



University of Nairobi

**ASSESSMENT OF VULNERABILITY OF PASTORALISTS TO THE ADVERSE
IMPACTS OF CLIMATE CHANGE: A CASE STUDY OF WEST POKOT COUNTY,
KENYA**

BY

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DECLARATION

I declare that this dissertation is my original work and has not been submitted anywhere for the award of degree in this university or any other institution.

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DEDICATION

I dedicate this dissertation to my family - my dear wife (Mrs. Lilian Dakta) and children (Nimrode Ruto, Nicole Chepkech, and Nimpha Cheporit). Your great inspiration and support were very key to the realization of my study. God bless you abundantly!

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ABSTRACT

The IPCC report of 2017 noted that climate change is expected to worsen the existing vulnerabilities of natural resource-dependent communities while at the same time imposing new risks beyond the range of existing experiences. This study examined how vulnerable pastoralists are to the adverse impacts of climate change by analyzing climate variables (temperature as well as rainfall) and the characteristics of pastoralists that reflect their exposure, sensitivity as well as adaptive capacity based the definition of vulnerability as a function of high level of exposure, sensitivity and adaptive capacity. The study sought to examine the spatial-temporal variability of climate, determine the characteristics of pastoralists and their vulnerability, and evaluates the existing adaptation and mitigation strategies of pastoralists from West Pokot County. The spatial-temporal variability of climate in West Pokot County was determined using trend and seasonal analysis of data for temperature and rainfall from climate hazard infrared temperature station data (CHIRTS) and climate hazard infrared precipitation station data (CHIRPS) for the period of 1981-2019. Questionnaires were administered to households to determine the characteristics of pastoralists in west Pokot County and the existing adaptation and mitigation mechanisms. The findings show that temperature was increasing in the county but at different rates in different sub counties with Pokot Central Sub County having significant increasing trend followed by Pokot North Sub County during October-November-December (OND) season. On the other hand, rainfall showed a partial increasing trend both in OND and (March-April-May) seasons. The study revealed that the pastoralists in west Pokot were mainly characterized by high level of illiteracy (66.7%), their main source of income coming from livestock (56.0%), their main occupation being livestock keeping (72.9%), higher household size ranged from 6-10 members (58.5%) and low monthly income ranged from Ksh. 1,000 to Ksh. 5000 (52.2%). These livelihood characteristics of pastoralists revealed that pastoralists were seriously exposed to climate change effects with high sensitivity to the negative consequences since it interferes with their only livelihood. Low literacy levels and the low level of monthly income indicated that those pastoralists were having low adaptive capacity. Pokot central was the most exposed community to climate change effects followed by Pokot north Sub County. The frequency of droughts in these sub counties had a yearly increasing impact where majority of the respondents (77.6%) reported that they had experienced yearly increasing death of animals as a major effect to their livelihoods because they felt that death of animals deprived them the main source of income. The coping mechanisms employed by

pastoralists west Pokot County included; migration (58.6%), cutting of tree leaves (23.2%), Paddocking (1.7%) Livestock off-take (1.4%) and reserving grazing lands (6.8%). Migration as a coping mechanism was not sustainable and cutting of trees was not environmentally friendly as it destroyed the forest cover which could help sequester carbon (iv) oxide. Pastoralists opted to these coping strategies not because they were the best but as a desperate move, having no other option. Recommendations for study included Diversifications of livelihoods to enhance pastoralists' resilience to climate change shocks in West Pokot County, more resilience interventions such as increasing irrigation schemes be implemented in Pokot central and other pastoral livelihoods areas of similar characteristics, capacity building of pastoralist to embrace climate smart livestock rearing and livestock breed diversification in order to build their resilience to climate extremes shocks

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LIST OF ABBREVIATIONS AND ACRONYMS

NCCRS	National climate change response strategy
KNBS	Kenya National Bureau of Statistics
ASAL	Arid and semi-arid lands
FAO	Food and Agriculture Organization
WMO	World Meteorological Organization
GDP	Gross Domestic Product
NDMA	National Drought Management Authority.
NGO	Non-governmental organizations
IPCC	Intergovernmental Panel on Climate Change
SSS	Sub-Saharan Africa
KMC	Kenya Meat Commission
ENSO	El Nino-Southern oscillation
EU	European Union
RVF	Rift Valley Fever
AR4	4 th assessment report on climate change.
NCAR	National Centre for Atmospheric Research
SREs	Special report on emissions scenarios
DPSIR	Drivers, pressure, state, impact, response
CIDP	County integrated development plan
ADP	Annual Development Plan
RRI	Risk Reduction Index
FGD	Focused Group Discussion
WRMA	Water Resource Management Authority
NDVI	Normalized Difference Vegetation Cover

AVHRR	Advanced Very High Resolution Radiometre
KMS	Kenya Meteorological Services
SPSS	Statistical Packages for Social Sciences
GIS	Geographic Information System
CHIRP	Climate hazards infrared precipitation
CHIRTS	Climate hazards infrared temperature
MAM	March-April-May
OND	October -November –December
CCAFS	climate change agriculture and food security

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DEFINITION OF KEY TERMS

Extreme events: this term has been used in this document to mean climatic events that are beyond the existing experiences.

