic public services and general accessibility. The study will concentrate in Kongelai Ward, West Pokot County which covers an area of 736.4km^2 and consists of four locations and 16 Sub-Locations.

1.8 DEFINATIONS OF KEY CONCEPTS

Adaptive capacity

It is the adjustments that are taken through behaviour, resource and technologies by a potential system in attempt to respond successfully to changes in climatic fluctuations.

Climate variability

Refers to the difference in all spartial and temporal scales of the mean state and other statistics of the climate beyond that of individual weather events.

Climate change

A change in the state of the climate due to natural and anthropogenic causes and stays for an extended period usually a decade or more that can be identified by changes in the mean and/or the variability of its properties.

Climate change adaptation

According to IPCC 2001, adaptation is defined as an adjustment of ecological, social, or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate the adverse impacts of change or take advantage of new opportunities.

Climate change coping

It refers to responses to an experienced impact with a short term vision and according to UNFCCC (2012) it is defines as actions taken to help communities and ecosystems cope with changing climate condition. It is responding to an experienced impact with a shorter term vision.

Food security

According to FAO (2002), food security is defined as a situation when "all people, at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

Household

A household is a unit of production, consumption and socialization feeding from the same family pot according to Piwoz(1985).

Indigenous knowledge (IK)

According to Grenier (1998) and McGregor (2004) traditional knowledge is defined as collective memory that is passed with speech from subsequent generations through songs, tales actions and observations.

Mitigation

Refers to the minimization of potential threats or impacts associated with exposure to risks.

Rangeland

Rangelands are expansive tracks of arid and semi-arid lands that are basically unsuitable for human activities.

Resilience

The ability of a system to recover from shocks.

Risk

A combination of event, its likelihood and its consequences.

Vulnerability

Is the propensity of being adversely affected.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to review literature on pastoralists coping and adaptation mechanisms in modelling studies of climate change and variability in order to understand changing adaptation strategies by the Pokot pastoralists for integration with the domain of climate resilience. Climate change and variability has significant impacts on human and natural systems due to increasing occurrence of uncharacteristic extreme weather events and intensification of both frequency and severity of climate stressors, such as drought (Hulme *et al,* 2001)

2.2 Documentation of Indigenous knowledge to cope with climate change and variability

The terms IK refers to the knowledge that is characterised by being acquired over along term period through observation of environment and are location specific an which is usually transferred oral transmission from subsequent generations according to (Nakashima et al 2002 and Roué *et al,* 2002), traditional ecological knowledge (TEK;) (Berkes *et al,* 1999; Huntington *et al,*2000), local knowledge (LK) and local ecological knowledge (LEK) Olsson *et al,*2001and Folke *et al,* 2001; Gilchrist *et al,* 2005).

Few studies (Speranza *et al,* 2010; Silvestri *et al.* 2012; Osano *et al,* 2013) have endeavored to comprehensively document pastoralists' adaptation and coping strategies to the complexity of drought at a micro-scale. Given the projections for increasing drought impacts in the pastoral areas and in order to reduce risks associated with drought, it is important to inform policy makers on various adaptation and coping responses at local levels.

Contributions made by IK in understanding and interpreting of ecological process and its utilization in environmental social impact assessment is greatly acknowledged though there are few contributons made by IK to climate change research according to (Berkes *et al,* 1999; Huntington *et al,* 2000; Nakashima *et al,* 2002, and Roué *et al,* 2002; Olsson *et al,* 2004). According to (Riedlinger *et al,* 2001 and Berkes et *al,* 2001)though the few existing studies on its contributions to climate change research show that IK and science can complement each other and can also be integrated in modelling and simulation.

Communities where formal education has had insignificant impact in most rural, arid and semi-arid parts of Kenya, oral art remains the most important means of transmitting knowledge and skills from one generation to the next as a way of maintaining societal continuity.

Traditional knowledge – the wisdom, knowledge and practices of indigenous people gained over period through experience and orally passed on from generation to generation – has over the years played a crucial role in solving problems, including problems related to climate change and variability. Other research has shown that pastoralists have an intimate relationship with their environment and a rich knowledge that enables them to both protect and exploit changing rangelands' conditions on which they depend (McGahey *et al*,2007; Notenbaert *et al,* 2012). Identification and adaptation to any changes through observation are first done by Indigenous people that live close to natural resources. Important signals of changes in time and seasons that are well understood in traditional knowledge systems include the appearance of certain birds, mating of certain animals and flowering of certain plants species. According to (Salick *et al*, 2007 and Byg *et al*, 2007), as a buffer against variation change and catastrophe, indigenous people have used biodiversity in the face of plague, if one crop fails, another will survive. Some traditional people grow different crop varieties which have different susceptibility to drought and floods in trying to cope with risk due to excessive or low rainfall, drought and crop failure and supplement these by hunting, fishing and gathering of wild food plants. To ensure that in the face of extreme weather as a safety measure some fields survive to produce harvestable crops, the diversity of crops and food resources is often matched by a similar diversity in location of fields.

Roncoli *et al*, (2002) analyzed farmers' responses to seasonal rainfall forecasts in Burkina Faso and found that most responses are minor modifications to a highly diversified and risk-averse production system rather than drastic changes that seek to maximize yields or profits. Roncoli *et al* (2002) went ahead and noted that it is difficult to identify causal links between forecasts and behavioral outcomes as many factors influence farming decisions. They found that pastoralists make their decisions based on outcomes of rains rather than forecast of rain which meant that they do not use forecasts to support livestock management decisions.

Luseno *et al*, (2003) through the different types of data collected, the different scales of analysis (IK—location-specific and detailed thus micro-level; formal climate change science—regional and global scales thus meso- to macro-level); and the temporal scales at which both forms of knowledge are generated (IK—continuous; modern climate change analysis—monthly, yearly).

Studies show that IK can contribute to fill gaps in formal seasonal forecasts, which are largely at broader spatial and temporal scales (Luseno *et al,* 2003). Suggestion has been made by Luseno *et al,* (2003) which shows that indigenous climate forecasting methods among the pastoralists in East Africa can offer insights to improving the value of modern seasonal forecasts since indigenous forecasting methods are need driven, focus on the locality, on the timing of rains, and can be 'communicated in local languages and typically by "experts" known and trusted by pastoralists'.

Studies show that IK can contribute to fill gaps in formal seasonal forecasts, which are largely at broader spatial and temporal scales (Luseno *et al,* 2003). On the other hand modern forecasts are made at very low spatial resolutions, focus on rainfall amounts rather than on the timing of the rains, which is of greatest importance to the pastoralists because their migration patterns depend on when grass and water are available in different sites, and not on the average availability over a period' (Luseno *et al,* 2003). Riedlinger *et al,* (1999) argues that limit to our understanding of climate change and its impact at local levels may result from concentrating exclusively on what science has to offer yet no generalizations can be made about the spread in the use of IK in climate related issues. The widely employ of extraordinary variety of indigenous forecasting methods by pastoralists in southern Ethiopia and northern Kenya like observing clouds, stars, wind, lightening and the behavior of animals, and had ex ante confidence and ex post perception of forecast accuracy according to (Luseno *et al,* 2003),

In addition, (Ziervogel *et al*, 2004 and Downing et al., 2004) show that local forecasting knowledge seems to be less widely used than in the past. Luseno *et al,* (2003) attributed the high confidence to the wide variety of indigenous forecasting methods that the pastoralists use: the focus on climatic features of interest to the pastoralists like the onset of rains, the small spatial resolution of the indigenous forecasts, their communication in local languages by recognized 'local experts' in the community and the accessibility of the indigenous forecasts compared to the forecasts by the meteorological agencies.

Berkesand *et al,* (2001) show that a viable way to involve the local communities is by linking IK to climate change science. Further, IK can offer different perspectives to academic questions according to (Cruikshank *et al,* 2001),in addition it provide opportunities to science for hypothesis testing on the impacts of climate change, enrich known observations, improve existing data, and contribute new insights to understanding weather at a local scale according to

(Thorpe *et al*, 1994; Riedlinger *et al*, 1999). It is at the local level that people have to adapt to the impacts of climate change and need to have the capacity to do so hence the reason for the IK being of special importance to adaptation (Berkes *et al,*2001, and Jolly *et al,*2001; Newton *et al,*2005).

Irrespective of the quality and precision of the forecasts (IK-based and meteorology-based) studies show that several socioeconomic, political and cultural factors constrain the ability of actors to respond and adapt to forecasts according to (Lemos *et al*, 2002; Roncoli *et al*, 2002; Luseno *et al*, 2003). Actors have a limited range of choices to adapt their strategies due to the high vulnerability of Climate change actors to climate variability, in terms of poverty, and lack of resources.

2.3 To determine perception and reliability of the adaptation and the coping mechanisms used by the Pokot community.

According to (Boko *et al*, 2007; Lobell *et al*, 2011), Africa is particularly vulnerable to climate Change and variability. Continent's high poverty levels, low adaptive capacity, dependence on rain-fed agriculture in addition to limited economic and institutional capacity have been attributed to its vulnerability (Boko *et al*, 2007). Climate change phenomenon has even been described as a new security threat for Africa (Brown *et al*, 2007).Climate change projections show that there is considerable variability and uncertainty. Africa is one of the most vulnerable continents to climate change and variability nevertheless there is a reasonable agreement from a suite of different models.

In Africa, climate change, variability, and associated growing disaster risks present an additional burden to sustainable development by threatening and impeding the attainment of the Millennium Development Goals (AMCEN 2011). Here, escalating temperatures, changing rainfall patterns, rising sea levels, and more frequent weather-related disasters pose risks for health, water supply and sanitation, agriculture, forestry, fisheries, food supply, energy, transport, industry, mining, construction, trade, tourism, environmental protection, and disaster management (The World Bank 2008b). This will in turn undermine any gains made in the fight against poverty, hunger and disease, thereby endangering the lives and livelihoods of billions of people (Ibid.).

According to studies (Hesse and Cotula *et al,*2006; Oesterle *et al*, 2008; Oxfam International 2008; Djoudi *et al,*2011 and Brockhaus *et al*, 2011), in Africa,the most vulnerable to the impacts

of climate change and variability include the dry land ecosystems as well as pastoral communities inhabiting them. Pastoral way of life is dependent on the rearing of animals (cattle, camels, donkeys, sheep and goats),availability of grass and pasture are affected since such areas are characterised by moisture stress, unreliable rainfall and fragile landscapes. An estimated 50 million pastoralists live in sub-Saharan Africa inhabiting arid and semi-arid regions which gives a better understanding of the magnitude of the problem. The livelihoods of pastoral communities are dependent on climate-sensitive resources such as water and pasture according to the literature. Pastoralists in Africa are also vulnerable people who often suffer repeated, multiple and mutually reinforcing shocks that affect their families, their settlements and their livelihoods due to famine, drought, floods, and other climate change-induced disasters. In these pastoral communities, the main actors in agricultural production and water collection are women whose activities are susceptible to risks of climate change and variability. Women are heavily affected by the outcomes of Climate change and variability despite playing key roles in managing the natural environment.

There are also indications that pastoralists are caught in a dilemma. On the one hand, the pressure to cope with and adapt to a multitude of changes has never been as high as today; whereas on the other hand, recent developments have led to reductions in spatial mobility, which have weakened the sustainability and resilience of traditional forms of pastoral production systems (Muller-Mahn *et al,* 2010). Under these conditions, pastoralists are challenged to modify their livelihoods according to the ongoing changes, to search for new alternative strategies, to diversify their livelihoods and at the same time to maintain their adaptive capacities with regard to future changes (Galvin *et al,* 2009). Similarly, Muller-Mahn *et al.* (2010) indicated that in conditions where traditional coping and adaptation strategies have become increasingly insufficient to sustain the local livelihoods, the state obviously played and still plays a crucial role in changing livelihood strategies and the emergence of new development pathways.

Pastoral areas in Africa are primarily located in low rainfall areas, and as a rule of thumb, the lower the average annual rainfall, the higher variability of rainfall and forage availability (see Nicholson *et al,* 1981 for data from West Africa). Countries in the tropics that depend primarily on rain-fed farming and/or on pastoralism are thought to be particularly vulnerable to the effects of climate change. For example, the Intergovernmental Panel on Climate Change (IPCC 2007) predicted that, in some of these countries, agricultural production could decline by as much as

50% by 2020. Similarly, UNEP (2006) has estimated that, by 2025, about 480 million people in Africa could be living in water-stressed areas. However, in a variable environment such as in the pastoral areas of Africa, trends of climate change are hard to detect. In the conference, rainfall data from Somali Region, measured at numerous stations, show a great variability but no upward or downward trend (Catley *et al*, 2011).

Research suggests that food production and related livelihoods will be disproportionately affected by climate change and variability in Sub-Saharan Africa (hereafter, 'SSA') (e.g. Schlenker *et al,* 2010 and Lobell et al., 2010). Climatic projections suggest that prolonged and more intense droughts are likely to cause SSA to become drier (Boko *et al*, 2007; Christensen *et al,* 2007).

The pastoral communities now seem to have become more vulnerable than they used to be (Helland *et al,* 2006).According to Blaikie *et al,* (1994) vulnerability means the characteristics or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of natural hazard, it involves a combination of factors that determine the degree to which someone's life and livelihood are put at risk by a discrete and identifiable event in nature or in society.

Today, climate change and variability and its consequences receive much attention in the public debate. It is thought that weather extremes (drought, floods, storms) will occur more frequently in the future. Rising temperatures will favour agents of tropical diseases, or will speed up their development, and probably also contribute to their spread into new areas (Henson *et al,*2006). Pastoralists in semi-arid areas therefore cannot plan with a fixed stocking rate and a long-term grazing plan. They have to adapt to the highly variable climatic and forage conditions.

Climate change variability has significant impacts on human and natural systems due to increasing occurrence of uncharacteristic extreme weather events and the intensification of both frequency and severity of climate stressors, such as drought (Hulme *et al.* 2001). The manifestations of climate change and variability have the potential to directly and severely impact communities that rely on climate-sensitive production systems like pastoralism (Bryan *et al.* 2013; Nicholson 2014). The increasing frequency of drought events as observed between 2008 and 2009, and thereafter in 2010 to 2011 underscored the need to examine adaptation strategies for long-term resilience to drought.

Studies in the region show that vulnerability to drought, is arguably increasing on the back of climate change and variability, and violent conflicts providing compelling justification for effective adaptation strategies in the Horn of Africa (Smit and Pilifosova 2001; Paavola 2008; Headey and Ecker 2013).

There are predictions that due to accelerated anthropogenic and man-made activities, climate change and variability may increase in the future and that extremes might become more frequent in sub-Saharan Africa (Intergovernmental Panel on Climate Change IPCC 2014). The increased climate change and variability under projected scenarios is expected to augment vulnerability in the tropics, unless key investments are made to improve adaptive capacity of communities. Concern has been raised about viability of pastoralism which is practiced in sensitive environment characterized by high spatial and temporal variability in rainfall, and thus thought to be highly vulnerable to both present and future climate change and variability (Conway *et al.* 2005; Little 2012). However, contrasting past and present adaptation responses of pastoralist communities with those that are likely to be required in the future could give some indication of where the greatest stresses and transformation processes will lie for long-term climate resilience building. Pastoralist populations have always been highly adaptive, a necessary trait given the weather variability that is characteristic of the arid and semi-arid ecosystems in which they inhabit in East Africa (Galvin 2009). Nonetheless, climate change and variability is forcing new levels of transformative adaptations among pastoral communities, and many are significantly affected by the consequences of their coping and adaptations strategies (Tsegaye *et al.* 2013). This raises the question to what extent past and present responses of pastoral communities and their system to climate change and variability and extremes facilitate their long-term adaptation to projected climate scenarios. Other studies have showed that adaptation to climate change and variability is necessary both to reduce current vulnerability to climatic extremes as well as to prepare for future climate variability and change (Adger *et al.* 2005; Notenbaert *et al.* 2013). While some adaptations may be developed specifically to cope with climate change and variability and projected change such as climate-proof infrastructures, adaptations often also involve policy, legal, institutional and financial responses to reduce sensitivity and increase adaptive capacity for resilience (Ford *et al.* 2013).

The likely impacts of climate change will add to these existing stresses and exacerbate the effects of land degradation. Increased temperature levels are expected to cause additional loss of

moisture from soil, reduced and more intense rainfall and higher frequency and severity of extreme climatic events, such as floods and droughts. These factors are already leading to a loss of biological and economic productivity and putting population in dryland at risk of short- and long-term food insecurity. Drought-prone areas are particularly deemed to suffer complex, localized impacts of climate variability/change. Given the social, legislative, market and weather-based sources of vulnerability already prevailing in the region, reduction in agricultural productivity and land area suitable for agriculture, even if slight, would cause large detrimental effects.

It is noted that interventions that restrict the mobility of pastoralists will make them more vulnerable to climate change effects. Hence, ensuring the group or community land and environmental rights, support for local institutions and indigenous knowledge, and conflict resolution mechanisms strengthen the resilience of pastoral systems to climate change related hazards (World Bank 2010).

There are also indications that pastoralists are caught in a dilemma. On the other hand, the pressure to cope with and adapt to a multitude of changes has never been as high as today; whereas on the other hand, recent developments have led to reductions in spatial mobility, which have weakened the sustainability and resilience of traditional forms of pastoral production systems (Muller-Mahn *et al,* 2010). Under these conditions, pastoralists are challenged to modify their livelihoods according to the ongoing changes, to search for new alternative strategies, to diversify their livelihoods and at the same time to maintain their adaptive capacities with regard to future changes (Galvin *et al,* 2009). Similarly, Muller-Mahn *et al,*(2010) indicated that in conditions where traditional coping and adaptation strategies have become increasingly insufficient to sustain the local livelihoods, the state obviously played and still plays a crucial role in changing livelihood strategies and the emergence of new development pathways. The question is whose interests are ultimately decisive for shaping these pathways, and to what extent the pastoralists are able to actively participate in this process.

2.4 To assess the adaptation and coping strategies that pastoralists adopt to mitigate the impacts of climate change and variability.

Adaptation refers to "changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change" (AMCEN 2011, 52). It

basically has to do with the adjustment in natural or human (eco)systems as a means for ameliorating the actual or anticipated adverse effects associated with climate change by moderating harm or exploiting beneficial opportunities (IPCC TAR 2001b). Adaptation to climate change and variability necessitates the adjustment of a system to moderate the impacts of climate change, to take advantage of new opportunities, and to cope with the consequences (IPCC 2001). Adaptation involves the action that people take in response to, or in anticipation of, projected or actual changes in climate to reduce adverse impacts or take advantage of the opportunities posed by climate change (Parry *et al*, 2005). Warming through the twentieth century in Africa has been estimated at between 0.26 and 0.5ºC per decade (Hulme *et al*, 2001; Malhi *et al*, 2004 and Wright *et al*, 2004). This trend is expected to continue and even to increase significantly, with attendant negative effects on livelihoods. According to the Intergovernmental Panel on Climate Change (IPCC, 2007), a medium-high emission scenario would see an increase in annual mean surface air temperatures of between 3º and 4ºC by 2080. This implies difficult times ahead for local people that depend directly on natural resources for their livelihoods and have few assets or technologies to cope with the changes to come.

In terms of climate change, this latter part of the definition is significant since climate change also presents certain opportunities and advantages in Africa, particularly for increased rainfall in certain areas of the continent (parts of the Democratic Republic of the Congo for example). Thus, it reduces communities' vulnerability or increases their resilience to climate shocks. It also enables ecosystems to coexist with the changing climate, thereby enhancing their capacity for providing the ecosystem services critical for human well-being (Parry *et al.* 2005).

