

# Risk Assessment of Traditional Strategies, Values and Practices of Pastoralists to Climate Change and Variability: A Case of West Pokot County, Kenya

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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. It 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 using Indigenous Knowledge. Pearson chi square test was performed to test the hypothesis on whether there is an association between climate variability and change, and traditional strategies, value and practices utilized by the Pokot pastoral 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 whereby Nasuirma model formula was used to arrive at the sample size of 98 households taken from 5,596 households. Multi-stage sampling technique was used, and information obtained was analyzed using inferential and descriptive statistics.. The results indicated that 100% of the respondents have heard and experienced effects of climate change and variability on their localities.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 indigenous signs and strategies used for coping with climate change and variability were different between the pastoralists and agro pastoralists. Some Positive indigenous strategies that are being practiced by agro pastoralists included; use of organic manure, crop rotation, traditional food preservation methods, use of ash to preserve the seedlings, agro forestry, irrigation, planting of appropriate crop varieties, preservation of pastures, application of organic and inorganic fertilizers and soil and water conservation while pastoralists use separation of livestock to control breeding, use of traditional herbs to treat animal diseases and migration of livestock, planting of drought tolerant crops, rain water harvesting, keeping of drought resistant animals and management of pest and diseases.*

*The FGDs further 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.*

*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. 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.*

*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 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. 62% of the respondents interviewed agreed that they have alternative strategies for adaptation to climate change and variability while 38% do not have an alternative source. Most commonly used adaptation strategies include; 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%).Other strategies include increase in sale of livestock, Cash*

*transfers from relatives, livestock insurance and use of early warning information. 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*

*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.*

**Keywords---** climate change and variability; traditional strategies, risk assessment

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## 1. INTRODUCTION

### 1.1 Background to the study

According to (Boko *et al*, 2007; Lobell *et al*, 2011), Africa is particularly vulnerable to climate Change and variability. The 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. 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.

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). This argument is likely to threaten the sustainable development goals 2013 which were adopted after the millennium development goals failed to be fully achieved. 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 like the case of west pokot. 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. 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 total of 268 million pastoralists reside in Africa who inhabit 43 percent of land mass and account between 10 to 44 percent of GDP of their respective countries according to African Union's policy framework for pastoralism (2010). Out of these, an estimated 50 million pastoralists live in sub-Saharan Africa inhabiting arid and semi-arid regions which give a better understanding of the magnitude of the problem. 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. 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. There are also indications that pastoralists are caught in a dilemma. On 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). 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). 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). 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). 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). 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).

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). 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. 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 because, communities possess different vulnerabilities and adaptive capabilities, they tend to be impacted differently, thereby exhibiting different adaptation needs. 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. 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).

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.

### **1.2 Justification of the study.**

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. According to Smith *et al.*, (2001) 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;

- The impacts of Climate change and variability are felt more on pastoralists since it affects crops and livestock production and they occupy the fragile arid and semi-arid lands where drought occurrence is more rampant.
- 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 of West Pokot County 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 communities' future in relation to adaptation strategy to climate change and variability.

### 1.3 Scope and limits of the study

Interactions of ecological, socio-economic and socio-political factors have led to vulnerability of Pokot 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. This paper shows new emerging traditional coping strategies and adaptation models and changes in vulnerability among the pastoralists. The variables addressed in the study include; climate change, adaptation and coping strategies of the Pokot pastoralists using traditional strategies values and practices. The paper has considered some of the implications of the findings, including the cultural consequence.

The research covers West Pokot County which is characterized by a variety of topographic features with three main livelihood zones namely Pastoralists, Agro Pastoral and Mixed farming.

The County experiences a bimodal type of rainfall with the Long Rains falling between March and June while the Short Rains fall between September and November. 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. Subsequently pastoralists have been highly affected by climatic variability

Kongelai Ward is situated in the lowlands of Pokot County where fluctuations in Climate coupled with structural challenges as a result of poor infrastructure development that affects access to basic public services and general accessibility.

## 2. STUDY METHODOLOGY

### 2.1. 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. Using Nasuirma Model formula to arrive at the sample size, a total of 98 households were selected to form the study population.