Pastoralists: the communities whose livelihoods are dependent on livestock mainly having the features of seasonal migration as a form of adaptation to droughts.

Climate change: It is a long-term observable statistical difference of a climatic condition such as variability in rainfall amounts and frequency, drought, floods and low temperatures.

Climate variability: refers to changes in statistical values such as means and standard deviations of climatic occurrences such as rainfall, temperature, and floods.

Dry lands: These are regions where agricultural production is done through rainfed means. Such areas are dry and sub-humid with an aridity index of between 0.50-0.65.

Exposure: this refers to items and units that are negatively affected (or with potential future harm) by climatic events including floods, rainfall, and temperature.

Mitigation: this refers to the elimination or reduction of calamity severity

Rangeland: This refers to land (e.g. communal land) with vegetation that has not been deliberately planted (mostly, grasses, shrubs and trees) are suitable for grazing of livestock.

Resilience: This refers to the ability of a social unit (e.g. a household) to maintain a given level of well-being amidst climate related shocks and stresses.

Risk: This is a quantifiable outcome that has known probabilities of likelihood.

Sensitivity: This refers to a measure of likelihood of a human system to be affected by climate change.

CHAPTER ONE

INTRODUCTION

1.0 Background of Study

Climate change is of great concern in the world today (FAO, 2017). Due to the geographical location, Africa happens to be one of the most affected continents by the adverse impacts of climate change, making it highly vulnerable to the impacts of changes in rainy periods to increased sensitivity to droughts. Africa is also severely affected with regard to adverse impacts of climate change on livelihoods and food security (FAO, 2017). Climate change triggers numerous threats of pests and diseases as well as illness in the agricultural sector which significantly affects productivity of the sector. To avert the negative effect of climate change, proactive adaptation measures are necessary to bring about systemic and transformational changes in livelihoods and food security systems accompanied by a combination of improved trade policies (CCAFS, 2015). Many parts of Kenya notably in arid and semi-arid lands (ASALS) such as west Pokot County experiences multiple climate related risks and are more vulnerable to extreme climate change episodes including drought, floods and landslides (Muricho *et al.* , 2018).

Whereas climate change is a phenomenal event, it severely affects poor people and countries much more compared to developed countries such as America (Muriithi *et al.*, 2017).

The livestock sector is estimated to more than forty percent of the total agricultural gross domestic product in Kenya. According to public policy research and analysis(KIPPRA ,2015), this sector recruits more than fifty percent of the entire agricultural labor in herding, marketing, and processing of livestock goods, cultivation of pasture and production or manufacture of commercial feeds and other inputs (serdeczny *et al.*, 2015). Indigenous livestock contributes to more than 70 percent of the local demands of meat, dairy products, and milk, among other products (Silver, 2017). Census conducted by Kenya national bureau of statistics in 2009 asserted that goats, sheep, and cattle are the crucial sources of the red meat.

Climate change is continuing to worsen the already bad condition in rural development in numerous parts of the world and across many communities, leading to greater poverty and

marginalization. Extreme weather conditions related to changes in climate are also responsible for increased risks in loss of livelihoods and capacities for resilience building. This study seeks to provide insights into climate change effects on the lives of pastoralists in West Pokot County of Kenya.

1.2 Problem Statement

It is evident that pastoralists go through many external stresses brought about by climate-related extremes. Recently, the trend of environmental pressures has completely altered the dynamics of conflict. For example, the research which was published by Huho (2012) discovered that the drought in 1999-2001 which killed the entire livestock among the Turkana people increased pressure on the community that made them to attack other pastoralists in an endeavor to restock their herd creating an unfriendly social environment. This escalated violence and inter-community conflicts. Oxfam (2012) stated that in the arid lands of northern Kenya, severe droughts were previously witnessed once in a decade, but now happen every five years or less. These pastoralists can be competing for the scanty pastures and water more frequently. The current scenario indicates that West Pokot County is increasingly becoming prone to droughts with cases reported on an almost annual basis.