Adaptation to climate change includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system (Smith et al11996, Ragland *et al*, 1996 and Pitts *et al*, 1996).

The Bali Action Plan speaks of the need for enhanced action on adaptation, which among other things entails international cooperation to support urgent implementation of adaptation actions especially in support of the most vulnerable; risk management, risk reduction and disaster reduction strategies; economic diversification to build resilience; and broader synergies between multilateral bodies, the public and private sectors and civil society, as a means to support adaptation in a coherent and integrated manner.

Whether people can adapt, and for how long, depends on the resources available. Africa is the region most vulnerable to the negative impacts of climate change and at the same time has low adaptive capacity. But the people, particularly at the local level, are making efforts to adjust to the changes they observe. Despite increasing coping and adaptation initiatives across the globe in general and Africa in particular, the phenomenon of climate change and variability remains one of the major threats to economic growth and development the world over. Whilst it affects people of all colour or races across the world, its impacts are distributed disproportionately as manifested not only among different regions, but also in terms of level of economic development, ecosystems, age and gender (IPCC 2007; UNFCCC 2007; Kraub 2011). As such, More severe consequences and vulnerability to climate shocks are likely to be experienced by certain regions and groups than others. For instance, the impacts of climate change are expected to hit developing countries the hardest (The World Bank 2008b).

Various pastoral communities have been studied for decades on their adaptation strategies to changing environmental conditions (Saitoti 1986; Ellis 1998; Campbell 1999; McCabe 2004; Davies and Bennet 2007; Neely *et al,* 2009; Oba 2014). Literatures show that livelihood of most pastoralists have evolved to some extent under variable climatic conditions in the arid and semi-arid environments (Blench *et al,*2000; Little *et al,* 2003; Notenbaert *et al,* 2007; Thornton and Gerber *et al,*2010; Notenbaert *et al,* 2012).

The African Union (African Union 2010) reports that pastoralism have "evolved over generations as a response to marked rainfall and temperature variability", with immense potential for reducing poverty, generating economic growth, managing the environment and promoting sustainable development. In fact, understanding how pastoral communities adapt to and cope with extreme climatic changes and particularly drought becomes even more important as Pokot pastoralists already faces environmental, political and socio-economic marginalization, violent conflicts over natural resources, and new challenges such as the discovery of oil which is likely to threaten pastoralist resilience to drought (Schilling *et al,* 2012).

In many cases, adaptation activities are local – district, regional or national – issues rather than international (Paavola *et al,* 2005 and Adger *et al,* 2005). Because communities possess different vulnerabilities and adaptive capabilities, they tend to be impacted differently, thereby exhibiting different adaptation needs. As a result, adaptation largely consists of uncoordinated action at household, company and organization levels. But it may also involve collective action at the

local, national, regional and international levels and cross-scale interaction where these levels meet (Paavola et al., 2005 and Adger *et al*, 2005).The vulnerabilities of climate change occur at various scales (Adger *et al*,2005), and hence successful adaptation will depend on actions taken at different levels as outlined by (Paavola et al.,2005 and Adger *et al*, (2005).

At national level, there has been;

Formulation of National Climate Change Response Policy which is geared towards vulnerable sectors, with emphasis on poverty reduction and food security in addition, there has been establishment of National Drought Management Authority (NDMA) which is an integrated drought monitoring and information system, with an early warning system and farmers' coping mechanisms. To support adaptation at community levels policies and institution have been developed which encourage private sector participation thus allowing greater dedication of resources to development of adaptive technologies and innovations. Resources have also been allocated to development of adaptive technologies and innovations which will enhance sustainable economic growth.

At the community level:

There has been an establishment of social institutions and arrangements that has discouraged marginalization of vulnerable population and encouraged collective/participatory decision-making process; In order to reduce vulnerability and risks of the poor people there has also been diversification of income sources and livelihood systems in addition, collective security arrangements such as farmers cooperatives and community based organizations (CBOs) has also been established, provision of knowledge, technology, policy, institutional and financial support e.g credit facilities has also been extended to the vulnerable communities. Also provision of feedback to stakeholders and prioritization of local adaptation measures have also been effected.

One of the important characteristics of an adaptation strategy is that it should reflect the needs and aspirations of the society or community it is meant to benefit. Thus, the most effective mechanisms are flexible and relatively independent of scale. Adaptation efforts must through simulation be coordinated across sectors and between agencies, which is a challenge in practice. Without proper coordination, desperate actions may diminish overall effectiveness (Adger *et al*, 2005).

Many governments and development organizations have begun to develop strategies to adapt to the effects of climate change (UNDP 2003). These include a wide variety of approaches, from 'climate-proofing' infrastructure to developing drought-resistant crops. Some adaptation programs also address underlying factors for vulnerability to climate change, such as poverty and ill health. The UNFCCC 7th *ad hoc* working group on long-term cooperative action estimated that USD 86 billion in new funding will be needed by 2016 to help the world's poor cope with the stresses of climate change (UNFCCC 2009). However, contributions to climate adaptation funding mechanisms have so far been relatively small and flowing slowly. Responsive adaptation strategies should focus on what makes people vulnerable to climate change impacts, or their ability to cope with change without experiencing declines in living standards. Important factors are income level and income inequality, as well as the health and human capacity, including education of a population, in addition to the quality of the natural environment, such as available water and quality of land (Young *et al,* 2008).

Different communities are affected differently by climate change and variability and, depending on their adaptive capacities, have developed coping strategies. This explains the region-to-region, village-to-village and household-to-household variation in coping strategies. However, as Cooper *et al,* (2006), correctly puzzled, "…farmers cope with climate variability, but can they adapt to climate change?"

The answers to that question are as varied as the agro-climatic zones and expected impacts on peoples' livelihoods due to climate change and variability. Depending on subjective assessment of risks and vulnerability, affected smallholder farmers logically make certain adjustments in their choices of technologies and production systems. Cooper *et al,* (2006) grouped such coping strategies in three categories:

• In-season adjustment of crop and resource management options in response to specific climatic shocks as they evolve

Ex-post risk management options that minimize livelihood impacts of adverse climatic shocks"

However, although many communities have adapted to changes induced by recurrent drought, some of those strategies, such as diversification into off-farm activities, may not be applicable to most smallholder farmers in vulnerable rain fed systems. New options and innovations are needed to enhance the resilience of agricultural production and reduce vulnerability to climate change and variability. Cooper *et al,* (2006) noted that research investments to enhance tolerance

for drought stress, improve water productivity and integrate management of land and water resources have the potential to reduce vulnerability to climate shocks while improving productivity.

This study therefore set out to examine risk assessment of the adaptation mechanisms more broadly as long-term measure, and analyze temporary coping responses to climate change and variability among Pokot pastoralists. Knowledge about pastoralists' adaptation and or coping responses to drought stresses will guide possible intervention measures, as well as better inform policy designed to reverse the decline in pastoral production systems and hence ensure continued sustainability of rural livelihoods in arid and semi-arid environments.

2.5 RESEARCH GAPS

According to (Engle *et al,* 2011) numerous scholars recognize the potential linkages between vulnerability and resilience frameworks whereby both vulnerability and resilience can be viewed as being specific to a perturbation, highlighting that a system can be vulnerable to certain disturbances, but not others (Gallopín *et al,* 2006, Holling *et al,* 2008; Gunderson *et al,* 2002). However, focusing on a particular disturbance can lead to "predict and prevent" approaches, which have been criticized for their limited ability to deal with the uncertainty and surprise associated with future climate change (Wardekker, *et al,* 2010).

Adaptive capacity is multidimensional: it is determined by complex inter-relationships between a number of factors at different scales (Vincent *et al,*2007) National indicators of adaptive capacity have been developed, but criticized for failing to capture many contextually relevant factors and processes; thus providing little insight at the level where most adaptations will take place (Vincent *et al,*2007) literature review revealed that a number of climate change and variability impact studies have been conducted on specific sectors such as water resources, agriculture, health, and rangelands by using impact models and to a lesser extent socio-economic analyses (Smit and Wandel *et al,*2006; Eriksen and O'Brien *et al,* 2007; Nassef *et al,* 2009). Global recommendation for Africa calls for an integrated assessment approach for vulnerability study, at a more local scale to account for the influence of local contexts (Intergovernmental Panel on Climate Change IPCC 2014).

From the perspective of pastoral households, an understanding of adaptation and coping mechanisms in a simulation of climate change and variability is needed at the level that would specifically address specific geographic location and to tackle climate challenges with the model precision that is necessary. Insights from previous studies on climate change and variability impacts, coping and adaptation strategies are crucial in appreciating extent of the problem and need to design appropriate mitigation human (pastoralism) strategies at the regional, national and or local levels.

However, much of the scientific knowledge for climate change and variability impacts on pastoralist fail to provide critical insights on the interaction between the climate variable and human factors at the micro or household level. As a result, the current study provides evidence for policy decisions with regards to the influence and use of indigenous knowledge in assessing the coping and adaptation strategies of Pokot pastoralists which will enable them to recover from climate shocks as a pre-requisite for enhancing resilience in the ASALs.

2.6 THEORETICAL FRAMEWORK

2.6.1 Vulnerability and resilience

Fig 2.1 shows a conceptual framework for building households resilience to climate change and variability. Studies from existing frameworks suggest that households' vulnerability to climate variability and change depends on the availability of resources, household characteristics, existing political institutions and social networks as well as environmental context (Brooks *et al.* 2005; Ifejika *et al.* 2014). The integrated framework focused on adaptive capacity of households which consists of access to assets, transformative structures and processes as well as diverse adaptation strategies (Frankenberger *et al.* 2012). However, in the face of climatic disturbances such as drought events, the vulnerability framework is more relevant because they integrate the livelihood framework with components on risk management and climate change adaptation (Fraser *et al.* 2011).To address the numerous threats pastoral livelihoods systems face as a result of climate change and variability, integration of risk based approaches is therefore neccesary.
According to Intergovernmental Panel on Climate Change - IPCC (2012) vulnerability to climate change is defined as "the degree, to which a system is susceptible to, or unable to cope with

adverse effects of climate change, including climate variability and extremes". Vulnerability is therefore a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and adaptive capacity. Emphasis on understanding the adaptive capacity of households and communities to respond to disturbances such as drought, floods, disease outbreaks and conflicts, and how such disturbances impacts on households' exposure to risks which results either in increased vulnerability or increased resilience over time is emphasized by vulnerability framework (Tschakert and Dietrich 2010). The framework comprises the interaction between exposure, sensitivity and capacity to adapt.

Exposure in the context of vulnerability is a function of magnitude, frequency, duration and spatial extent of shocks and stress (IPCC 2014). Shocks can be one-off extreme events of short duration (no more than a few minutes, hours or days), such as disease outbreaks. On the other hand, stress is a long-term trend that undermines the potential of a given system and increases the vulnerability of actor within it to adverse effect e.g. droughts. The already vulnerable households can be made even more vulnerable by increasing their risks of exposure to future hazards resulting from their inability to cope with seasonal shocks or stresses. The inability to cope with seasonal shocks or stresses can make already vulnerable households even more vulnerable by increasing their risk of exposure to future hazards (O'Brien *et al.* 2004). Adaptive capacity is discussed as the ability of a system to evolve in order to accommodate hazards which encompasses ability for households to plan, prepare for hazards, facilitate and implement adaptation measures (Cutter *et al.* 2003; Galloping 2006). .

Adaptive capacity of individuals revolve around household characteristics, social networks and political institutions, bio-physical and environmental factors according to this study. The build-up or erosion of the elements of resilience that determine the ability of a household to absorb stresses, and maintain essentially the same structure, function and feedbacks is influenced by vulnerability (Adger 2006). As such, vulnerability is a function of macro (economic, institutional and environmental setting) and micro (access to resources, adaptation and coping strategies) factors at household level. A useful conceptual framework for vulnerability should not only describe the current state of the system under analysis (households), but should also capture a complex dynamics and sensitivity which is the degree to which a system is modified or affected by perturbations (Galloping 2006).

The pathways to resilience and vulnerability are viewed as processes rather than static states of a system. Households or communities' that are able to reduce their vulnerability and use their adaptive capacity to manage the shocks or stresses they are exposed to are less sensitive and are on a resilience pathway. In contrast, households that are likely to go down a vulnerability pathway are not able to use their adaptive capacity to manage shocks or stresses and are sensitive to shocks and stresses. The needs and objectives that households are trying to realize depends on livelihood outcome. Resilient communities and households are able to meet their food security needs, have access to adequate nutrition, well protected environment and income security, health security, and are able to participate in the decisions that affect their lives (Frankenberger 2012*)*.

Vulnerable households experience deficits, or a high risk of deficits in each of these aspects. This study is framed to enhance understanding of the risk assessment of the coping and adaptation mechanisms of the pastoralists to climate variability and change among the Pokot community based on the vulnerability and resilience conceptual framework.

Using this theoretical framework, this study contributes in deepening understanding and identification of climate induced processes that interact in an arid environment to impact on pastoralist livelihood system. It also contribute to scientific understanding of the specific response adaptation and coping strategies that pastoralists are practicing to cope with climate-induced disturbances for more effective targeting of policies and resilience programs. From the perspective of pastoral households, an understanding of risk assessment of the coping and adaptation mechanisms to climate variability and change is needed at the level that would specifically address specific geographic location and to tackle climate challenges with the precision that is necessary.

2.7 THE CONCEPTUAL FRAMEWORK

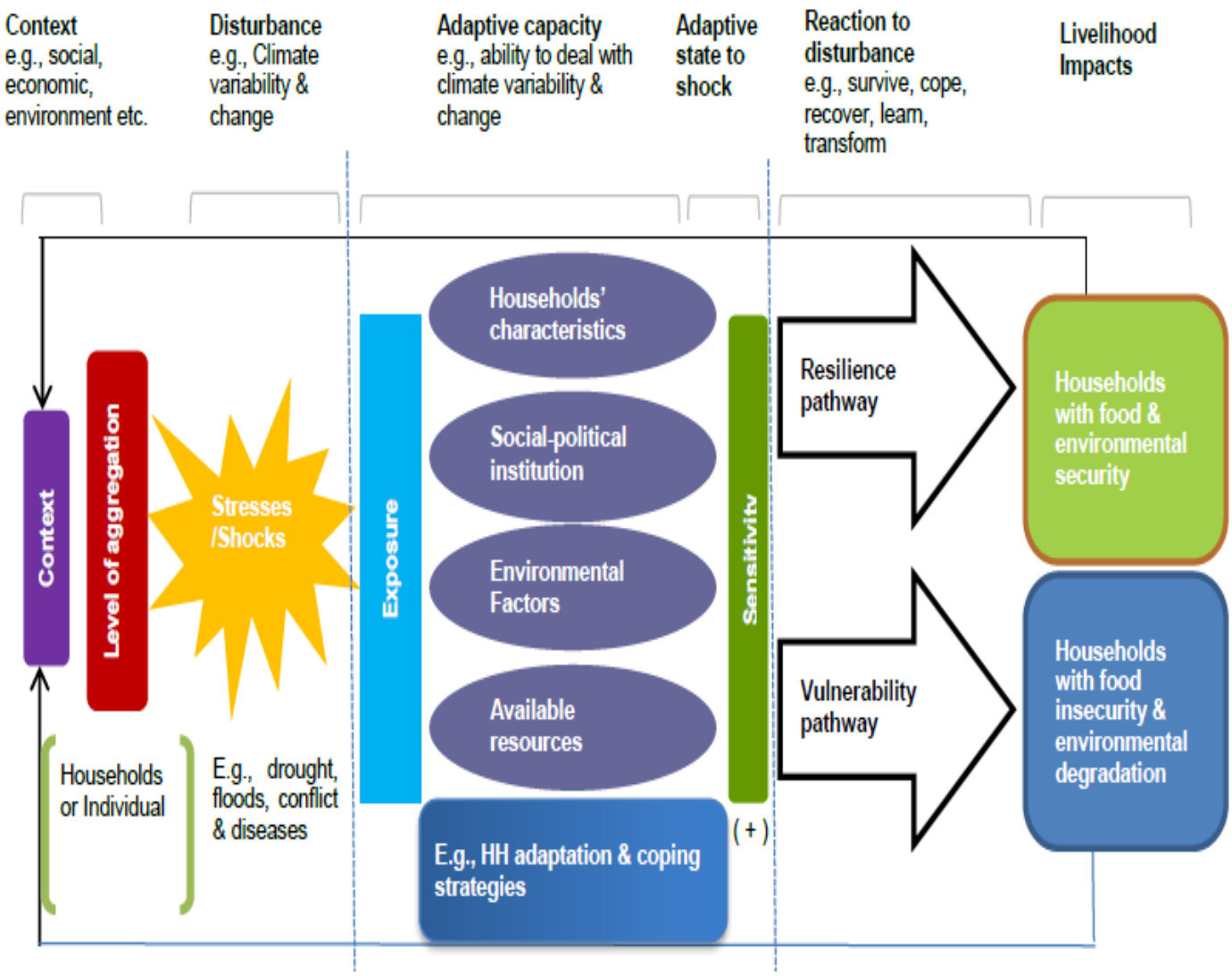


Fig 2.1 Conceptual framework for building households resilience to climate variability and change (Adapted from Disaster Resilience Framework in Frankenberger *et al.* 2012)

CHAPTER THREE

THE STUDY AREA.

3.1 INTRODUCTION

This section deals with a detailed explanation of the study area in terms of population characteristics, climate, geology and soil, Fauna and flora, and infrastructure.

3.2 THE STUDY AREA AND CHARACTERISTICS OF THE POPULATION

West Pokot County is one of the 14 Counties in the Rift Valley region. It is situated in the North Rift along Kenya's Western boundary with Uganda. It borders Turkana County to the North and North-East, Trans-Nzoia County to the South, Elgeyo Marakwet County and Baringo County to the South East and East respectively and also on Western side it shares an international boundary with Uganda. The County lies within Longitudes 34^0 47'and 35^0 49'East and Latitude 1^0 and 2^0 North. It covers a surface area of 9,169.4 square kilometers and has a population of 512,690 with a population density of 59.33 per square kilometre (KNBS, 2009).It has three main livelihood zones namely Pastoral-All species, Agro Pastoral and Mixed farming segregated in various proportions as shown in figure one below.