In order to select participating villages and households for interviews, a Multi-stage sampling procedure was adopted. Based on geographical location, dominant livelihood activity and vulnerability to drought events, Kongelai Ward was purposively sampled. 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. Therefore, every head of household had a chance of being selected to participate in the research.

**Sample distribution in each Sub-Location**

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

source: researcher 2016

### 2.2 Methods of data collection:

**household survey** was conducted using a standard questionnaire. 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. Questionnaires was administered to the household heads and was designed to capture information on family characteristics (educational, marital status, family size, age, gender) ,traditional knowledge used to assess climate change risk, local perception about climate change and variability, their coping and adaptation strategies, unreliable rainfall onset and seasonal distribution. 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.

**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 was appropriate for generating information and ideas in situations when general descriptive information was needed, and when understanding of the underlying motivations and attitudes of a target population was required. The interview focused on climate pattern, Pastoralists, impact of climate variability and change, indigenous knowledge and coping and adaptation strategies.

**Focus group discussion** 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 3 FGDs were carried out in Kongelai, Kitalakapel and Serewo Sub-Locations. FGDs were used to complement the information obtained from the key informant interviews. FGDs participants were selected based on their role in the community, acceptance with community and knowledge of the culture and social organization of the community. FGD 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

**Field observations** were 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.

**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.

### 2.3 Data Analysis

This research used qualitative and quantitative methods. Qualitative method gave 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

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 was used in testing the hypothesis.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Socio-economic characteristics of the respondents

#### 3.1.1 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 were more perceived by female-headed households than their male counterparts as major threat to pastoralists economy. The findings show that gender of household head significantly influenced the likelihood that a household took up the climate variability and change adaptation strategies towards risk assessment. 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).

#### 3.1.2 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%.

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 using traditional mechanisms. 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.

### **3.1.3 Level of education of the household head**

Male headed household heads dominated the Study area, 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. Education level of the household head is important since it enables them utilize ICTs/model which creates awareness through early warning system that prepare them in the event of weather variability. Planning for grazing management and prediction of rainfall patterns has been hindered by illiteracy. However, households have remained loyal to their traditional values and practices which have made them survive turbulent climatic conditions

### **3.1.4 Household's main source of income**

Pastoralism according to the findings is the main source of livelihood in the study area; most respondents derive their income from livestock production (69%) although livestock keeping alone for most households is not enough to secure their livelihood. Additional activities that households engage in include; crop production, mixed farming and poultry production. Livestock species kept by most households were goats, sheep, camels, cattle and donkey. The results suggest A shift in herd composition is suggested as 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. Pokot pastoralists do not have enough food for better part of the year as a result of frequent weather variability. Engagement in wage labour, receiving cash remittances from relatives and government, engaging in sale of charcoal and firewood, in addition to venturing in other small businesses enterprises in households have been devised as a way to cope with these situations.

Access to affordable credit facilities is likely to ease cash constraints and allows households to invest in production inputs for climate variability and change adaptation as suggested by the study. 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). Probability that pastoralists adapt to climate change and variability is determined by farm income which has a positive and significant impact. 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.

## **3.2 Households' perceptions of climate change and variability**

Climate change and variability has been heard and experienced by 100% of farmers. The research findings pointed out clearly that deforestation and pollution from industries are the main causes of climate change as reported by some farmers. Majority of the farmers that were interviewed 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. High levels of illiteracy and poor sources of information leading to low awareness levels is attributed to most farmers not understanding or rather know the causes of changing climatic condition which they have felt and experience.

Majority (100%) of the respondents perceived various changes in climatic factors in the study area though it varies between different respondents. Experience in temperature changes and rainfall amount, frequency and length of rainy season over the last three decades has been reported by high proportion of the respondents. Most of the respondents (100%) perceived increasing temperature, while none observed a decrease in temperature. 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. 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).

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.