According to Huho (2012), whenever there is drought, grazing regions as well as water points are mostly located in disputed lands which are mostly shared by different communities. Each community struggles hard for the scarce commodity and in the process, clashes erupt creating an unfriendly social environment that escalates violence and inter-community conflicts. For example, drought was recorded in 1999-2001, 2002, 2003, 2004-2006, 2007 and 2008-2011 and this has resulted in increased violence and banditry which resulted in increased poverty rates (Huho, 2012).

1.3 Objective of the Study

The overall objective of this study was to assess the vulnerability of pastoralists to climate change in West Pokot County. To achieve this objective, the following specific objectives were undertaken:

- I. To analyze the spatial-temporal variability of climate parameters (rainfall and temperature) in the County of West Pokot.
- II. To determine the livelihood characteristics of pastoralists in west Pokot County.
- III. To determine the vulnerability of pastoralists in west Pokot County.
- IV. To evaluate the existing adaptation and mitigation strategies of pastoralists in west Pokot County.

1.4 Research Questions

- i. What are the trends of rainfall and temperature in west Pokot County?
- ii. Why are pastoralists of west Pokot County becoming victims of drought crisis every year?
- iii. What are the existing coping mechanisms among the Pokot community to unpredicted weather patterns?

1.5 Justification of the Study

Most research findings have pointed out that climate change leads to food insecurity in low-income households (Christopher, 2019). The livestock subsector is a key component of the agricultural economy in developing countries. Livestock production significantly contributes to food availability through their skins, fertilizer for example the animals can be sold and the cash be used to buy food, the hides and skin can also be sold and the cash be used to buy food items. Livestock is also important for capital accumulation among the farming households. Livestock are closely associated with the social and cultural lives of numerous smallholder farmers (FAO, 1993).

Climate change presents health risks to both the pastoralists and their livestock resulting in various diseases which pose a huge risk of morbidity or mortality of animals. Infectious diseases have also become prevalent due to greater intensity and frequency of heat waves, droughts, and floods. The increased health risks are mostly acute in the livelihood of pastoralists since they are not empowered, have low coping mechanisms and the health facilities are very scarce. People walk approximately 25km to get to the nearest equipped health facility (west Pokot County Rapid assessment report, 2019). Likewise, veterinary services are very rare and inaccessible. climate change has become a public health concern among the livestock producing communities due to the association of infectious and vector-borne diseases with warm or hot weather conditions whereby the warmer the weather the more prevalent these types of diseases become.

This study provides a mechanism that will enable the community to appreciate and keenly note the impacts of climate change as the main contributing factor to violent resource-based conflicts in West Pokot County and other neighboring ASALs. The findings of this study will also strengthen community adaptive capacity to adverse climate change adaptation for realization of sustainable development. This study's findings provide relevant data to the County Government of West Pokot, local communities and NGOs relevant for planning and addressing the implication of climate extremes to the livelihood of pastoralists. The findings from the study also add to the body of knowledge in academia and provide insights on climate change and its impacts on pastoralism.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction.

This chapter reviews the existing literature on trends of temperature and rainfall, vulnerability of pastoralists to climate change in Kenya and other ASAL countries, how pastoralists are exposed to impacts of climate change and sensitivity of the natural resources to climate extremes.

2.2 Temperature and Rainfall Trend over Kenya

Hulme et al. (2001) reported that temperature in Africa was getting warmer than the reported temperatures a century before. The researcher also alluded to different meanings concerning the warming rates indicating that African temperature since the 1900's had been about 0.5 °C every century. During the same period, the overall warming in the continent was said to be 0.7 °C (Hussein, 2011). According to Niang et al. (2014), there was a general rapid increase in minimum temperature than maximum temperature.

Williams et al. (2012) report that the last half a century has shown an increased seasonal mean temperature in areas around the eastern equatorial countries including Kenya. Countries bordering the western side of the Indian Ocean showed an increase in extreme event frequency and a rise in near-surface temperatures from 1961 to 2008, (Vincent *et al.* 2011). During the 50 years, it was discovered the temperature in Kenya had significantly risen by 1 °C.

In a report by Makokha et al. (2010), focusing on Nairobi's minimum and maximum temperatures, there was a reported rise in both temperatures for the period between 1966 and 1999. On the other hand, about 80% of the total landmass of Kenya (NDMA, 2017) comprises of arid and semi-arid lands, and therefore there exists a large precipitation deficit. Rainfall being an important variable when analyzing the effects of climate change on livestock, understanding its trend was important in this study in order to counter check the strategic decision making in adaptation options. (NDMA, 2017) highlighted that millions of people in Kenya were in danger of food insecurity because of the low rainfall in MAM season of 2016. (Paavola, 2004) cited those changes in the availability of

water have the potential to exacerbate adverse health outcomes, malnutrition and poverty as well as vulnerability to all forms of environmental.