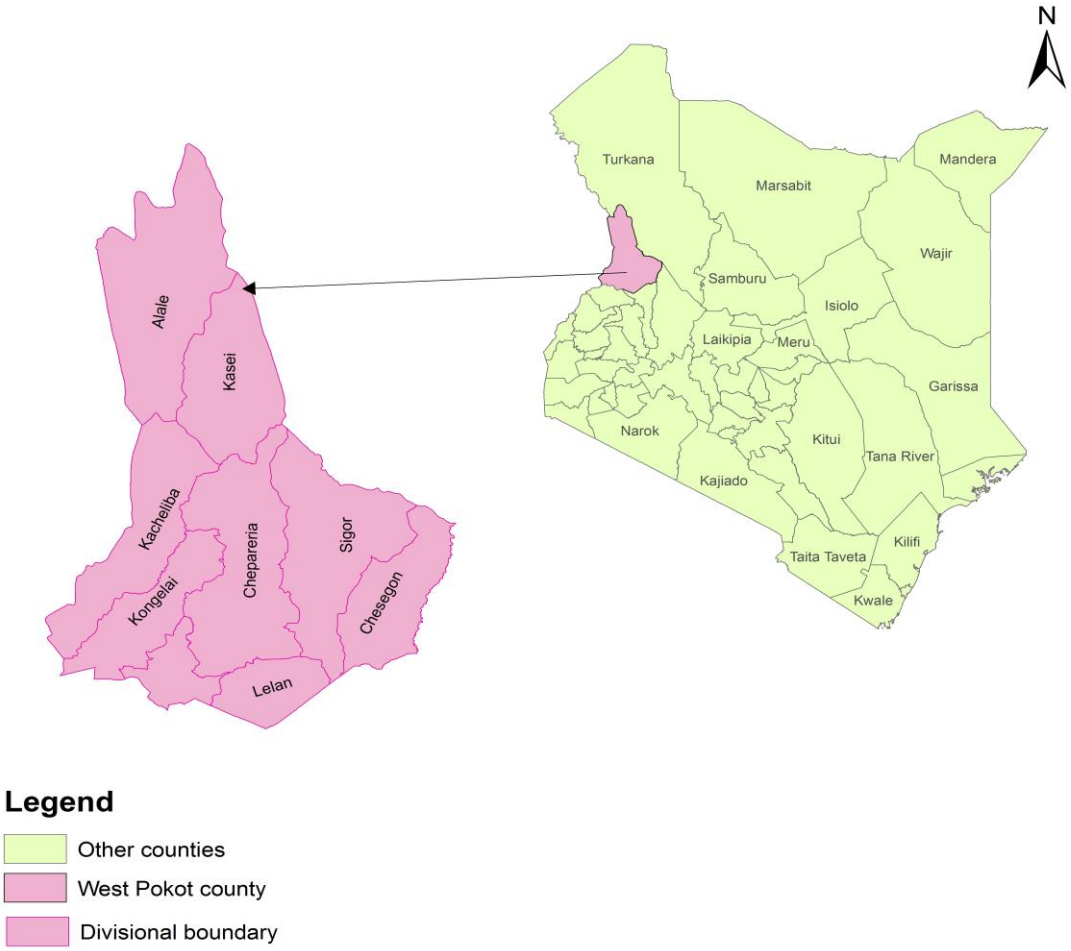
Rainfall varies from 400 mm (lowlands) to 1,500 mm (highlands) per annum. Temperature ranges from a minimum of 10 °C to a maximum of 30 °C in different parts of the county. The county depends more on the Long Rains than the Short Rains for crop, regeneration of pasture and browse and recharge of water sources. The district experiences a bimodal type of rainfall with the Long Rains falling between March and June while the Short Rains fall between September and November.

The high altitude areas of the County constitute the Sekerr hills, Cherengany range and Chemoringit hills rising up to the height of more than 3000 meters above sea level. The lowlands constitute of the Masol plains and Kacheliba and Kongelai lowlands recording a height of 1500 meters above sea level.

Agriculture and livestock constitutes the major activities of the County, since there is no major industrial or mining activity. While Barton *et al,* (1921) comments that the agricultural Pokot tribe may be said to present the original physical type and speak the purer dialect, they are generally regarded by all Pokot as the repositories of tribal tradition. The agricultural Pokot tribe

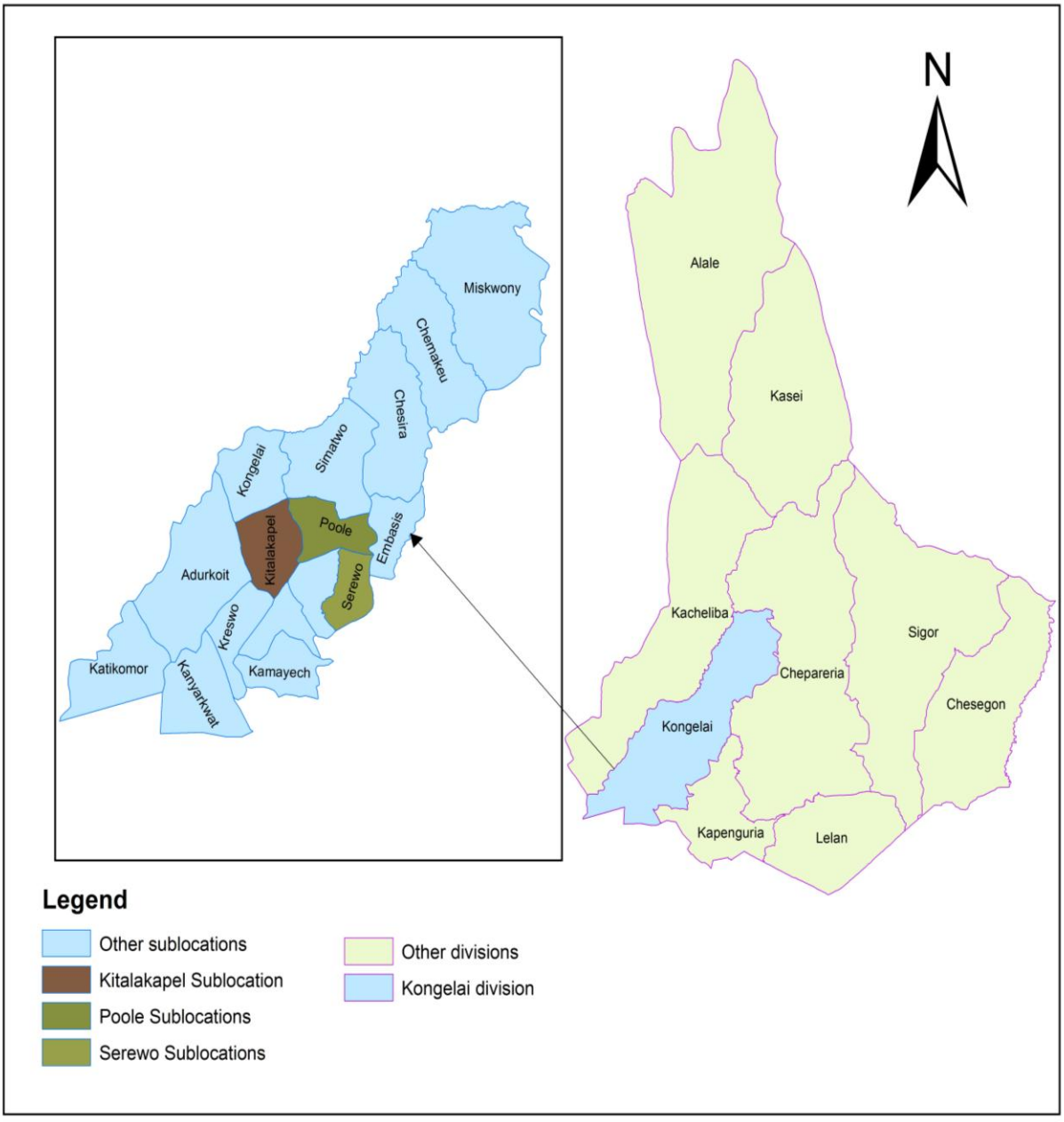
is known as “Pi-pa pagh” the people of the flour and inhabit the escarpment and the foothills. The pastoral Pokot is known as the ‘Pi-po-tich” the people of the cattle and infringe upon the grazing of the Turkana and Karamojong.

Fig 3.1: Map of Study area, West Pokot County



Source: Kenya National Bureau of Statistics,2013

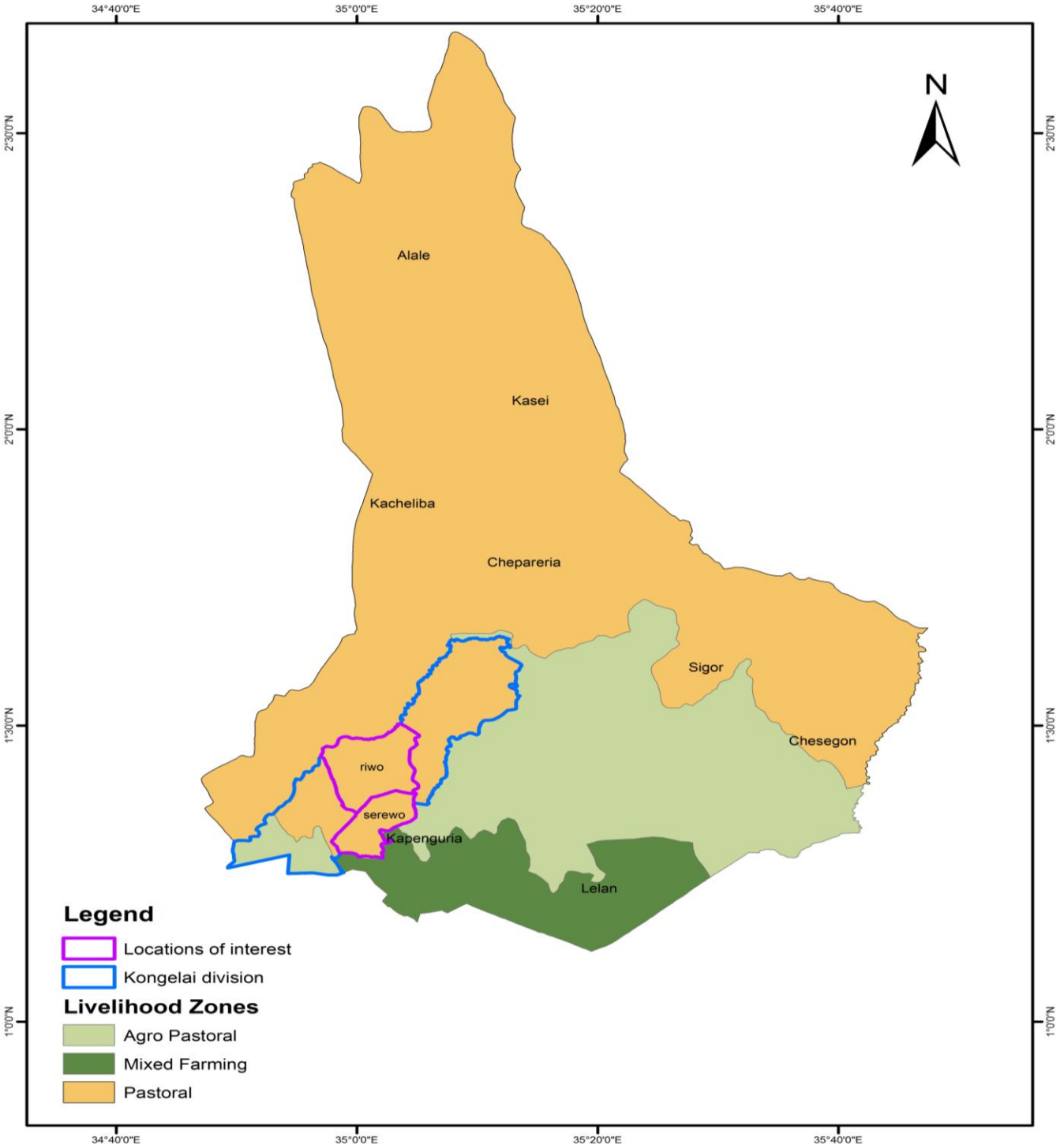
Fig 3.2.Map of Kongelai Ward showing Sub-Location.



Source: West Pokot County Commissioner's office, 2013.

The research covered the Pokot ethnic group specifically living in North Western part of Kenya in West Pokot County. The study concentrated in Kongelai Ward, West Pokot County. Kongelai Ward covers an area of 736.4km^2 and consists of 4 Locations and 16 Sub-Locations.

Fig 3.3 Map showing West Pokot County Livelihood Zones.



Source: West Pokot County Commissioner's office, 2013.

3.2.1 Physiographic Characteristics

The county is characterized by a variety of topographic features. On the North and North Eastern parts are the dry plains, with an altitude of less than 900 m above sea level. On the South-Eastern part are Cherangani Hills with an altitude of 3,370 m above sea level. Landscapes associated with this range of altitude include spectacular escarpments of more than700 m. The high altitude areas have high agricultural potentials while medium altitude areas lies between 1,500 m and 2,100 m above sea level and receive low rainfall in addition to being predominantly pastoral land. The low altitude areas include Alale, Kacheliba, Kongelai, Masol and parts of Sigor. These areas are prone to soil erosion due to flash floods.

3.2.2 Climate

The county has a bimodal type of rainfall. The long rains fall between April and August while the short rains fall between October and February. There is, however, great variation in the total amount and distribution of the rainfall received in the county. The lowlands receive 600 mm per annum while the highlands receive 1,600 mm per Annum. Low rainfall amount received in the lowland cannot support arable farming, the arid and semi-arid Lands are used as pastoral and ranch-based livestock systems. The County also experience great variations in temperature with the lowlands experiencing temperatures of up to 30^0 C and the highlands experiencing moderate temperatures of 15^0 C. These high temperatures in the lowlands cause high evapo-transpiration which is un-favourable for crop production. The high altitude areas with moderate temperatures experience high rainfall and low evapo-transpiration hence suitable for crop production.

3.2.3. Geology and Soils

The geology of the study area comprises of a shallow basement zone where only localized aquifer occur in the weathered pockets of the bedrock or in the fractured zones which are potential for ground water discharge. The Basement System rock comprising various gneisses, schists, qurtzites and crystalline limestone which are found in the study area. These rocks give rise to a variety of soils such as Ferralsols, Luvisols, Arenosols, Regosols, Leptosols, Lixisols, Cambisols and Vertisols in low-lying areas. The Luvisols have a tendency to form a surface capping and hence are susceptible to soil erosion and high water run-off. The Cambisols and leptosols are shallow to moderately deep and their main limitation for crops and vegetation

growth is shallow depth and low water holding capacity. Ferralsols are deeply weathered and are chemically poor, hence requires high input levels to improve their soil fertility for crop production. (Soil Map of the World – FAO, 1990).Land degradation causes a decline in the productive capacity of the land, thus potential yields reduce, which has a great impact on the community's livelihood in the study area. The inhabitants practicing arable farming have to use additional inputs such as fertilizers or change the variety of crops they cultivate to maintain yields. The land degradation issue as a result of overgrazing also causes problem due to insufficient pastures for the livestock.

3.2.4 Fauna and flora

The study area was originally covered by tracts of scrub land inhabited by wildlife of different species but due to adverse human activities such as felling of trees for fuel wood, construction, cultivation and more so game hunting, wildlife population had diminished to a negligible scale. However, there are small organisms that depend on low vegetation (grass), rodents and some bird's species and small animals. The main vegetation type in the county is determined by altitude, soil type and rainfall received in the different parts of the County. However, anthropogenic and animal causes have modified the status significantly. Overgrazing, charcoal burning, extraction of fuel wood, forest fires and quarrying activities are some of the leading causes of this trend.

For grazers there is need to move over large areas in order to have enough grass for the animals while subdivision of land continue to restrict grazing capacity considerably. Browsers have more potential particularly in the Southern part of the study area.

Presence of invader species to vegetation has been noticed in the study area these species not only colonises the vegetation but also reduce the grazing potential available to the livestock and wildlife. The main vegetation types in the county, comprises wooded grassland, open grassland, wooded bush land, bushed grassland and forest. Woody species include; Acacia tortilis, Acacia xanthopholea, Acacia mellifera, Commifora schemperi, Balnites aegyptiaca, Balanites gabra, and Salvadora persica. Grasses include; Pennisetum mezianum, Pennisetum stramineum, Chroris roxburghiana and sporobulus angustifolia, Chloris guyana and Cenchrus ciliaris.

3.2.5 Population and settlement

The County is inhabited primarily by the Pokots and has a population of 396,000 people with a density of 37 persons per square kilometer. Kapenguria Division has the highest population density with about 210 persons per square kilometer while Kasei Division has the lowest density at 10 persons per square kilometer. Kapenguria has a population of 399,964 as per the 2009 Census and was projected to be 512,690 by 2010 with an urban population of 12,984.

Table 3.2: Population density per sub-county

Sub- County/Constituency	Area in Sq. KM	Pop. 2009	Density (persons/Sq Km)	Pop. 2013	Density (persons/Sq Km)	Pop. 2015	Density (persons/Sq Km)	Pop. 2017	Density (persons /Sq Km)
		Total		Total		Total		Total	
North Pokot/Kacheliba	3,953.2	156,011	39	192,083	49	213,135	54	236,495	60
Pokot Central/Sigor	2109.7	85,079	40	104,750	50	116,231	55	128,970	61
Pokot South	1284.0	132,100	103	162,643	127	180,469	141	200,249	156
West Pokot/Kapenguria	1822.5	139,500	77	171,754	94	190,579	105	211,466	116
TOTAL	**9,169.4**	**512,690**	**56**	**631,231**	**69**	**700,414**	**76**	**777,180**	**85**

Source: West Pokot County Planning Unit (2013), Kapenguria

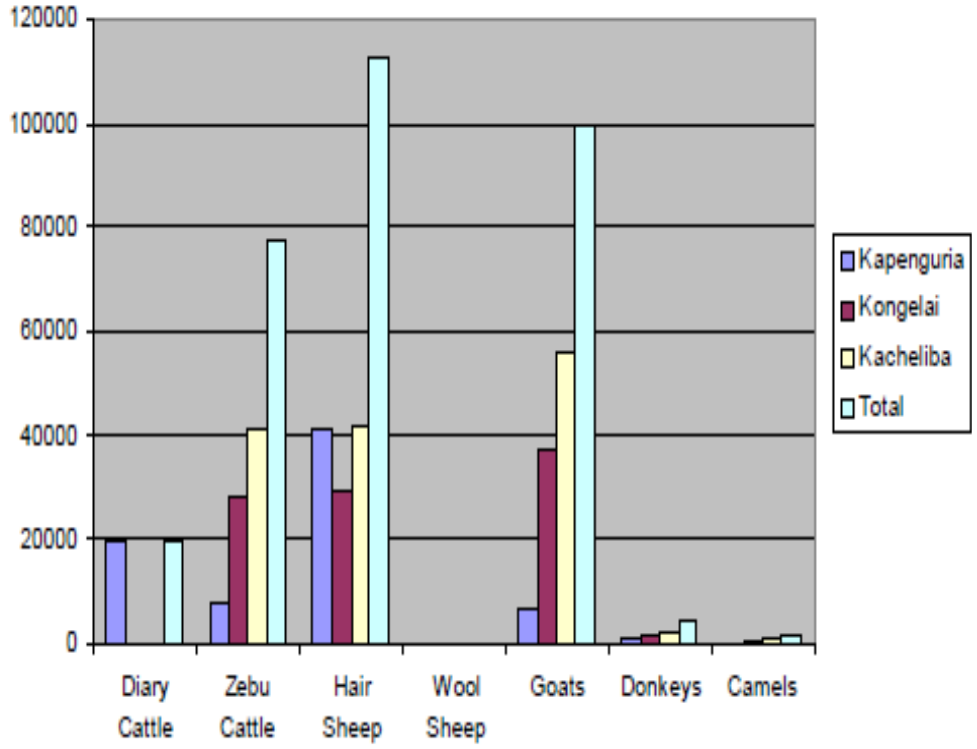
3.2.6 Income Generating Activities

The traditional zebu is the main breed in Pokot Central and North Sub-Counties for meat production while West Pokot and Pokot South Sub-Counties keep improved dairy cows such as Ayrshire and Friesian. There are 686,375 indigenous Zebu cattle, 460,327 sheep, 551,596 goats, 30,617 camels, 36,473 donkeys and 397 pigs. The annual production of beef stands at 3.6 million kg valued at Ksh.653 million while annual milk production is 4.7 million litres valued at Ksh.134 million. The livestock subsector has huge potential for generating household income and revenue for the county.