### **3.3 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. The ultimate impact of these changes has been loss of livestock and increased food insecurity among the pastoralists community

### **3.4 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.

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

### **3.5. Perception and reliability of the traditional strategies, values and practices used by the Pokot community to cope with climate change and variability.**

#### **3.5.1 Perception of farmers on the traditional coping strategies**

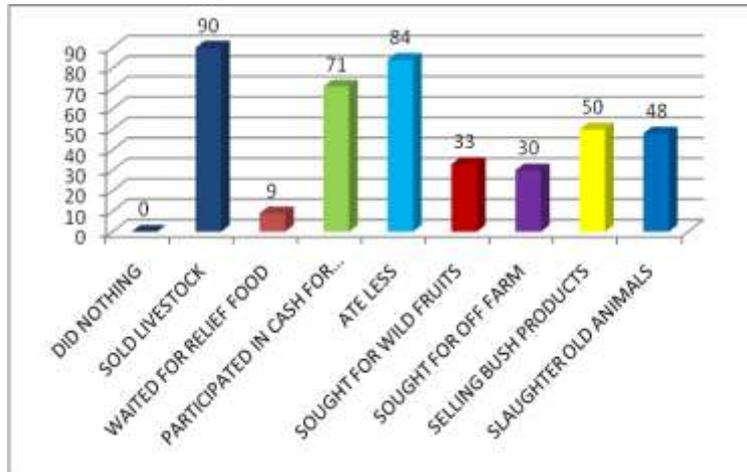
According to the research findings, 88 respondents perceived traditional coping strategies being effective while 10 respondents perceived it not being effective. The findings suggested that most respondents rely on traditional approach when making coping strategies compared to the scientific approach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

##### **3.5.1.1 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%) as shown in the figure below. The drought coping strategies reported by respondents varied from household to households based on existing support systems and local knowledge.

**Figure: 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 scarce 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 Figure above. Despite the challenges faced by the coping measures used in the study area, they help households to buffer the adverse effects of droughts

### 3.5.1.2 Reliability of the coping strategies.

The reliability of the coping strategies is based on indigeneous and scientific knowledge in the study area. The findings suggested that in Serewo sub-location none of the 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 respondents rely on indigeneous approach, and while in Kitalakapel 4 respondents preferred the scientific approach and 30 respondents preferred the indigeneous approach on making coping strategy. The overall 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.

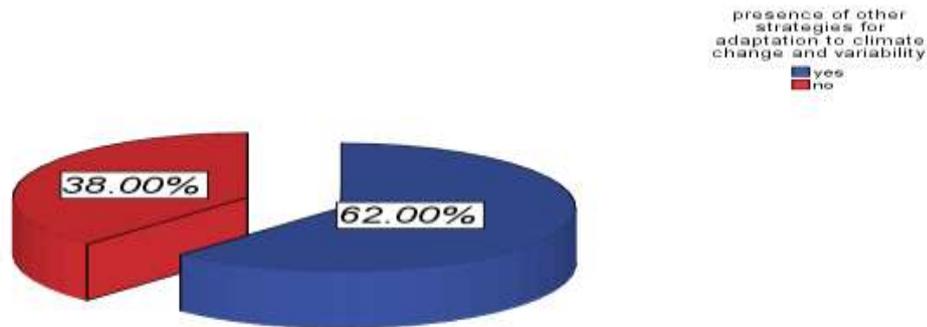
The findings from the research suggested that 47% of the respondents agreed that the accuracy of scientific in weather forecasting being moderate, 20% being low, 19% being fairly high, 9% being high and 5% being very low in the rating scale of 1(low) to 5(high). This majorly depended on the literacy level of the respondent and their ability to access the ICTs according to the FGDs. 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.

### 3.6 Risk assessment of the climate resilience Pokot pastoralists households 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;