There are few farm forests in the county with woodlots for commercial purposes. The Kerio Valley Development Authority (KVDA) has set up fruit seedling demonstration plots at Kongelai to encourage farmers to engage in farm forestry as a source of income. There exists a huge market for forests products such as poles, timber and wood fuel which can be tapped. Several community based organizations are also engaged in woodlot establishment as an income generating activity.

3.2.6.1 Herd composition and size

Figure 3.4 shows the livestock Population distribution in West Pokot County, 2013



Source: Livestock development Office, West Pokot County, Kapenguria

Rearing of mixed-species herds is a coping and risk management strategy employed by pastoral households in Pokot community to optimize the use of heterogeneous ecosystem and meet different socio-economic obligations. Livestock species have different uses, feeding preferences, levels of physiological and behavioral adaptation, and tolerance to environmental stressors. Therefore, keeping a herd of mixed species is necessary for exploitation of the different ecological niches and the animals' complementary adaptabilities, as well as for meeting social and economic needs during drought conditions. Pokot pastoralist's stock their herd with a mixture of cattle, camels, donkey, goats, and sheep. The high population of sheep and goats (shoats) is partly attributed to their drought tolerance and socio-cultural roles. In addition, shoats can be readily sold for cash to meet basic needs of pastoral households.

3.2.7 Infrastructure

3.2.7.1 Communication network

The study area is well served with proper communication network. This has strong implications on the socio-economic development activities. The county has electricity coverage of about 2 per cent. The study area has electricity within its major centers currently; Kenya Power is in the process of extending the supply lines to connect more centers and institutions. On communication, the four mobile Service providers (Airtel, Yu, Orange and Safaricom) provide good service to the area.

3.2.7.2 Roads

The road network within the study area are generally poor with most of them being predominantly earth and gravel surface and inaccessible during the rainy season. The road serving Kongelai to Kacheliba though murramed is in good condition and accessible. A rugged and hilly terrain within the county poses another challenge in road connectivity. However, with the support from CDF and KERRA more access roads have been opened to connect the high potential rural areas to the market centres. The county has no rail network, ports and airports. The airstrips are completely inactive.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This section deals with a detailed explanation of how the research project was carried out to answer the specific questions. It includes proposed study sites, sources of data and reasons for their selection; types of data that was collected; sampling methods used; techniques of data collection and analysis.

Similarly, by using different methods of qualitative research helped me to corroborate one source and method with another, and enhance the data quality, in the form of triangulation.

4.2 STUDY DESIGN

Since the emphasis of this study was to carry out assessment of the coping and adaptation mechanisms of pastoralists to climate change and variability within a specific locality, a case study design was used. Case study design is important in gathering data through careful observation of community actions and situations and exploring individuals' attitudes, preferences and behaviour. In case study research, exploratory questions, 'what' and 'how' are important in harnessing detailed and valuable insights and understanding of the topic which cannot be achieved by a survey (Bryman,2008).The case study design was both quantitative and qualitative.

4.3 SAMPLE SIZE AND SAMPLING PROCEDURE.

Out of the 5,596 Households as a target population (KNBS,2009 Census) a sample of 98 households was randomly used in the selected villages in the study area after general observations which was made through the transect survey (East-West, North- South) prior to the start of the field survey.

The Nasuirma model determined by:

$n= \{NC_V^2\} / \{C_v^2 + (N-1)\, e^2\}$

Where;

N = Is the target Population

C_v = Is the coefficient of variation

e= Is tolerance at desired level of confidence

For this study:

$C_v = 0.5$

$e = 0.05$

Therefore: $n= n= \{NC_V^2\} / \{C_v^2 + (N-1)\, e^2\}$

$$n=5,596\ (0.5)^2/0.5^2 + (5,596-1)0.05^2$$

$$n=1399/114.2375$$

$$n=98.261$$

The sample size therefore will be (n) 98

A multi-stage random sampling procedure was adopted in order to select participating villages and households for interviews. Kongelai Ward was purposively sampled based on geographical location, dominant livelihood activity and vulnerability to drought events. Afterward the Locations within the Kongelai Ward was listed and categorized on the basis of the various livelihood zones- land-use systems activities, accessibility and the extent to which they will be perceived to be prone to extreme climatic events. This was then followed by random selection of three study Sub- locations from Serewo, Kitalakapel and Poole. After random selection of the study Sub-locations, the total number of households was obtained from the Kenya National Bureau of Statistics records for the area. The questionnaires were distributed to the three Sub-Locations based on the total population (Kitalakapel 43, Serewo 28, and Poole 27). After getting

the households from the respective Sub-locations, the respondents (head of households) were selected randomly to participate in the research. Role (2010) indicates that this method involves the random selection of groups that exist. In this method, every head of household has a chance of being selected to participate in the research.

Table 4.0: Sample distribution in each Sub-Location

SUB-LOCATION	**NO. OF HOUSEHOLDS**	**SAMPLED HOUSEHOLDS**
Kitalakapel	309	43
Serewo	204	28
Poole	197	27
TOTAL 6,606		**SAMPLE TOTAL = 98**

SOURCE: RESEARCHER 2016.

4.4 DATA SOURCES

4.4.1 Primary data

Before the actual research, a pilot study was carried out from a randomly selected respondent. Mugenda & Mugenda (2003) states that a pilot study is aimed at assessing the validity and reliability of the instruments so that items that fail to meet the validity and reliability of the instruments anticipated data was discarded or modified. The researcher personally performed the pilot study for the instrument and the same procedure was followed during data collection.

a) Household surveys

There are different techniques/methods of qualitative data collection during fieldwork. Interviewing is one of the methods, and it is defined by Cloke *et al,* (2004) as "conversation with purpose", and although the conversations varies across a range of structured, semi-structured, and structured formats, their purpose is to give an authentic insight into people's experiences. Interviews were conducted face-to-face with the household heads (either male or female heads) in their homes or with an adult that was at home in the absence of the household heads.

A formal survey was conducted using a standard questionnaire. Questionnaires was administered to the household heads and was designed to capture information on family characteristics (educational, marital status, family size, age, gender) as well as other parameters such as indigenous knowledge, local perception about climate change and variability, their coping and adaptation strategies, unreliable rainfall onset and seasonal distribution. Samples of 98 respondents were interviewed. The questionnaires constituted both structured and unstructured questions. The purpose for the structured questions was to get information that facilitated data analysis and classification in a specific way. On the other hand un-structured question was to seek an in-depth response. According to Mugenda and Mugenda *et al,* (2003) questionnaire ensures uniformity, economy and time saving.

b) Key informants

Key informants are individuals with whom the researcher begins in data collection because they are well informed, are accessible, and can provide leads about other information (Creswell *et al,*2007).In a similar way Kumar *et al,*(1989) writes that "key informant interviews involve interviewing a selected group of individuals who are likely to provide needed information, ideas, and insights on a particular subject", with two characteristics: only a small number of informants are interviewed and key informant interviews are essentially qualitative interviews. Key informants included Village elders and personnel from government, Community Based Organizations (CBOs) and non-governmental organizations (NGOs). They also included extension workers, local administrators, decision-makers and leaders of relevant NGOs.

Key informant interviews are appropriate for generating information and ideas in situations when general descriptive information is needed, and when understanding of the underlying motivations and attitudes of a target population is required. It is argued that key informant interviews can help determine not only what people do but why they do it. Such interviews are excellent for documenting people's reasons for their behavior and people's understandings or misunderstanding of issues (Kumar *et al*, 1989) because information comes directly from knowledgeable people, key informant interviews often provide data and insight that cannot be obtained with other methods. The interview focused on climate pattern, Pastoralists, impact of climate variability and change, indigenous knowledge and coping and adaptation strategies.

c) Focus group discussion

Focus group discussions with community leaders, elders and experienced pastoralists was carried out using guide checklist questions so as to explore local knowledge practices in climate adaptation and coping strategies. A total of three focus group discussions were carried out in Kongelai, Kitalakapel and Serewo Sub-Locations.

Focus group discussion was used to complement the information obtained from the key informant interviews. Focus group participants were selected based on their role in the community, their acceptance with community and their knowledge of the culture and social organization of the community. Information about the participants was acquired from different angles. For instance, while conducting key informant interviews, informants were asked to tell me any other individual whom they think is capable of explaining and has a vast knowledge on the issue at hand. This technique may be similar to what Hay *et al*, (2010) calls snowball sampling, which is a sampling technique used to identify cases of interests reported by people who know other people involved in similar cases. In addition local administrators nominated capable individuals that were interviewed. In focus group discussion, individuals who were key informants were not included. This helped to avoid the redundancy of information from the same individuals and to find new information from new participants. Focus group discussions were conducted with groups of seven people in two different groups, one group contained seven women and the other group seven men, at different places. This grouping was done to avoid some traditional perceptions in the community that women could not speak equal to men at public; hence in this way of grouping women spoke with full confidence helped me to acquire full information from their perspective.

It is argued that focus group discussion allows the researcher to develop an understanding about why people feel the way they do according to (Byrman *et al*, 2004). The focus group approach offered the opportunity of allowing people to probe each other's reason for holding a certain view and it was used to validate and triangulate the responses that came out of household survey.

d) Field observations.

Choosing to use observational methods usually coincides with the view that social explanations and arguments require depth, complexity, roundedness and multidimensionality in data, rather than surface analysis of broad patterns, or direct comparisons of "like with like" (Mason *et*

*al,*2002). Observation is a fundamental and highly important method in all qualitative inquiry (Marshall *et al*, and Rossman *et al*, 2011). It is used to discover complex interactions in natural social settings. They argue that even in studies using in-depth interviews, observation plays an important role, as the researcher notes the interview partner's body language and affect, tone of voice, and other paralinguistic messages, in addition to the words. Hence, knowledge or evidence of social world can also be generated by observing, or participating in, or experiencing natural or real-life settings, and interacting with situations.

Field observations were carried out a number of times. During field visit, an observation was made on the impacts of climate variability and change on livelihoods sources. Observation was carried out in respondent's homes, grazing fields and surrounding environments and photographs was also taken. Observation technique was utilized to triangulate the information gathered from other sources.

4.4.2 Secondary data

a) Desk studies

The desk studies included analysis of resource problems based on literature. Secondary data was collected from books, journals, maps, reports and other research publications. Development related secondary information (e.g. reports and policy documents) was reviewed/synthesized to get idea of pastoralism and development policies, their implementation and impact in the county.

4.5 VALIDITY OF THE INSTRUMENT

Validity refers to the extent to which an instrument measures what it is supposed to measure. It assessed the relevancy of the questionnaire to the research objectives. To achieve this, the developed instrument was handed over to the supervisors who checked the content validity and give recommendations for revision. The pilot study enabled the researcher to make final modification and readjustment on the instrument.

4.6 RELIABILITY OF THE INSTRUMENT

Kothari *et al*, (2002) assert that a reliable instrument consistently produces the expected results when used more than once to collect data from the same sample randomly drawn from the population. In this study, reliability was attained through test and pretest technique, which was

carried out during pilot study. Five questionnaires were administered to randomly select respondents. Then the same was repeated after 3 weeks. Person Correlation Coefficient of $r=0.799$, $p<0.05$ will be established between the two score thus illustrating that the instrument high test retest value therefore suggesting that the questionnaire contents would be elicit consistent responses. The credibility of qualitative research studies rests not just on the reliability of their data and methods but also on the validity of their findings according to (Silverman *et al*,2006).He suggests that both reliability and validity are important issues in field research, and reliability can be addressed by using standardized methods to write field notes and prepare transcripts. To assure reliability, Tremblay *et al*, (1957) argues that, cross comparison is feasible and should be utilized as much as possible during data collection; this will give some indication of reliability and reveal areas of discrepancy where more intensive interviewing may be needed. Engaging multiple methods, such as interviews, focus group discussions and observation will lead to more valid, reliable and diverse construction of realities.

4.7 DATA ANALYSIS METHODS

According to Kothari *et al*, (2005) and Mugenda & Mugenda *et al*, (2003), this step is essential in scientific and social research in ensuring that all relevant data are captured for making comparison and analysis. This research used qualitative research which gives respondents a chance to participate in the process of decision making that ultimately affected the well-being of the Pokot Pastoralists in the study area.

4.7.1 Data entry and analysis

The collected data (quantitative) were analyzed using Statistical Package for Social Sciences (SPSS). Data collected through personal interviews were subjected to descriptive analysis. The information on changing aspects of climate, impacts of climate change on Pokot pastoralists, Indigenous knowledge strategies used and the type of communication used as sources of information were summarized in terms of frequency tables, charts and graphs to facilitate description and explanation of the study.

Inferential statistics, notably Pearson Chi-square analysis will be used in testing the hypothesis.

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Where;

χ^2 = Chi-square statistic.

O = Observed values

e = Expected values.

4.8 ETHICAL ISSUES

All social research involves ethical issues. This is because the research involves collecting data from people, and about people (Punch et al, 2005, Hay et al, 2010). Decisions about which research topics to pursue, appropriate and worthwhile methods of investigation, right way to relate to sponsors of and participants in research, and appropriate modes of writing and communication of results involve ethical questions (Kyale *et al*, 2009, and Brinkmann *et al*, 2009,Hay *et al*, 2010) These questions include how researchers ought to behave, the role of research in the pursuit of social change, and whether and how research methods are 'just' (Hay *et al*, 2010).These research finding will strictly be used for academic purposes; therefore, all the responses therein was treated with confidentiality as accorded by academics ethics. The originality of the research was paramount; the research was solely founded on the data collected from the field.

Authors such as Marshall *et al*,2011 and Rossman *et al*, (2011), Punch *et al*, (2005), (Hay *et al*,2010), Kvale *et al*,2009 and Brinkmann *et al*, (2009) argue that informed consent, privacy and confidentiality, and harm to participants are the most important issues of ethical guidelines for researchers. These ethical issues go through the entire process of the research, and potential ethical concerns were taken into consideration from the very start of an investigation to the final report. In what follows, I addressed these important issues in relation to my research.

a) Informed consent

Informed consent is an informant/subject agreement to participate in a study having been fully appraised of the conditions associated with that study (for example, time involved, methods of investigation, likely inconveniences, and possible consequences) (Hay *et al*, 2010). It is a key principle in social research ethics (Bryman *et al*, 2004). Bryman further argues that informed consent implies that prospective research participants should be given as much information as might be needed to make an informed decision about whether or not they wish to participate in a study.

b) Privacy and confidentiality

Qualitative methods often involve invading someone's privacy (Hay *et al*, 2010), as it involve asking very personal questions or observing interactions in people's homes that are customarily considered private. To protect the privacy of my informants, all materials that was used, like tape recording, field notes and transcribed documents were kept confidential, in such that they will not be released to the public at any time.

As Kvale *et al*,(2009) and Brinkmann *et al*, (2009) argue the principle of the research participants' right to privacy is not without ethical and scientific dilemmas; however I made possible efforts for privacy of my informants and the confidentiality of the information they provided me.

c) Harm to the participants

The consequences of a qualitative study need to be addressed with respect to possible harm to the participants as well as to the benefits expected from their participation in the study (Kvale *et al*, 2009 and Brinkmann *et al*, 2009). It is clear that the research should not expose the researcher and the participants of the research to any physical or social harm, as Marshall and Rossman *et al*, (2011) writes "first, do no harm". It is the responsibility of the researcher to do whatever he/she reasonably can to ensure that participants are not harmed by participating in the study. This was done by being aware in designing the research and knowing the possible harms and minimizing it to the least possible.

4.9 STUDY LIMITATIONS.

The anticipated time frame allocated for data collection was much longer than expected due to unpredicted weather patterns as a result of heavy downpour in Kongelai Ward and therefore the period of data collection was extended for a period of one month.

In addition, the questionnaires and interview schedules that were used for data collection were prepared in English which could not be used effectively as a media of communication with the rural household respondents. Therefore the questions had to be translated into the native language in order for the respondents to answer the questions. Lack of sufficient financial resources on the side of the researcher limited the study in one ward. The ward was sampled out to represent the rest. In spite of these challenges limiting the achievement of results, the study was not affected much since the information given in the questionnaires and interviews gave relevant data for analyses

CHAPTER FIVE

RESULTS AND DISCUSSION

This chapter presents the study findings and interpretation. It mainly comprises of general descriptive statistics.

The rate of respondents was 100% as shown in the diagram below.

Table 5.1: Rate of respondents

	Number of Respondents	% of the Respondents
Questionnaires Administered	98	100
Questionnaires Received	98	100
TOTAL	98	100

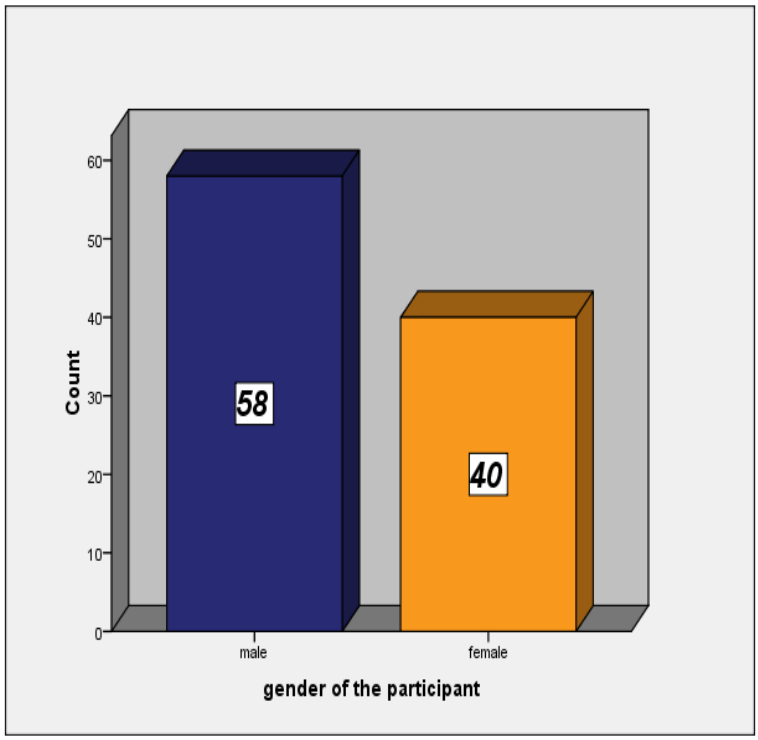
Source: Field data-2016

5.1 Socio-economic characteristics of the respondents

5.1.1 Gender of the respondent

The results showed that 40 of the respondents were female whereas male respondents accounted for 58.This implies that the society is male dominated who determine important decisions as pertains the access and utilization of natural resources within the society. In the FGDs, gender of the household head, livestock ownership and herd size, access to extension services were found to influence households' perception of climate change. According to the Socio-economic factors that were assessed, changes in climate such as increase in temperature and decrease in the length of rainy seasons are more likely to be perceived by female-headed households than their male counterparts .The fact being that female-headed households are more likely to perceive changes may be attributed to the fact that they are responsible for most of the household duties.

Fig 5.1: Gender of the respondents



Source: field data 2016

5.1.2 Age of the respondent.

Majority of the respondents were within the ages between 31 and 50 years and accounts for 45.9% which is a reproductive age group; 18-30yrs accounts for 30.6%; while above 51yrs accounts for 21.4%; while those who don't know accounts for 2% (Table 4.2)

In the study area, households live in clustered homesteads with an average family size of six persons. This is higher than the national household average of 5.1 persons (Kenya National Bureau of Statistics 2013). The average size of household had a significant and positive influence on the likelihood that pastoralist cope and adapt to climate change. Larger households are associated with higher labour endowments, which would enable the household to accomplish various production tasks (Nhemachena and Hassan 2007; Silvestri *et al*. 2012).

Household age was important demographic factor determining how vulnerable a household could be. For example, households headed by person above 50 years of age are more likely to be vulnerable compared with the younger persons. Consequently, elderly household heads are

probably worse off in terms of preparing strategies to cushion their families against adverse climatic stresses and impacts and likely to make them more vulnerable.

Table 5.2: Age of the respondents

Age of respondents	Frequency	Percent (%)
18-30 yrs.	30	30.6
31-50 yrs.	45	45.9
51 and over	21	21.4
don't know	2	2.0
Total	98	100.0

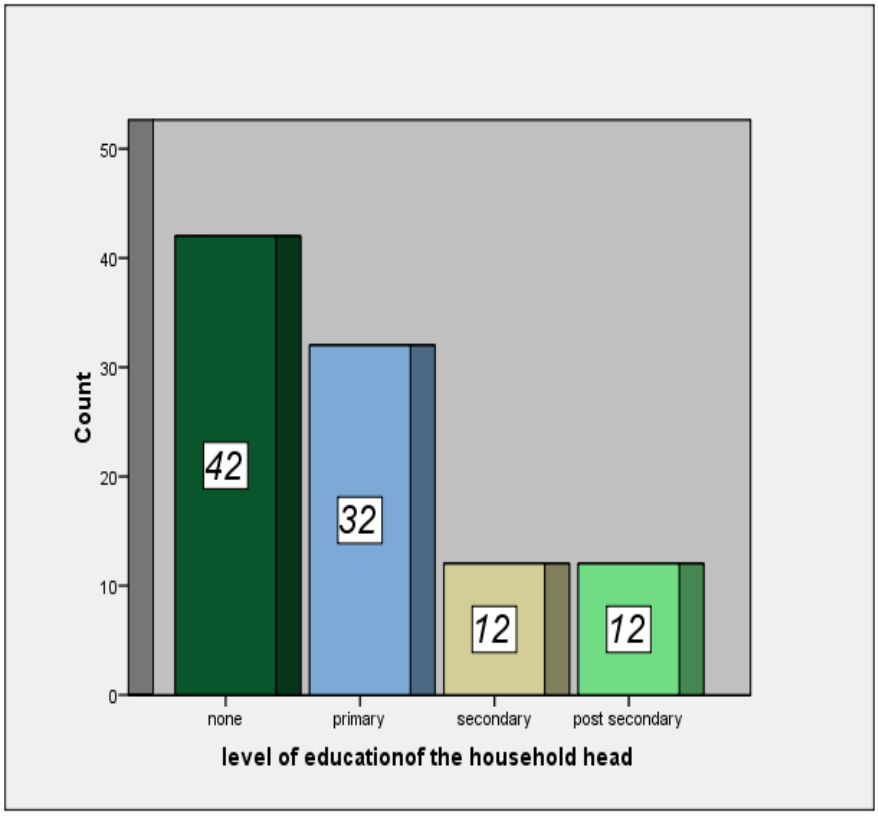
Source: Field data 2016.

5.1.3 Level of education of the household head

The study area is dominated by male headed household heads, 74 respondents with no formal education and low literacy level. This implies that most farmers have felt the changing climatic conditions but don't understand or rather know the causes of such changes which could have been attributed to high illiteracy levels and poor sources of information leading to low awareness levels.

The level of education of the household head is important since it enables them to utilize ICTs/model which creates awareness through early warning system that prepare them in the event of weather variability.Illiteracy has hindered the community's ability to predict rainfall patterns and plan grazing managements accordingly.

Fig 5.2: Level of education of the household head



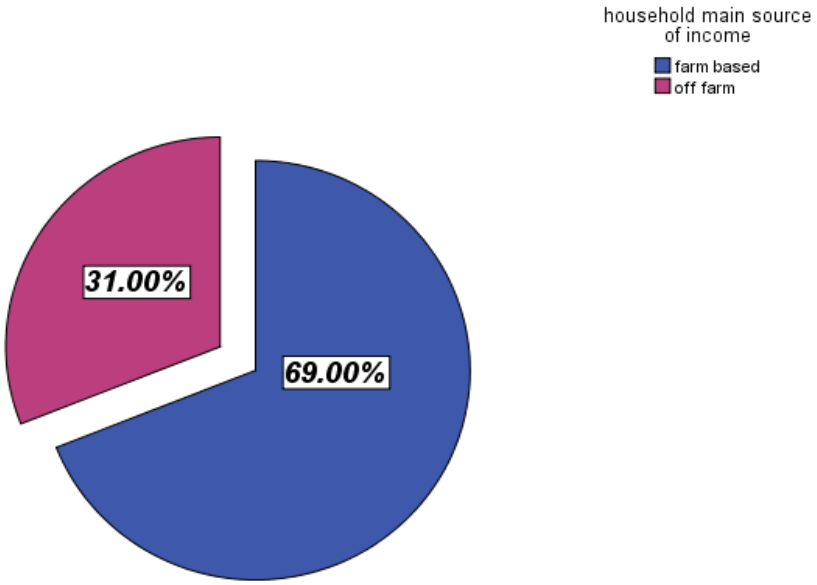
Source: Field Data-2016

5.1.4 Household's main source of income

The finding shows that pastoralism is the main source of livelihood in the study area, and that most respondents derive their income from livestock production (69%) although livestock keeping alone for most households in the study area is not enough to secure their livelihood. Other farm activities households engage in were crop production, mixed farming and poultry production. Most livestock species kept by households were goats, sheep, camels, cattle and donkey. The results suggest a shift in herd composition in an attempt to adapt to changing climatic conditions since goats and camels were increasing in numbers and are known to be more resilient to drought compared to cattle (Toulmin 1996; Kagunyu and Wanjohi 2014). However, some of the respondents 31% also engaged in off-farm activities. Frequent weather variability means that Pokot pastoralists do not have enough food for better part of the year. In order to cope

with these situations, households are engaging in wage labour, receiving cash remittances from relatives and government, engaging in sale of charcoal and firewood, and are also venturing in other small businesses enterprises.

Figure 5.3: Households' main source of income



Source: Field Data-2016

5.1.5 Households' perceptions of climate change and variability.

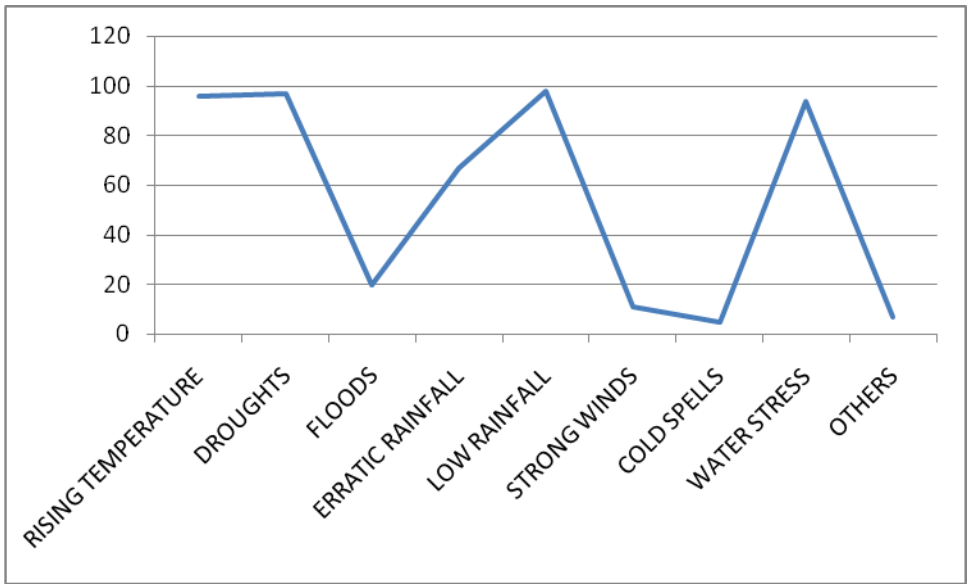
Climate change and variability has at least been heard and experienced by 100% of farmers. In the research findings, it was clear that some farmers reported deforestation and pollution from the industries as the main causes of climate change and variability. Out of the farmers that were interviewed majority of them had experience on climate change and variability, 24 respondents had no idea at all on contributors of climate change. This calls for the need of awareness for farmers on climate change mitigation, adaptation and coping strategies. This implies that most farmers have felt the changing climatic conditions but don't understand or rather know the

causes of such changes which could have been attributed to high illiteracy levels and poor sources of information leading to low awareness levels.

Majority (100%) of the respondents perceived various changes in climatic factors in the study area. The perception of these changes, however, varies between different respondents. A high proportion of both respondents experienced changes in temperature and rainfall amount, frequency and length of rainy season over the last three decades. Most of the respondents (100%) perceived increasing temperature, while none observed a decrease in temperature (Fig 4.6). This implies that households could be highly valuable key informants on studies related to climate change. The valuable knowledge of the pastoralist could also be used for climatic forecasting. Temperature increases are known to have a significant impact on water availability and pasture resources, thus likely to exacerbate vulnerability of the pastoralists (Hererro *et al.* 2010).

With regard to rainfall amount, frequency and length of rainy season, households specified various changes they had perceived in the study area. Overall, 98 respondents perceived rainfall amounts to be decreasing, with 80 respondents indicating that rainfall had become highly variable and more erratic (Fig 4.6). These observations were consistent across the entire study area. 98 respondents also noted decreasing rainfall frequency and length of the rainfall seasons over the past 30 years. From the FGDs and interviews with key informants, majority confirmed a decrease in the number of rain days coupled with frequent droughts in 1990 to 1995, 1999 to 2000, 2008 to 2009 and 2010 to 2011. The main concern expressed by the respondents was about greater variability and seasonal changes, which hindered their ability to predict rainfall patterns and plan their grazing managements accordingly. In addition, many respondents reported that the shorter rainy seasons has led to longer dry periods in between seasons, which results in higher pressure on the available pasture resources. These observations by respondents correspond with reports from weather stations that revealed high level of variability of rainfall distribution over the past three decades in the arid and semi-arid environments of Kenya (Galvin *et al.* 2001; Shisanya *et al.* 2011).

Fig 5.4: Households perception of climate Variability and Change

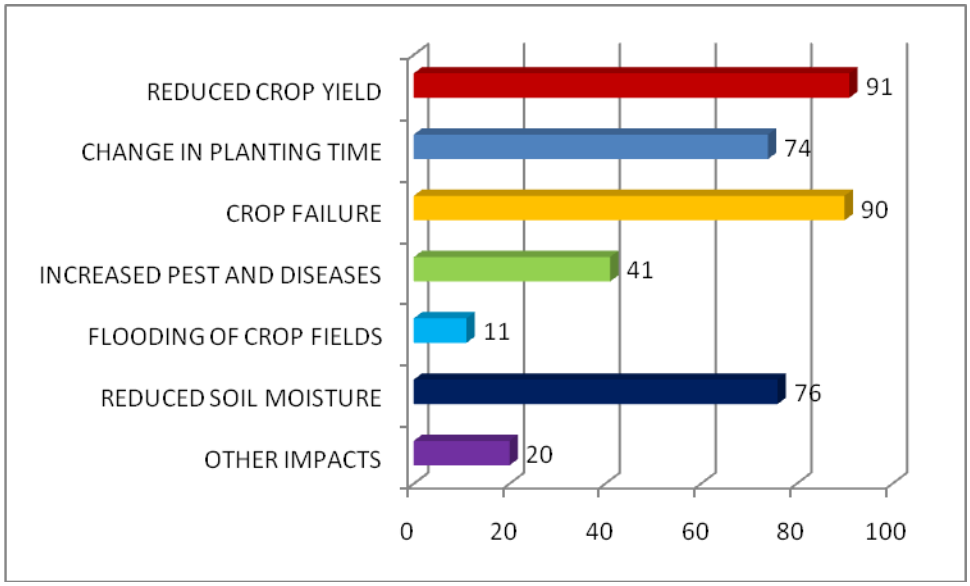


Source: Field data-2016

5.1.6 Influence of Climate change and climate variability on Pastoral/agricultural activities at Local / Farm level.

The farmers interviewed reported that, reduced crop yield (100%), crop failure (98%), reduced soil moisture (68%) change in planting time (65%), increase in crop pest and diseases(40%), were the highest climate change impacts in agro pastoralists' as compared to the pastoral areas. High crop/pasture failure was reported to be very high in pastoral area than in the Agro pastoral which may be attributed by low mean rainfall compared to agro pastoral area which receives higher mean rainfall. Low rainfall received in the pastoralists area have made them experience high pasture and crop failure as compared to the agro pastoralists highland areas where crop farming thrives very well. The most remarkable drought that had highest impact on farmers based on the results from the various discussions held with Key informants was in the year 2004 and 2009 which led to loss of livelihoods especially pastoralists who entirely depended on livestock. In the agro-pastoral area, crop failure and lack of adequate water for both animal and human consumption was also highly felt.

Figure 5.5: Extent to which the climate change experienced has influenced on pastoral/agricultural activities at local/farm level

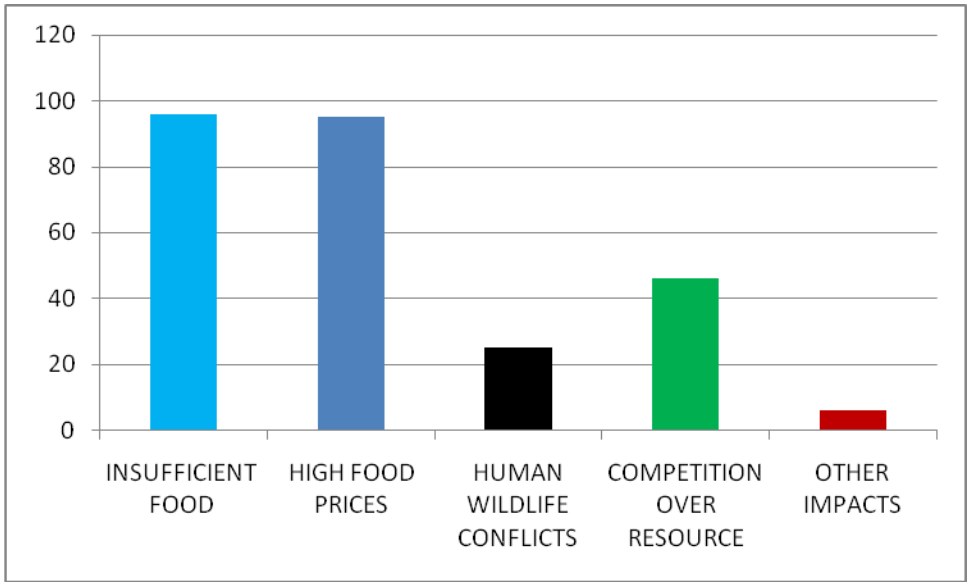


Source: Field Data -2016

5.1.7 Extent to which Climate change and variability experienced has influenced on Pastoral / agricultural activities at National level

At the off-farm level insufficient food (98%), high food prices (96%), human wildlife conflict (28%) and competition over resources, (45%) and other impacts accounted for (7%) were highly felt in agro pastoral areas compared to pastoral areas. This could have been attributed by high population rate in agro pastoral areas, reduced crop yield and nearness to reserved areas leading to high human wildlife conflict.

Figure 5.6: Extent to which the climate change experienced has influenced on pastoral/agricultural activities at National level



Source: Field Data 2016.

5.2: Objective 1: To document the Indigenous knowledge used by the Pokot Community to cope with climate change and variability

This objective was carried out to find the level of indigenous knowledge usage by pastoralists and agro pastoralists' farmers and why they prefer to use indigenous knowledge in the management of their livestock and farms to address impacts of climate change and variability.

To evaluate farmers' perception regarding climate change and variability effects, farmers were asked if they have heard or experienced climate change in their localities, perceived causes of climate change and the most felt impacts of climate change on agriculture and livestock.

The results indicated that 100% of the respondents have heard and experienced effects of climate change and variability on their localities. Deforestation was thought by the farmers to be the highest contributor of climate change and variability, followed by pollution and global warming as the main causes of climate change having been reported by 98, 38, and 17 respondents respectively. Sand harvesting, soil erosion and overstocking were thought as least contributors of climate change having 6 respondents each while 24 of the households didn't know at all the causes of climate change and variability.

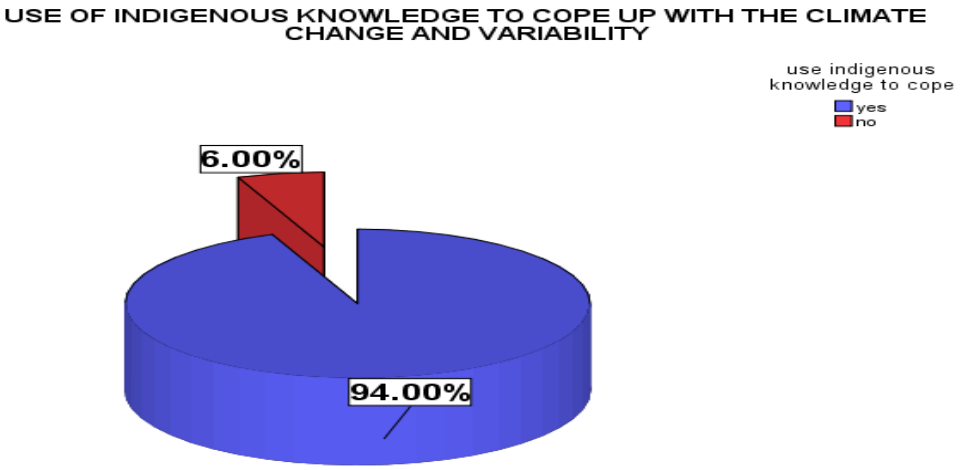
5.2.1 Use of indigenous knowledge to cope with Climate Variability and Change.

The results indicated that, 94% of farmers still apply Indigenous knowledge in the management of their farms and livestock while 6% don't use it all. The reason behind being traditional approach is 85% accurate and 15% less accurate.

94% of the farmers still use Indigenous knowledge on agriculture/livestock keeping, prediction of different weather patterns and food preservation techniques in the management of their farms. The main reason behind relying on IK more than scientific knowledge is that they are used to, it's reliable, accurate and more affordable. The indigenous signs and strategies used by farmers for coping with climate change and variability were similar between the pastoralists and agro pastoralists because the study area is being predominantly occupied by the Pokot community. Migration of livestock and people was a very common strategy which is being practiced by the pastoralists more than the agro pastoralists which could be attributed by the fact that agro pastoralists are practicing preservation of pastures for the use during drought seasons unlike the pastoralists who reported to practice no pasture preservation at all hence the need to move in search of pastures in times of drought.