### 3.6.1 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.

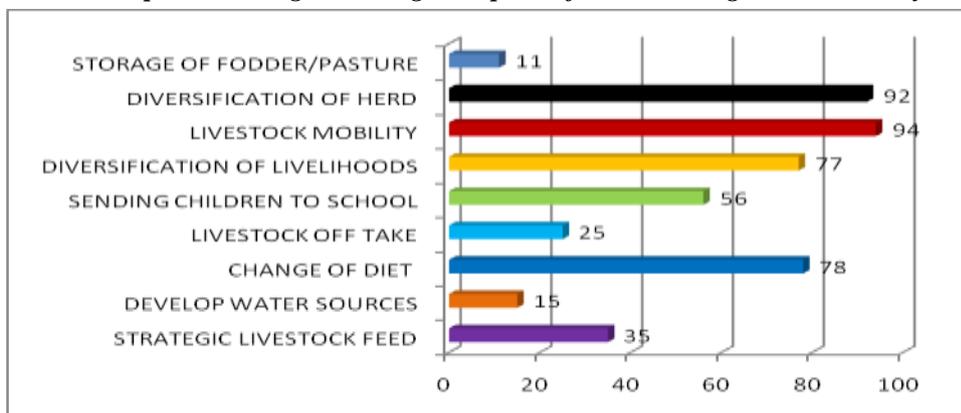


Source: Field data-2016

#### 3.6.1.1 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. Figure below summarizes a number of adaptation techniques and the percent of respondent using the strategies. Diversification of livelihood (77%), 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 (11%) 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.

#### 3.6.1.2 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 vera 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.

Many literate youths with animal health training and skills through sale of veterinary drugs and attending to sick animals 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.

### **3.6.1.3 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.

### **3.6.1.4 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.

### **3.6.1.5 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.

### 3.6.1.6 Livestock 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.

### 3.7. 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%). 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 scarce 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.

## 4. 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 study area 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 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. The perception of these changes, however, varies between genders. 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. 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. These observations were consistent across the entire study area. 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 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. During the FGDs, 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.

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 ease 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 Vera cultivation.

Findings from the study has shown also 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.

#### 4.1 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 <sup>a</sup>	1	.017		
Continuity Correction <sup>b</sup>	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 <sup>b</sup>	100				

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

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.

## 5. 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 finds considerable challenges in their adaptation and coping strategies.

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. 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. Strengthening education sector could be one of the key areas for building climate change resilience of the households in the study area. 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. 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%). The drought coping strategies reported by respondents varied from household to households based on existing support systems and local knowledge. 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. 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 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. 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. RECOMMENDATIONS

The findings from the have demonstrated that climate change and variability has significantly impacted on the Pokot pastoralists coping and adaptation strategies with Frequent droughts in Kongelai ward which has constrained households' level strategies compounded by widespread poverty, violent conflicts, disease outbreak and poor range. From the study a number of recommendations can be suggested which includes:

### 6.1 Recommendations to policy makers

- Integration of indigenous knowledge on perceptions of Climate change and Variability with Scientific meteorological data on rainfall and temperature trends is paramount for better planning and targeting interventions for both government and non-governmental Organizations.

- Capacity building to farmers by government ministries and private bodies to farmers on the impacts on environment of their daily activities such as deforestation, sand harvesting, overstocking and overuse of inorganic chemicals are vital.
- There is need to support pastoralists' adaptation and coping strategies and indigenous knowledge in order to avoid future scenarios on climate change and variability. Concentration should focus on efforts by County and National Government to reduce climate risks and expanding opportunities for diversification in addition to interventions that promote women empowerment, support education, enhance accessibility to markets and climate information in order to have climate resilient households in Pokot.
- Enhancement of Extension services by both government and non-governmental organization by providing information on varieties 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, availability of credit facilities and pasture/hay preservation.
- Review on the current plan and strategies to assess the synergies and gaps on climate change adaptations at a more local level in order to enhance and improve engagement by the National and County government on climate change and variability. The policy document by the government needs to address the threat to sustainability of pastoral mobility brought about by fragmentation and privatization of rangelands.
- The government should enhance pastoralists resilience to drought and heat stresses in Pokot through diversification of livestock herd with more browsers-goats and camels which will also be appropriate.

## 6.2 Recommendations for future Research

In order to strengthen the basis of decision making and generate more information to enhance understanding on Climate Change and variability in Pokot Community an additional research is needed. Future research should focus and not limited to the following;

- Consideration in the future research on underlying factors influencing the Climate, Causes of variation in temperatures and impacts on the changing land use patterns and degradation needs to be ascertained.
- In order to improve rainfall early warning predictions in the area of study, a further research needs to be carried out to identify and understand physical factors which affect Climate Change and variability.
- There is need to ascertain the relationship between climatic factors and anthropogenic activities, and coping and adaptation strategies using the indigenous knowledge among the pastoralists livelihoods.

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