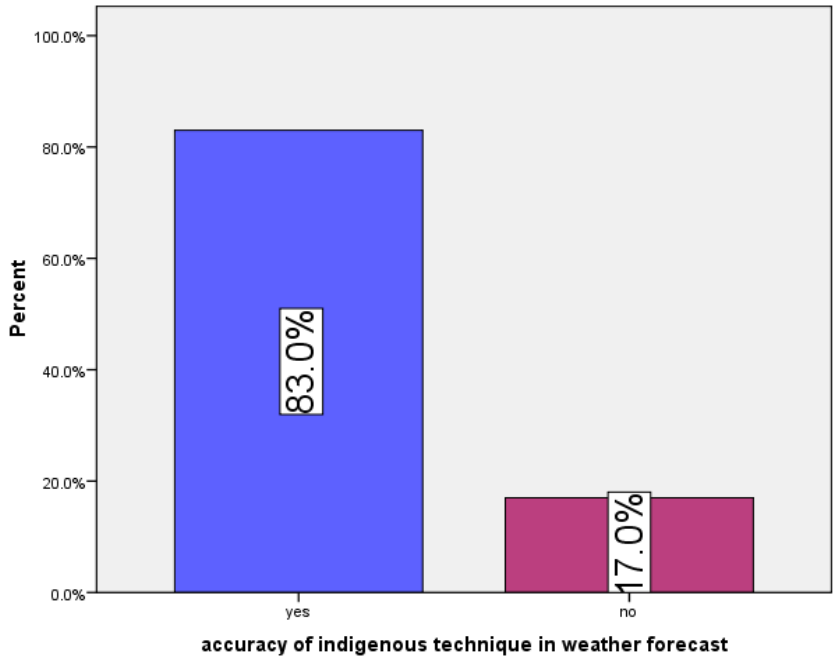
Some of the Positive indigenous strategies that are being practiced in the study area included; use of organic manure to increase crop production, crop rotation, traditional food preservation methods like smoking of meat, use of ash to preserve the seedlings, separation of livestock to control breeding, use of traditional herbs to treat some of the animal diseases and migration of livestock during drought.

Figure 5.7: Use of indigenous knowledge to cope with Climate Change and variability.



5.2.2 Accuracy of indigenous Knowledge in weather forecasting.

Fig 4.8: Accuracy of indigenous Knowledge in weather forecasting.



Source: Field data-2016.

Indigenous strategies practiced by the agro pastoralists more than the pastoralists were agro forestry, irrigation, planting of appropriate crop varieties, preservation of pastures, application of organic and inorganic fertilizers and soil and water conservation. On the other hand, pastoralists practice more of migration, planting of drought tolerant crops, rain water harvesting, keeping of drought resistant animals and management of pest and diseases.

Livestock is an integral form of Pokot pastoralist community capital, besides functioning as a means of production, storage, transport and transfer of food and wealth (Behnke and Muthami et al, 2011).It is also essential for payment of dowry, compensation of injured parties during raids, symbol of prosperity and prestige, currency for exchange, store of wealth and security against drought, disease and other calamities.

During the Focus group discussions, it came out clearly that the agro pastoralists are no longer practicing migration as compared to ten years ago while the pastoralists are now practicing it more due to frequent prolonged droughts and lack of pasture preservation. From the FGD also, it was clear that women from agro pastoralists' areas practice indigenous strategies such as traditional methods of food preservation examples dried white ants mixed with honey, consuming wild cassava *"akan"* and taking milk cream from gourd and use of organic manure in their farms, crop rotation and pasture enclosures. This explains the different activities practiced in both areas. The agro pastoralists produce their own agricultural food hence conversant with food preservation methods and with the few cattle they keep, they use the organic manure to enrich their soils for optimum food production. It was also clear that men from both areas are using traditional herbs to treat certain livestock diseases more than the women. This explains that men are the ones responsible for their cattle and they are the ones who also know specific traditional herbs to be used for treating specific diseases. The FGD results also indicated that women from pastoral areas prefer other strategies in coping with drought such as use of shallow wells to draw water, separation of livestock to control breeding as compared to the men who prefer migration of animals during drought in search of water and pastures. This could have been attributed by the facts that, during migration of livestock and people, women and children are left behind while men and boys move with the cattle.

The nomadic transhumance practiced by Pokot pastoralists is characterized by risk-spreading and flexible mechanisms, such as mobility, communal land ownership, large and diverse herd sizes, and herd separation and splitting (Schilling *et al.* 2012). The livestock types kept to manage and

spread risk include cattle, camels, goats, sheep and donkeys. These livestock species have different forage and water requirements with variable levels of resilience during drought periods according to the FGDs. Livestock possession plays multiple social, economic and religious roles in pastoral livelihoods, such as providing a regular source of food in the form of milk, meat and blood for household members, cash income to pay for cereals, education, health care and other services.

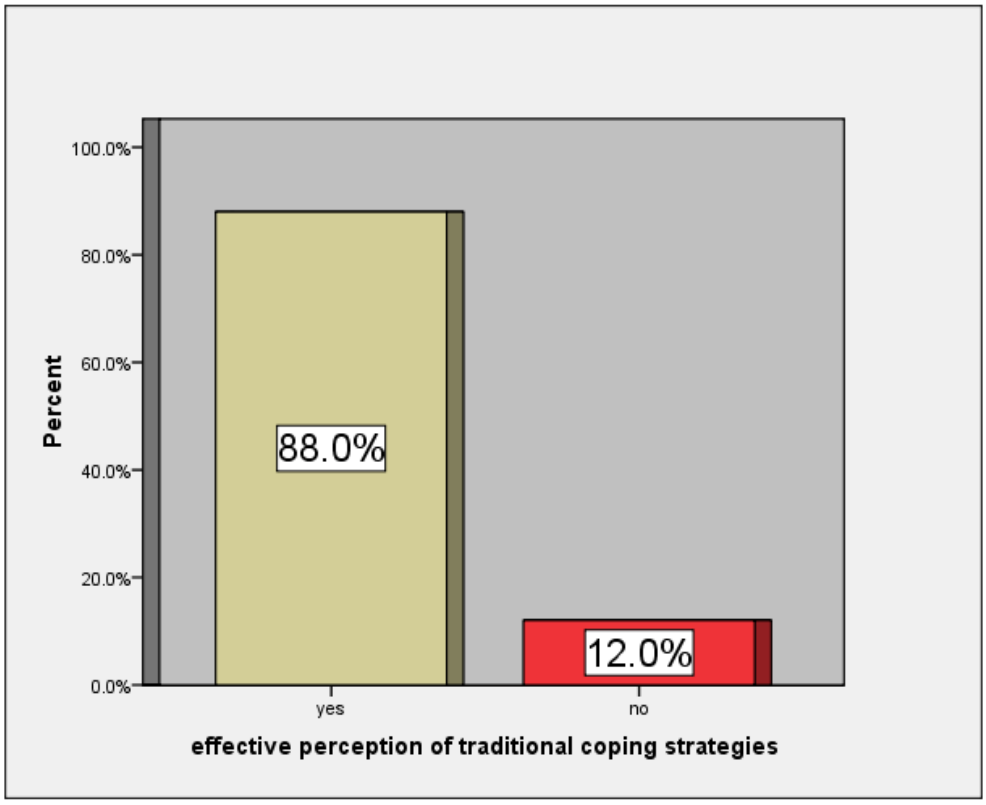
Crop farming has been acclaimed as a viable climate risk management and livelihood strategy for the sedentary farmers and agro-pastoralist (Smith et al,1998) others on the other hand view it as an unsustainable (even destructive) option for the rangelands especially with the challenges of climate variability and change. That notwithstanding, the Pokot pastoralists cultivate staple crops predominantly for own consumption but also sell what they produce in major urban centres of the County.

5.3. Objective 2: To determine perception and reliability of the adaptation and the coping mechanisms used by the Pokot community.

5.3.1 Perception of farmers on the traditional coping strategies

According to the research findings, 88 respondents perceived traditional coping strategies being effective while 10 respondents perceived it not being effective. The findings suggested that most respondents rely on traditional approach when making coping strategies compared to the scientific approach because of the low level of literacy and accessibility to ICT materials to pass information and communication.

Figure 5.9: Perception of farmers on the traditional coping strategies

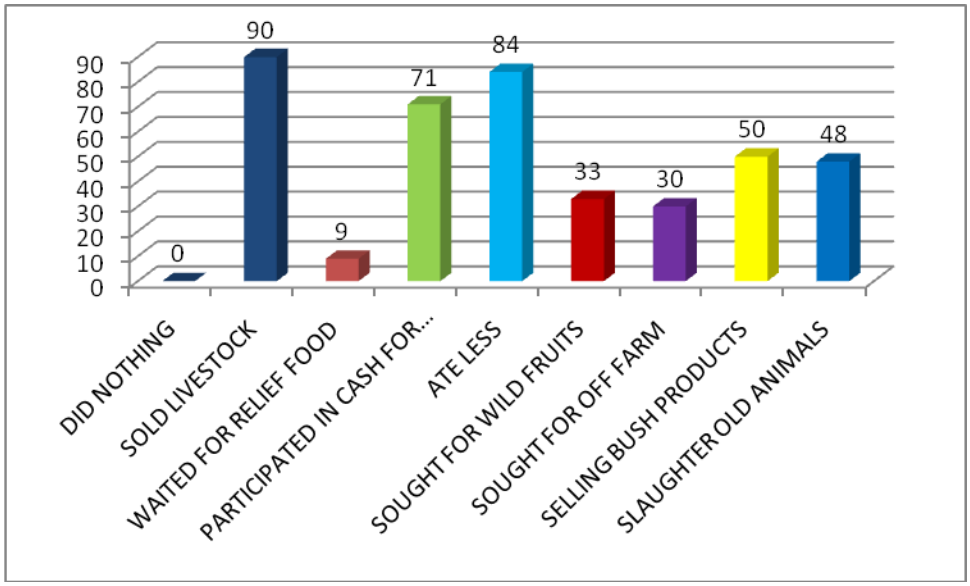


Source: Field data-2016

5.3.2 Coping strategies

Pokot pastoralists employ various coping responses against extreme drought events. Unlike adaptations which involve long-term shifts, coping responses were more reactive and mainly involve temporary adjustment of livelihood activities in response to drought. However, selling of livestock and livestock products fall in both categories as pastoralists use this option to cover regular adaptation costs but also to cope with short-term shocks as 70.6% of the respondents stated. Other coping strategies to mitigate drought related risk include: Sold livestock (90%), waited for relief food (9%), Participated in cash/food-for-work (71%),slaughter of old and weak livestock (58%),Sought for wild fruits (33%),Selling bush products such as *Aloe vera,* charcoal, firewood (50%), Sought for off-farm employment (30%), and minimization of food for consumption (84%) (Figure 4.13). The drought coping strategies reported by respondents varied from household to households based on existing support systems and local knowledge.

Figure 5.10: Coping responses against climate variability and change



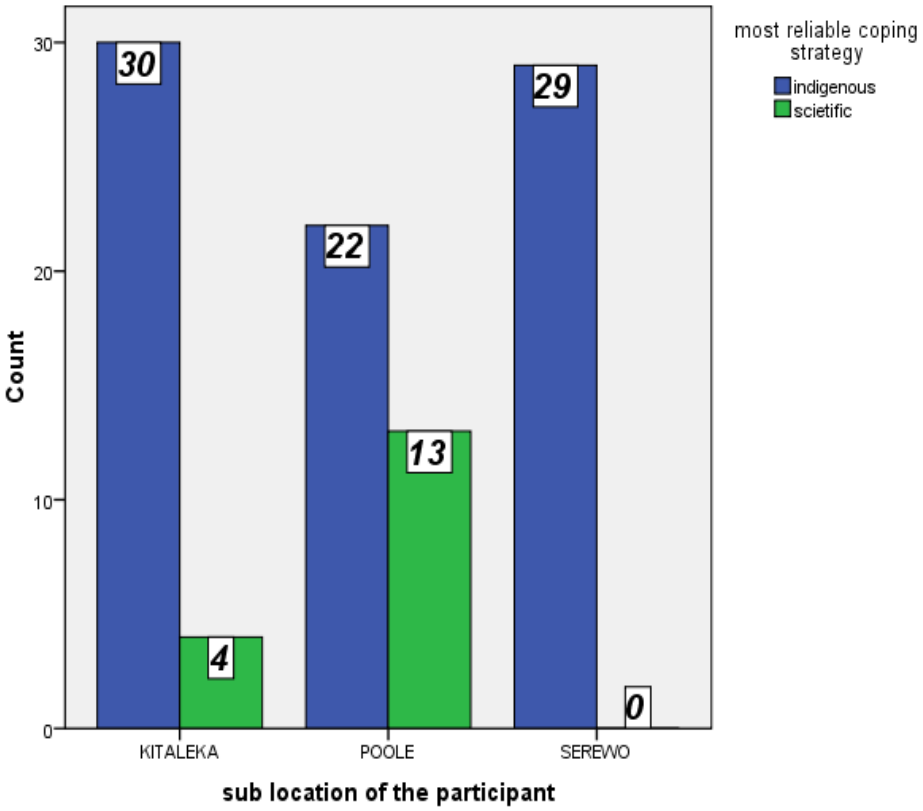
Source: Field data-2016.

The results revealed that some of the Pastoralists coping responses to drought are reactive and mainly involve intensive exploitation of scare resources. However, proactive responses such as selling of livestock at the beginning of drought are few. Further analysis shows that of the 8 coping strategies practiced by respondents, 6 strategies are practiced during drought periods and for more than a month (> 1 month) as shown in Fig 4.13. Despite the challenges faced by the coping measures used in the study area, they help households to buffer the adverse effects of droughts

5.3.3 Reliability of the coping strategies.

The reliability of the of coping strategies based on indigeneous and scientific knowledge in the study area.The findings suggested that in Serewo sub-location none respondent agreed that he relies on scientific approach most when making coping strategy,while 29 respondents rely on traditional approach.In Poole sub-location 13 respondents rely on scientific approach while 22 repondents rely on indigeneous approach,and in Kitalakapel 4 repondents prefered the scientific approach and 30 respondents prefered the indigeneous approach on making coping strategy.The findings suggested that most respondents rely on traditional approach when making coping strategies compared to the scientific approach because of the low level of literacy and accessibility to ICT materials to pass information and communication.

Figure 5.11: Reliability of coping strategies as perceived in different Sub-Locations of the study area.

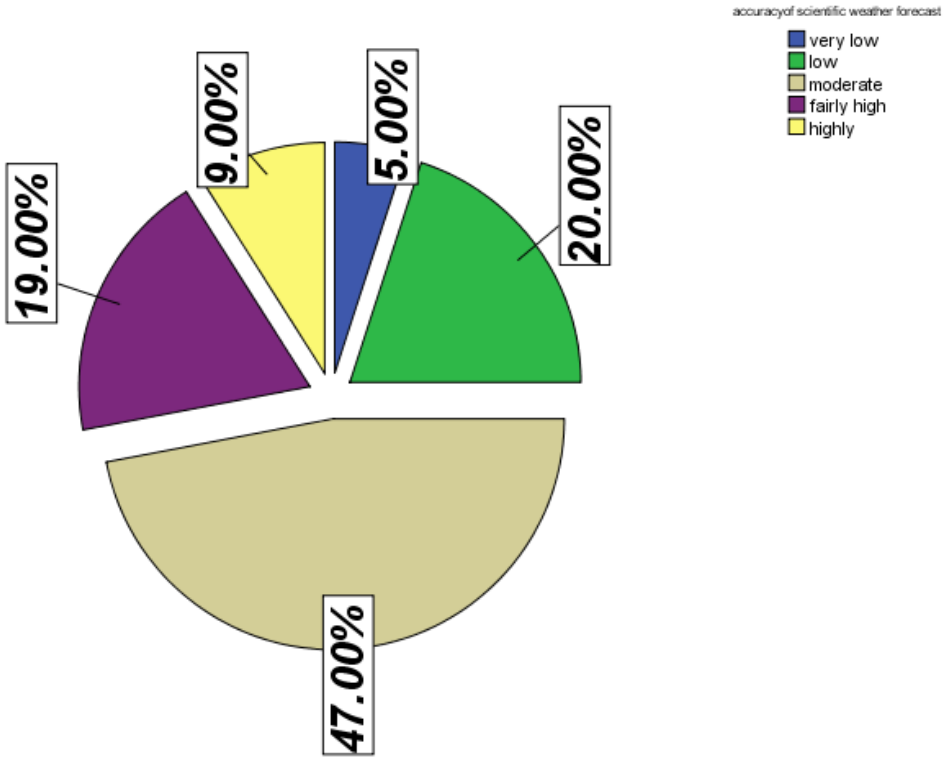


Source: Field data-2016

Table 5.3:Perception of traditional coping strategies by the respondents

Perception of the traditional coping strategies	Frequency	Percent (%)
Yes	86	87.8
No	12	12.2
Total	98	100.0

Figure 5.12: Accuracy of scientific methods in weather forecasting



The findings from the research suggested that 47% of the respondents agreed that the accuracy of scientific in weather forecasting being moderate,20% being low,19% being fairly high,9% being high and 5% being very low in the rating scale of 1(low) to 5(high).This majorly depended on the literacy level of the respondent and their ability to access the ICTs according to the focus group discussions.Awareness creation and education through the use of the ICTs according to the FGDs have enabled farmers to prepare as an early warning. The study suggest that heads with higher level of education are likely to have better level of planning, access and understanding of early warning information for effective climate change adaptation. The key area for building climate change resilience of the households in the study area is through the strengthening of education sector.

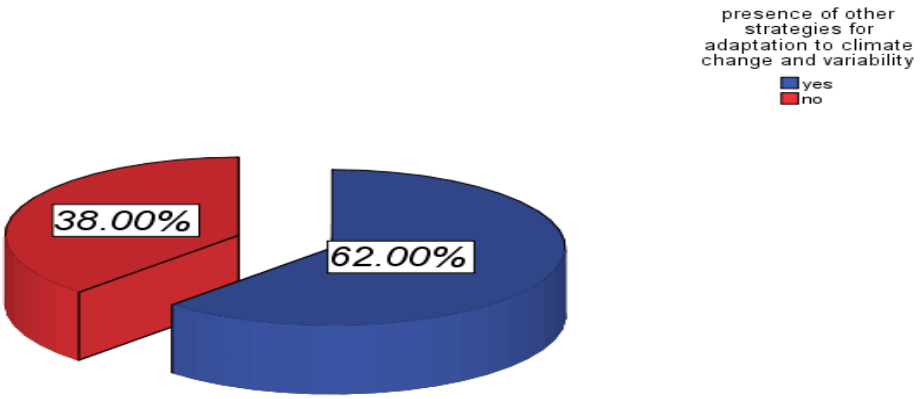
5.4 Objective 3: To assess the adaptation and coping strategies that pastoralists adopt to mitigate the impacts of climate change and variability.

This study revealed a myriad of actions and strategies households are using to adapt to or cope with the vagaries of drought. The discussion that follows highlights some of the multiple strategies deployed in response to changing conditions by the respondents;

5.4.1 Adaptation strategies

Out of the total number of respondents interviewed, 62% agreed that they have alternative strategies for adaptation to climate change and variability while 38% do not have an alternative source.

Fig 5.13: Alternative strategies for adaptation to Climate variability and change.

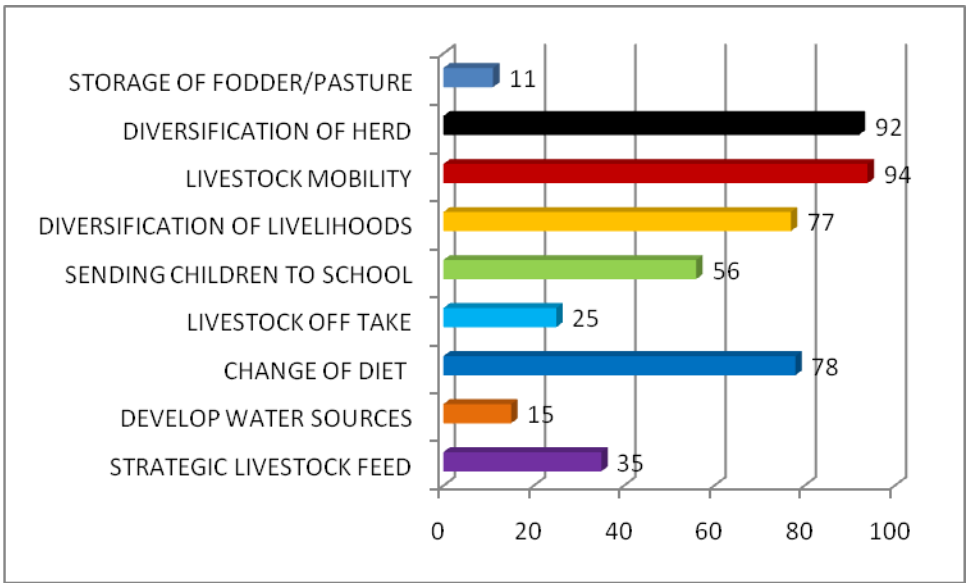


Source: Field data-2016

5.4.2 Adaptation Strategies to Mitigate impacts of Climate change and Variability.

A number of adaptation strategies to mitigate adverse impacts of drought are being pursued by majority of the households in the study area. Fig 4.18 summarizes a number of adaptation techniques and the percent of respondent using the strategies. Diversification of livelihood (92%), Livestock mobility (94%), sending children to school (56%), Strategic livestock feed (35%), Develop water sources (15%),Change in diet consumption (78%),Livestock off-take (25%),Storage of pasture (35%) were identified as some of the most commonly used adaptation strategies in the study area. In addition, other adaptation strategies used include increase in sale of livestock, Cash transfers from relatives, livestock insurance and use of early warning information

Figure 5.14: Adaptation strategies to mitigate impacts of climate change and variability.



Source: Field data-2016

Detailed explanations of these adaptations measures are explained below.

5.4.2.1 Livelihoods diversification

This is being practiced by 92% of the respondents and it is a major adaptation strategy in the study area. The study revealed that as a result of frequent drought events in the region, majority

of the households undertake a myriad of activities to supplement resources from livestock production. Livelihood diversification in this research refers to processes by which households construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living (Ellis et al, 1995). There were two forms of livelihood diversifications reported by respondents which included both on-farms (31%) and off-farm (69%) activities.

On-farm activities included mainly crop farming (sorghum, maize, green grams, cowpeas and vegetables), Livestock farming and aloe production. Majority of respondents prefer to engage in non-climate sensitive off-farm activities such as micro-business/small-scale, casual labour, artisan, salaried/fixed employment, charcoal burning. In addition, other off-farm activities include harvesting of wild fruits for food, honey production, and sand harvesting.

Through sale of veterinary drugs and attending to sick animals many literate youths with animal health trainings and skills managed to support their families with the income earned as revealed by the key informants. The most common diseases in the study area include; *Peste des Petits Ruminants* (PPR), *Contagious Bovine Pleuropneumonia* (CCBP) and *Contagious Caprine Pleuropneumonia* (CBPP) being endemic in Pokot, Minge, Trypanosomiasis, and Lump skin diseases this is in accordance with the livestock incidence reports of the study area.

Most of the livelihoods diversification activities have been adapted to complement pastoralism, rather than to substitute livestock production in the area according to key informants, interestingly; according to (Schilling *et al.* 2010) most of these activities are being practiced by women. Women in Study area other than the informal milk business rely heavily on the sale of charcoal as an alternative source of income which has a high demand in the nearing urban and peri-urban areas. This activities leads to desertification as so majority of the people are engaging in wanton cutting of trees without planting others. Women in these areas should be educated on alternative technologies for fuel such as using agricultural wastes (sugarcane, coffee husks) converted into charcoal briquettes to provide much needed source of cheap fuel that is cleaner in burning.

Moreover, in the three Sub-Locations Sand harvesting along river beds which is rampant have degraded the environment by lowering the waterbeds hence diminishing the water availability potential. As a result of these activities there is steepening and destabilization of riverbanks

thereby causing erosion and river channel widening. This leads to the Habitats of aquatic community being destroyed through increase in Sediment bed loads.

5.4.2.2 Mobility

Mobility is applied particularly in times of drought and is well known as a primary risk reduction strategy and other processes that encroach slowly on pastoralists' rangelands. Results show that majority of the respondents (94%) view mobility as an adaptation strategy to reduce risk, and also for other economic purposes, to access livestock markets or urban centres. However, the level of mobility differs across the surveyed Sub-locations (Serewo, Kitalakapel and Poole), depending on access to grazing land and water resources.

Herd mobility enables opportunistic use of resources and helps minimize the effects of droughts and other associated hazards as revealed in the discussion with key informants. The Pokot's herders were found to migrate across border to Uganda, mainly to access resources and markets, and are often affected by impacts such as conflicts, diseases outbreaks and recurrent drought.

According to studies by (Ellis and Swift 1988; Little and Leslie 1999) show that seasonal decisions to migrate is to ensure that households maintain the productivity of their herds and security of their families. This form of mobility is pursued primarily for livelihood purposes and is very strategic according to (McCabe et al 2006). However, movement of livestock to areas with secure water and pasture resources is an effective strategy against droughts according to (Niamir-Fuller 1999) and remained important for Pokot pastoralists.

Currently, Mobile pastoralism are becoming increasingly constrained according to Mbote (2013) due to recent changing land tenure systems in the rangelands, In addition, Further results according to the FGDs show that high rates of declining mobility have been driven by a combination of factors, which include major droughts, increased individualization and disruption of social structures, increased competition and violent conflicts over grazing land, and increased land ownership by investors especially the agro-pastoralists. Despite the fact that most pastoralists have become increasingly semi-sedentary, their herds are still quite mobile. The ability of pastoralist to continue managing the rangelands at communal scale, rather than fragmenting rangelands into private and individual tenure systems will remain a key issue for future of mobility as an adaptation strategy.

5.4.2.3 Herd composition and species diversification

These are key strategies that have enabled pastoralism to thrive in the harsh environmental conditions for centuries according to Speranza et al (2010). Result shows that 92% of the households diversify herd composition and keep a mixed of livestock species that include cattle, shoats, camel, and donkeys. Increased drought frequency, hastens herd depletion, narrows the window for livelihood recovery, and intensifies pressure on depleted water and pasture resources according to Studies by Ali and Hobson (2009). Key informant discussions revealed that shoat and camels are presently preferred since they are more resistant to drought compared to cattle .In order to allow for adequate accumulation of sustainable herd size, increasingly short timeframes between droughts are likely to be insufficient.

5.4.2.4 Acquisition of education and trainings through sending children to school

This is partly seen as an essential strategy to facilitate income diversification for pastoral households in Pokot community. Results show that 56% of the respondent view education as long-term adaptation strategy against drought events.

Redistribution of household tasks including livestock herding to parents and part of children who are not able to access school is likely to occur with young boys and girls attending school according to the FGDs results. In contrast, according to Fratkin (1986) previously reported that increase in the number of children going to school will result in limited source of labour, whereas labour force is central to other adaptation and risk management strategies in pastoral areas.

5.4.2.5Livestock off-take

This takes place at different stages of drought and is a crucial adaptation strategy utilized by the Pokot pastoralists. However, 25% of the respondents reported that they sell livestock on a regular basis to have a source of cash income.

According to the results, most respondents sold goats much often than any other livestock type. The motivation leading to the sale of goats was to purchase food, medical care, school fees and to obtain cash income for other household needs. Another incentive for adaptation measure comes from the increasing demand and price for livestock products from urban areas.

5.4.2.6 Coping strategies

Pokot pastoralists employ various coping responses against extreme drought events. Unlike adaptations which involve long-term shifts, coping responses were more reactive and mainly involve temporary adjustment of livelihood activities in response to drought. However, selling of livestock and livestock products fall in both categories as pastoralists use this option to cover regular adaptation costs but also to cope with short-term shocks as 62% of the respondents stated Other coping strategies to mitigate drought related risk include: Sold livestock (90%), waited for relief food (9%), Participated in cash/food-for-work (71%),slaughter of old and weak livestock (58%),Sought for wild fruits (33%),Selling bush products such as *Aloe vera,* charcoal, firewood (50%), Sought for off-farm employment (30%), and minimization of food for consumption (84%) (Figure 4.13). The drought coping strategies reported by respondents varied from household to households based on existing support systems and local knowledge.

The results revealed that some of the Pastoralists coping responses to drought are reactive and mainly involve intensive exploitation of scare resources. However, proactive responses such as selling of livestock at the beginning of drought are few. Further analysis shows that of the 16 coping strategies practiced by respondents, 11 strategies are practiced during drought periods and for more than a month (> 1 month). Despite the challenges faced by the coping measures used in the study area, they help households to buffer the adverse effects of droughts.

Further probing with FGDs participants revealed that some of these desired strategies like irrigation farming, development of water sources and insurance for assets require greater initial investment capital beyond the reach of many households. Similarly, the result indicates that while many households are interested in grain and fodder storage facilities, few would be interested in investing in these facilities because of pasture scarcity in the study area. While improved livestock breeds were mentioned as a desired effective adaptation measure to drought, access to livestock breeds and suitable veterinary services are problematic, because of economic, social and infrastructural challenges among the Pokot pastoralists. Investment in education to improve literacy levels which is a major constraint to desired adaptations is key in addressing cyclic drought vulnerability in the study area. Furthermore, the respondents highlighted the crucial role of local governance and institutions, political leadership and structures in improving markets access and for upholding the rule of law. Consistent with the survey results, lack of

affordable credit facilities access was frequently mentioned by FGDs respondents as the most significant constraint to desired adaptation and coping strategies identified.

5.5 Results and discussions

The results indicated that 40 respondents were female whereas male respondents accounted for 58. Majority of the respondents were within the ages between 31 and 50 years. Households in the area of study live in clustered homesteads with an average family size of six persons which is higher than the national household average of 5.1 persons (Kenya National Bureau of Statistics 2013). The study area is dominated by male household heads with no formal education and low literacy level (42%). Most respondents derive their income from livestock production (69%) with pastoralism as the main source of livelihood. Other farm activities households engage in were crop production, mixed and poultry production. Most livestock species kept by households were goats, sheep, camels, cattle and donkey. In attempt to adapt to the changing climatic conditions, the result suggests a shift in herd composition since goats and camels were increasing in numbers and are known to be more resilient to drought compared to cattle (Toulmin 1996; Kagunyu and Wanjohi 2014). However, some of the respondents also engaged in off-farm activities. Frequent drought events in the study area are likely to affect majority of the households since they earn their income from climate sensitive activities. The climate change and variability effect are exacerbated by other climate induced shocks and stresses such as livestock diseases, for example *peste des petit ruminants* (PPR) and floods. Frequent hazards, means that pastoralist do not have enough food for better part of the year. Households are engaging in wage labour, receiving cash remittances from relatives and government, engaging in sale of charcoal and firewood, and are also venturing in other small businesses enterprises in order to cope with these situations.

Majority (100%) of the respondents perceived various changes in climatic factors in the study area. The perception of these changes, however, varies between gender. A high proportion of both males (96%) and females (97%) experienced changes in temperature and rainfall amount, frequency and length of rainy season over the last three decades. Most of the respondents (89%) perceived increasing temperature, while none observed a decrease in temperature (Fig 4.6). The respondents' perceptions of rising temperature are in agreement with actual climate data recorded in the nearby meteorological stations in the study area. This implies that households could be highly valuable key informants on studies related to climate change and variability. The

valuable Indigenous knowledge of the pastoralist could also be used for climatic forecasting. Significant impact on water availability and pasture resources are a result of increase in temperature, thus likely to exacerbate vulnerability of the pastoralists (Hererro *et al.* 2010). With regard to rainfall amount, frequency and length of rainy season, households specified various changes they had perceived in the study area. Overall, 70% of the respondents perceived rainfall amounts to be decreasing, with 45% indicating that rainfall had become highly variable and more erratic (Fig 4.6). These observations were consistent across the entire study area. From the focus group discussions and interviews with key informants, majority confirmed a decrease in the number of rain days coupled with frequent droughts in 1990 to 1995, 1999 to 2000, 2008 to 2009 and 2010 to 2011. The main concern expressed by the respondents was about greater variability and seasonal changes, which hindered their ability to predict rainfall patterns and plan their grazing managements accordingly. In addition, many respondents reported that the shorter rainy seasons has led to longer dry periods in between seasons, which exerts higher pressure on the available pasture resources. These observations by respondents correspond with reports from weather stations that revealed high level of variability of rainfall distribution over the past three decades in the arid and semi-arid environments of Kenya (Galvin *et al.* 2001; Shisanya *et al.* 2011).

In the analysis, households' perception of climate variability and change were found to be influenced by gender of the household head, livestock ownership and herd size, and access to extension services. From the socio-economic factors examined, the results suggest that female-headed households are more likely to perceive a change in climate such as increase in temperature and decrease in the length of rainy seasons than male-headed households. The fact that female-headed households are more likely to perceive changes may be because they are responsible for most of the household duties.

A number of studies in Africa have shown that female-headed households are more likely to perceive climate change (Nhemachena and Hassan 2007; Silvestri *et al.* 2012). The possible reason for this observation is that in most pastoral communities, men are more often move with their animals in search for pasture while, women and children remain at home.A positive and significant influence on the likelihood that households perceive climate variability and change is determined by Livestock ownership and herd size. In addition, this study revealed that access to extension services significantly increases the likelihood that households perceive climate

variability and change. Studies by Deressa *et al.* (2009) similarly reported that access to extension services play an important role in the availability and flow of information critical for climate perception. Probability of adaptation was affected by most of the explanatory variables. Explanatory variables that positively and significantly influenced adaptation to climate change and variability include gender of the household head, age and education level of the household head, household size, access to credit, cash remittance, farm-based income, distance to livestock market and access to extension services, livestock ownership and herd size.

The findings also show that gender of household head significantly influenced the likelihood that a household took up the climate variability and change adaptation strategies. In the study area, female-headed households were more likely to take up climate variability and change adaptation because they are responsible for most of the household welfare activities and have better experience on various farm based production practices. In contrast, studies in the Nile basin of Ethiopia indicate that male-headed households adapt more readily to climate change (Hassan and Nhemachena 2008).

Significant determinant of adaptation to climate variability and change was found on education level of the household head. Heads with higher level of education are likely to have better level of planning, access and understanding of early warning information for effective climate variability and change adaptation. One of the key areas for building climate change and variability resilience of the households is through strengthening education sector in the study area. A positive and significant influence on the likelihood that pastoralists adapt to climate change and variability was determined by the average size of the household. Larger households are associated with higher labour endowments, which would enable the household to accomplish various production tasks (Nhemachena and Hassan 2007; Silvestri *et al*. 2012).

This study suggest that access to affordable credit facilities is likely to eases cash constraints and allows households to invest in production inputs for climate variability and change adaptation. Similarly, cash transfers and remittance from relatives and friends are important determinants of climate change and variability adaptation and normally allow households to have additional cash for livelihood diversification (Bryan *et al.* 2009). Farm income has a positive and significant impact on the probability that pastoralist adapt to climate change and variability. Given the climatic-induced challenges facing households in the drylands, income from livestock has previously been reported to play an important role for enhancing climate change adaptation (Rao

et al. 2011). Other farm based income activities include small scale sorghum production and Aloe cultivation.

Findings from the study has shown that female-headed households,household heads with no primary level of education and households headed with no access to extension services and early warning information, in particular, are disproportionately likely to be affected by climate stresses and variability. In times of climate stresses and shocks like drought, these categories of households tend to have fewer options to find other ways of making a living, because of their low levels of literacy reduce their opportunities in coping mechanisms such as wage employment. Similarly, female or divorced and widowed household heads are likely not to be empowered enough in pastoral communities to make household decisions (Nabikolo *et al.* 2012) and are frequently without access to credit services and adequate capital assets or not able to own large herds to manage households' daily requirements. Similar observations have been made by (Kakota *et al.* 2011) in Malawi and (Tesso *et al.* 2012) in Ethiopia that widowed or divorced household heads are more vulnerable since they rely on income earned by either the father or mother as the bread winners. These findings make a strong case for continuous targeting of pastoralist women in resilience-building interventions in the rangelands.

For the biophysical variables, the greater the level of household reliance on natural resources, such as pastoralism or dry land crop farming, the greater will be their vulnerability to climate change and variability. This is partly because the use of such natural resources is dependent on rainfall, which is projected to change. This study observed that almost all the postulated biophysical/ environmental variables contribute positively to household vulnerability. It is likely that the level of dependence on natural resources especially pastures and water will vary from household to household.

The determinants of households' vulnerability were found to be significantly influenced by the sex of the household head, age of the household head, size of the household, number of dependents, marital status, social linkages, access to extension services and early warning information. In addition, non-farm income, herd size and diversity, herd structure and herd mobility, access to markets, households' employment status, coping strategies and access to credit were also observed to be the key determinants of the households' vulnerability to climate-induced stresses. This concurs with studies by Eriksen *et al.* (2005) and Notenbaert *et al.* (2013)

which similarly observed some of these factors to be the key determinant of households' vulnerability to climate variability and change in rural communities. The results are also consistent with previous findings by Kakota *et al.* (2011) and Gebrehiwot and van der Veen (2013). From these findings, there is still more to be done to understand the risk assessment of the coping and adaptation of pastoralists in the wake of climate change and variability.

5.6 Testing of hypothesis

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.660[a]	1	.017		
Continuity Correction[b]	3.831	1	.050		
Likelihood Ratio	7.958	1	.005		
Fisher's Exact Test				.028	.019
Linear-by-Linear Association	5.604	1	.018		
N of Valid Cases[b]	100				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.82.

b. Computed only for a 2x2 table

To test the hypothesis, Pearson chi square test was conducted to test whether there is an association between climate variability and change, and coping and adaptation strategies utilized by the Pokot community. In the analysis, Climate change and variability was independent variable while indigenous knowledge, coping and adaptation strategies were dependent variables.

The results gave a p value of 0.017, df=1. The p value is less than the 0.05 which was the desired significance level.

This meant that the research hypothesis of Pokot pastoralists has not developed strategies of coping with Climate change and variability was rejected as there was sufficient evidence to do so. It was therefore concluded that there is a significant association between climate change and variability and coping and adaptation strategies. The null hypothesis is therefore, rejected for the

alternative. The alternative hypothesis states that Pokot pastoralists have developed strategies of coping with climate change and variability. Hence there is an association between climate change and variability and the coping and adaptation strategies among the Pokot pastoralists. This means that there is a significant impact caused by the climate change and variability on the coping and adaptation strategies employed by the Pokot community. Despite the changing climate the community still continues to use their traditional coping and adaptation strategies to live and survive.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This Chapter concludes the major findings of this study and provides the conclusion and recommendations for the policy makers. The summary of the findings are presented according to the study objectives and the recommendations are based on the conclusions made from the study.

6.2 Summary of key findings

The results indicated that 100% of the respondents have heard and experienced effects of climate change and variability on their localities. Deforestation was thought by the farmers to be the highest contributor of climate change and variability, followed by pollution and global warming having been reported by 98, 38, and 17 respondents respectively. Least contributors include Sand harvesting, soil erosion and overstocking having 6 respondents each while 24 of the households didn't know at all the causes.

The results also indicated that, 94% of the farmers still use Indigenous knowledge on agriculture/livestock keeping, prediction of different weather patterns and food preservation techniques in the management of their farms. The main reason behind relying on IK more than scientific knowledge is that they are used to; it's reliable, accurate and more affordable. The indigenous signs and strategies used by farmers for coping with climate change and variability were similar between the pastoralists and agro pastoralists because the study area is being predominantly occupied by the Pokot community. Migration of livestock and people was a very common strategy which is being practiced by the pastoralists more than the agro pastoralists which could be attributed by the fact that agro pastoralists are practicing preservation of pastures for the use during drought seasons unlike the pastoralists who reported to practice no pasture preservation at all hence the need to move in search of pastures in times of drought.

Some of the Positive indigenous strategies that are being practiced in the study area included; use of organic manure to increase crop production, crop rotation, traditional food preservation methods like smoking of meat, use of ash to preserve the seedlings, separation of livestock to control breeding, use of traditional herbs to treat some of the animal diseases and migration of

livestock during drought. In addition, indigenous strategies practiced by the agro pastoralists more than the pastoralists were agro forestry, irrigation, planting of appropriate crop varieties, preservation of pastures, application of organic and inorganic fertilizers and soil and water conservation. On the other hand, pastoralists practice more of migration, planting of drought tolerant crops, rain water harvesting, keeping of drought resistant animals and management of pest and diseases.

During the Focus group discussions, it came out clearly that the agro pastoralists are no longer practicing migration as compared to ten years ago while the pastoralists are now practicing it more due to frequent prolonged droughts and lack of pasture preservation. Agro pastoralists produce their own agricultural food hence conversant with food preservation methods and with the few cattle they keep, they use the organic manure to enrich their soils for optimum food production. The FGD results also indicated that women from pastoral areas prefer other strategies in coping with drought such as use of shallow wells to draw water, separation of livestock to control breeding as compared to the men who prefer migration of animals during drought in search of water and pastures. This could have been attributed by the facts that, during migration of livestock and people, women and children are left behind while men and boys move with the cattle.

The nomadic transhumance practiced by Pokot pastoralists is characterized by risk-spreading and flexible mechanisms, such as mobility, communal land ownership, large and diverse herd sizes, and herd separation and splitting (Schilling *et al.* 2012). The livestock types kept to manage and spread risk include cattle, camels, goats, sheep and donkeys. These livestock species have different forage and water requirements with variable levels of resilience during drought periods according to the FGDs. Research findings shows that 88 respondents perceived traditional coping strategies being effective while 10 respondents perceived it not being effective. The findings suggested that most respondents rely on traditional approach when making coping strategies compared to the scientific approach because of the low level of literacy and accessibility to ICT materials to pass information and communication.

Pokot pastoralists employ various coping responses against extreme drought events. However, selling of livestock and livestock products fall in both categories as pastoralists use this option to cover regular adaptation costs but also to cope with short-term shocks as 70.6% of the

respondents stated. Other coping strategies to mitigate drought related risk include: Sold livestock (90%), waited for relief food (9%), Participated in cash/food-for-work (71%), slaughter of old and weak livestock (58%), Sought for wild fruits (33%), Selling bush products such as *Aloe vera*, charcoal, firewood (50%), Sought for off-farm employment (30%), and minimization of food for consumption (84%) (Figure 4.13). The drought coping strategies reported by respondents varied from household to households based on existing support systems and local knowledge.

The results further revealed that some of the Pastoralists coping responses to drought are reactive and mainly involve intensive exploitation of scare resources. However, proactive responses such as selling of livestock at the beginning of drought are few. Despite the challenges faced by the coping measures used in the study area, they help households to buffer the adverse effects of droughts. The findings suggested that most respondents rely on traditional approach when making coping strategies compared to the scientific approach because of the low level of literacy and accessibility to ICT materials to pass information and communication. Awareness creation and education through the use of the ICTs according to the FGDs have enabled farmers to prepare as an early warning. The study suggest that heads with higher level of education are likely to have better level of planning, access and understanding of early warning information for effective climate change adaptation. The key area for building climate change resilience of the households in the study area is through the strengthening of education sector.

Out of the total number of respondents interviewed, 62% agreed that they have alternative strategies for adaptation to climate change and variability while 38% do not have an alternative source. A number of adaptation strategies to mitigate adverse impacts of drought are being pursued by majority of the households in the study area. Diversification of livelihood (92%), Livestock mobility (94%), sending children to school (56%), Strategic livestock feed (35%), Develop water sources (15%),Change in diet consumption (78%),Livestock off-take (25%),Storage of pasture (35%) were identified as some of the most commonly used adaptation strategies in the study area. In addition, other adaptation strategies used include increase in sale of livestock, Cash transfers from relatives, livestock insurance and use of early warning information

The findings of this study therefore, have contributed to a better understanding of risk assessment of the coping and adaptation mechanisms for Pokot pastoralists households' to climate change and variability and provides information for supporting adaptation interventions, particularly on how Pokot pastoralist can take advantage of the heterogeneity of the arid and semi-arid environments.

6.3 Conclusions

In Pokot community, majority of the pastoralists and agro-pastoralists are already taking measures to protect their lives and livelihoods against increasing drought events. However, majority find considerable challenges in their adaptation and coping strategies, only a few in the study area are able to withstand the impacts of frequent droughts. The community has rich indigenous knowledge which is highly held in tacit form. Ignorance of this indigenous knowledge has led to loss of traditional strategies, values and practices. Ways of integrating the rich indigenous knowledge with formal knowledge should be the new way to go for adaptation of climate variability and change. A way of communicating, disseminating, storing and retrieving by the use of Information and communication technologies should be devised for the indigenous knowledge to be useful for future generation.

Long term adaptations strategies to drought have been constrained by a number of socio-economic, political changes and deteriorating ecological conditions as per the FGDs carried out during the study. For instance, violent conflicts, lack of affordable credit facilities and financial services, limited access to markets, changing land tenure and poor infrastructure. Also problematic in addition, there are some indicators which include access to veterinary services, degradation of grazing lands and extension services. The main factors associated with increasing rangeland degradation in the area include over-exploitation of resources due to localized increase in human and livestock populations, changing land use patterns, Sedentarisation of the pastoralist, privatization of the communal land tenure, insufficient and unreliable rainfall and poverty caused by changing climatic conditions.

The study suggest that heads with higher level of education are likely to have better level of planning, access and understanding of early warning information for effective climate change adaptation. Thus strengthening education sector could be one of the key areas for building

climate change resilience of the households in the study area. The average size of household had a positive and significant influence on the likelihood that pastoralist adapt to climate change. Larger households are associated with higher labour endowments, which would enable the household to accomplish various production tasks (Nhemachena and Hassan 2007; Silvestri *et al*. 2012).

Important roles in strengthening the adaptation and coping strategies lies with the government, the private sector, non-governmental organizations, and donor agencies. It is critical in particular to value pastoralism as a productive and sustainable adaptation strategy for Pokots, by guaranteeing free and safe livestock mobility, improving the provision of security, access to education, markets and communication infrastructure. This ought to be coupled with offering affordable credit facilities, strengthening extension services, diversification of livelihoods, and enhancing livestock diversity and species for drought resilience.

The recently adopted Kenya ASALs policy is a good starting point but its implementation will be paramount in offering pastoralists' support required for effective adaptation and coping responses. Resilience to drought will remain a mirage without significant support by the government to reduce drought risks in Pokot, including violent conflict, households' resilience to drought.

This research therefore in a nut shell concludes that pastoralism remains one of the most important sustainable livelihood production systems in Pokot community with the right policies and targeted investment in identified adaptation and coping responses in the area.

6.4 Recommendations

This study therefore has demonstrated that the Pokot pastoralists coping and adaptation strategies have been significantly affected by climate change and variability. Households level strategies for adapting to climate variability and change are constrained by frequent droughts all compounded by widespread poverty, violent conflicts, diseases outbreak and poor range conditions in Kongelai Ward has been revealed by the research. From the study a number of recommendations can be suggested which includes:

6.4.1 Recommendations to policy makers

- For better planning and targeting interventions for both government and non-governmental organization, integration of indigenous knowledge on perceptions of climate change and variability with scientific meteorological data on rainfall and temperature trends are necessary.

- Awareness creation for farmers by the government ministries and Private research organization on detrimental effects on environment caused by their daily normal activities such as deforestation, sand harvesting, overstocking and over use of inorganic chemicals are vital.

- To reduce on the rate of deforestation for fuel and charcoal businesses which is being practiced by majority of the farmers as a source of income an alternative source should be solicited for by the government.

- To avoid future scenarios of climate change and variability, there is a need to support pastoralists' adaptation and coping strategies and indigenous knowledge. More concentration should focus on efforts to reduce climate risk and expanding opportunities for diversification of livelihoods, safe livestock mobility and herd diversification. In addition for climate resilient households in Pokot, interventions that promote women empowerment, support education, enhance access to markets and climate information is paramount and should be provided by both County and National governments.

- In the areas experiencing severe drought, extension services should be enhanced by government and non-governmental organizations to give information on types of drought tolerant crops/animals, importance of organic manure, rain water harvesting techniques, use of ICTs to disseminate information, treatment of different pests and diseases, credit facilities available for farmers, preservation of pastures/hay.

- There is need to systematically review current plan and strategies to assess the synergies and gaps on climate change adaptations at a more local level in order to improve the national and county government engagement on climate change and variability. Threat to

sustainability of pastoral mobility through fragmentation and privatization of rangelands needs to be addressed in the policy documents by the government.

- Documentation and dissemination of information by the government and non-governmental organizations using the new emerging ICTs for all indigenous knowledge strategies useful for coping and adaptation to climate change and variability by the Researchers should be emphasized.
- To enhance pastoralists' resilience to drought and heat stresses in Pokot by the government, diversifications of livestock herd with more browsers – goats and camels would also be appropriate.

6.4.2 Recommendations for future Research

Additional research is needed to strengthen the basis of decision-making and generate more information to enhance understanding on climate change and variability in the Pokot Community. The areas for future research should include but not limited to the following:

- Research to ascertain the underlying factors influencing the climate of Kongelai Ward, causes for the differences in temperatures and at the same time impacts of changing land use patterns, and degradation needs consideration in future research.
- Further research is also required to identify and understand physical factors which affect Climate change and variability in the Study area. This understanding would be a pre-requisite for improving rainfall early warning predictions.
- The increasing use of charcoal burning in Serewo, Kitalakapel and Poole Sub-Locations as coping strategy need to be understood better especially with challenges of future climatic scenarios in terms of socio-economic and ecological sustainably.
- The relationship between human activities and climatic factors, and coping and adaptation strategies using the indigenous knowledge among the pastoralist livelihood need to be ascertained.

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APPENDICES

Appendix 1: Introductory Letter to Respondents

RAPHAEL PKEMOI MAGAL
P.O. Box 664-30600 Kapenguria,
7th July 2016

RE: QUESTIONNAIRE

Dear respondent,

I am a post graduate student at the University of Nairobi undertaking a Masters course in Environmental Planning and Management and as part of the course, I am undertaking research study on "Assessment of the Coping and adaptation mechanisms of Pokot Pastoralists to climate change and variability-(Case study Kongelai Ward).

Kindly please assist in filling the attached questionnaire honestly and precisely as possible. The information will be treated with utmost confidentiality and will be used for the purposes of the study only. Please tick[√] appropriate or fill in the required information on the spaces provided.

Thank you for your cooperation.

Yours faithfully,

Raphael P. Magal.

Appendix 2: Household Questionnaire

Household Characteristics

1.Date of interview:	2.Questionnaire No:
3.County:	4.Name of respondent:
5. Location:	6.Sub-Location:

7. Gender: Male (1) Female (2)

8. Age of the household head? (1)18-30yrs (2)31-50yrs (3)51+yrs (4) don't know.

9. What is your marital status?

(1)Single/never married

(2) Married

(3)Divorced/Separated

(4)Widowed

9. How long have you lived in this village?

What is your household size?

How long have you lived in this village?	(√)	What is your household size?	(√)
(1)Less than five years		(1)1-5 Persons	
(2) 5-10Years		(2) 6-10 Persons	
(3) 11-15 Years		(3) 11-15 Persons	
Over 16years		(4) >16Persons	

10. What is the highest level of education for the household head in terms of number of years in school? (√ As appropriate)

0 yrs	No formal education	
8yrs	Primary education	
12yrs	Secondary education	
14yrs	Tertiary education	
16yrs	University education	

12. How many persons in each age bracket? (1)0-4 yrs….. (2) 5-14yrs…… (3) >15yrs……

13. What is your household's main source of income? (1) farm-based (2) Off-farm

Farm based	How much per month(Kshs)	Off/non-farm based	How much per month?(Kshs)
Livestock farming		Micro-business/small-scale	
Crop farming		Casual labour	
Crop and livestock farming		Artisan	
Others(Specify)		Salaried/fixed employment	
		Charcoal burning	
		Fishing	
		Mixed(Specify)	

1.0 <u>Indigenous knowledge and Climate variability</u>

1.1 Have you ever experienced or/noticed any climatic changes and variability in your locality?

(1) Yes (2) No

1.2. If Yes in 1.1 above, what aspects of climate change or variability have you experienced?

(a) Rising temperature

(b) Droughts

(c) Floods

(d) Erratic rainfall

(e) Low rainfall

(f) Strong wind

(g) Cold spells

(h) Water stress

(i) Others (specify)_____

1.3. To what extent have the changes identified in 1.2 above impacted on Pastoral/agricultural activities? (Please tick as appropriate)

At your farm/local level	**At the national/regional level**
Reduced crop yield [ ]	Insufficient food [ ]
Change in planting time [ ]	High food prices [ ]
Crop failure [ ]	Human wildlife conflicts [ ]
Increased pest and disease infestation [ ]	Competition over resources [ ]
Flooding of crop fields [ ]	Others (specify) ……..
Reduced soil moisture [ ]	
Others (specify) …….	

1.4 Have you ever noticed any changes in the following indicators? If yes explain

Indicators	Yes(1)	No (2)	If yes, explain
Drought			
Floods			
Wind			

1.5. What in your opinion are the possible causes of climate change and variability?

1.6. Do you use indigenous knowledge to cope and adapt to climate change and variability?
(1) Yes (2) No

1.7 If yes, what kind of indigenous knowledge?

1.8 How is the knowledge helpful in coping and adapting to climate change?

1.9 Where did you get the knowledge from?

Any components of the knowledge?

1.7. From your point of view would you recommend adoption of indigenous knowledge in livestock production as a way of coping and adapting to climate change and variability?

- Yes
- No

1.8. Using the indigenous techniques above, are you able to forecast weather changes accurately?
(1) Yes (2) No

1.9. If yes to 1.8. Which indigenous strategies do you employ in livestock to adapt to climate change and variability?

1.10. In what ways do you think the indigenous knowledge related to adaptation of climate change can be strengthened to be adopted in other various part of the world?

2 Coping mechanisms

2.1 What are the coping strategies that your household used during the previous droughts?

2.1.2 Which one did you use during the previous drought?

1) Did nothing
2) Sold livestock
3) Waited for food
4) Participated in cash/food-for-work
5) Ate less
6) Sought for wild fruits
7) Sought for off-farm employment.

2.2 Were there any traditional (observable and non-observable) indicators suggesting there would be a disaster/hazard that year? Yes (1) No (2)

If yes which one?

2.3 How did the disaster/hazard affect your household?

1) Decline in crop yield
2) Loss of income
3) Food insecurity/shortage
4) Death of livestock
5) Decline in consumption
6) Others(specify)

2.4. Apart from the indigenous knowledge mentioned what is the other source of information for climate variability?

2.4.1 Between the traditional approach and the scientific approach, which one do you rely on most when making coping strategy?
(1) Traditional approach (2) scientific approach

2.5. Why would you go for the approach in 2.4above?

2.6 What are some of the traditional coping mechanisms that you are still using?

2.7 Do you perceive traditional coping strategies effective? Yes (1) No (2)

2.8 Are you able to move your livestock freely to the traditional grazing areas? Yes (1) No (2).

2.9 What challenges do you face during migration

2.10 In a scale of 1 (low) to 5 (high), how do you rate the accuracy of scientific weather forecasting 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]

2.11 What are the factors that you consider to influence your climate adaptation and coping process?

1) Lack of climate information
2) Lack of money
3) Shortage of labour
4) Lack of skills
5) Lack of education
6) Lack of alternatives
7) Others (Specify)

3.0 Adaptation strategies

3.1. Which types of practices are used in your locality in response to climate change?

3.2. Which strategies of the ones mentioned in 4.1 above do you use?

3.3. Are you aware of other strategies that can be used in response to current and/or anticipated climate change? (1) Yes (2) no

3.4. If yes, which are they?

APPENDIX 3: GUIDING QUESTIONS TO FOCUS GROUP DISCUSSIONS (FGD)

Address (Location) of the village.....

Focus group size…….....

Focus group composition: No. Males……No: Females……No: Youths…….....

1. Do you feel the pattern of weather is generally changing?
2. Over the last 5-30 years have you noticed any changes in weather patterns?
3. What do you think is the cause of the change?
4. What are the main stresses (or difficulties) faced by community today? Are these stresses or difficulties changed over the past years? And how?
5. Have you heard of "Climate change"? From which source?
6. Can you describe any major climate related events which have happened recently?
7. What was your experience of this? How was your household or the community affected?
8. What are your traditional or local indicators to realize that there are these changes?
9. What has been the main impact of climate change on livestock, water resources and pasture?
10. How has the climate change and variability affected livelihoods?
11. Is this area drought and /or flood prone? If yes, explain the frequency over years of climate extremes?
12. What can you say about intensity/strength of climatic extremes (flood and drought) compared to scenarios 10-20 years ago?
13. What are the main livelihoods strategies of the community in this area? Has this changed over the past years?
14. How important are climate conditions for these livelihood strategies?
15. What are the coping and adaptation strategies people put in place when facing climate related events?
16. What are the main challenges to cope?
17. What are the locally perceived existing barriers and obstacles to adaptation, and in which way do community members consider to overcome them?

APPENDIX 4: INTERVIEW GUIDE FOR KEY INFORMANTS.

County Agricultural Officer, County Environment Officer, National Drought Management Authority, County Livestock Officer.

Name……..Position/Profession……

1. Has there been any form of climate change and variability in your County in the last 5-30 years? If your answer is yes, please can you explain?
2. If the answer to Q1 is Yes, please explain the extent of climate change and variability?
3. What is the impact of climate change and variability on the livelihood of the people there? (Livestock farming, water resources, land resources)
4. Which areas are prone to climatic shocks e.g. floods, drought, and other extreme weather events?(Identify areas/hotspots and groups of people more at risk to climate change and variability in relation to water resources, pasture and ecosystem degradation).
5. How has climate change and variability affected livestock, pasture and water availability in the county?
6. Who are the most vulnerable group to the impacts? Why?
7. What are the local coping mechanisms used to reduce the impacts?
8. What are the past and present external (governmental and NGOs) responses to climate variability and change and what are their impacts?
9. What are the institutions efforts to reduce future impacts?
10. To what extent is the community able to anticipate and identify triggers for forthcoming changes in livelihoods?
11. How does your organization interact with the community and what measures have been taken in order to develop the adaptive capacity of the community to climate variability or change?
12. What are the locally perceived existing opportunities and capacities to foster adaptation of the community to climate variability?
13. What are the formal & informal organizations/ institutions, rules & regulations, that either support or hinder local livelihoods in facing climate related impacts and changes? How do they interact with the community?
14. What are the main challenges and how do you think they can be improved?

15. Are there facilitations and supports from County government to strengthen individual farmers' adaptive capacity to climate changes?
16. Are there capacity building opportunities available for the County leaders relating to climate Change?
17. Are there policies that improve farmers' productivity and adaptive capacity, including policies on new technology extension, livestock infrastructure development, market and price scheme, income diversification etc.

APPENDIX 5: TIMEFRAME

Proposal Writing	November-December, 2014
Preparation of Instruments	January-February,2015
Pre-testing instruments	March-April,2016
Data collection	May-June,2016
Data analysis	July-August,2016
Report Writing	August-September,2016
Oral examination	September-October,2016
Corrections	October
Final submission	October-November,2016