Obwocha, (2022) highlighted that the amount of rainfall in West Pokot County remained inconsistent between a maximum of 1347.9 mm observed in 1982 and minimum of 619.4 mm in 2000 and an annual rainfall average of 973.4 mm. 1984 was the year with the least amount of rainfall and the year 2000 recorded the highest amounts of rainfall. The paper further noted that rainfall peaked in April, while the lowest rainfall was reported in January of every year, (obwocha, 2022).

2.3 livelihood Characteristics of Pastoralist Community

Pastoralists depend on livestock activities, which is their way of life and livelihoods (Cornwall & Gaventa, 2000). Pastoralism by transhumant was a way of life in many communities in the world whose livelihoods are intertwined with rearing of goats, cattle, sheep and other species of ruminants that depend wholly on natural resources. Despite the modern economy being dominated by other economic activities such as cyber and mining, pastoralism has remained a strong source of livelihood in many areas especially the ASAL areas because cattle serve both economic and cultural functions. It has However been noted that climate changes in the form of thunder, increased intensity and frequency of storm, droughts, floods, hurricanes etc have direct effects on pasture quality and grazing land. (Ayanda,2013).

Pastoralism is heavily dependent on availability of natural resources which by extension, is dependent on climate variability and change. According to (Moorland, 2017), many people raise domesticated animals on open rangelands in arid and semi-arid lands across the world. Climate extreme events and unreliable weather patterns mean that, pastoralist have to be adaptive and deploy a range of specialized skills although this has made the lives of pastoralists increasingly hard (Moorland ,(2017). These salient characteristics of pastoralists makes them vulnerable to extremes of climate change. Vulnerability in pastoral communities was associated with the nature and extent of (exposure), its sensitivity, and community adaptability (IPCC, 2007).

The research conducted by Kibria *et al.* (2017) asserts that climate change associated with the rise of temperatures, sea level rises and extreme events is another additional threat to seafood securities,

fisheries, and aquaculture among other stressors that make the situation worse. The livelihood of pastoralists depends on natural resources, and hence can be adversely affected in the event of a climate change event. The climate change-vulnerable communities typically rely on the harsh natural environment including mountains as well as dry lands among other aspects (IIED, 2015). The climate change problem is not only a change of the century; it is posing a risk to society, and it is being felt by everyone.

Pastoralism is one of the major economic activities practiced in over 21 countries in Africa. In Kenya, pastoralism is mostly practiced in arid and semi-arid lands (ASALS) which covers over 80% of Kenya's landmass and supports more than a third of the country's human population. It has been estimated that 13 million cattle, 25 million goats, 14.9 million sheep, 1.7 million donkeys and 2.9 million camels are found in arid and semi-arid lands of Kenya (KNBS, 2010). Most of the communities engaged in this type of livelihood experiences various common challenges of conflicts over grazing lands, water shortage and superiority. Adaptation and resilience is absolutely Kenya's and Africa's first option in responding to climate change. This is because the impacts of climate change have been notably experienced in each sector and development systems occasioned by various extreme events such as landslides, prolonged droughts, flooding, intense and unpredictable rains that sometimes turn violent, especially in the ASALs (climate change Profile-Kenya, April 2018).

2.4 Climate Change Impacts on Livestock Production

According to the report published by World Bank in 2010, It is projected that livestock productivity could fall by 50% by the year 2050 if the status quo could persist. Consequently, agricultural GDP in Kenya could drop by 3% to 30% by the year 2050, if necessary interventions are not implemented (World Bank, 2010). Poor development in the agricultural sector also has potential to increase incidences of food insecurity by 30% by the year 2050 (FDRE, 2015). Livestock reproduction is vulnerable to climate changes through introduction of heat stresses that compromise animals mating (Amundson *et al.*, 2006; Sprott *et al.*, 2001). (Madan and Prakash, (2007) noted that rise in temperature is associated with poor reproduction in livestock. Climate change is also responsible for poor livestock production through poor growth of grass and fodder

crops, drying of water points and changes in the distribution and composition of pasture quality (Herrer *et al.*, 2016).

2.4.1 Pastoralist Vulnerability to Impacts of Climate Change

According to (Adger, 2006) and (IPCC, 2007) vulnerability in the context of climate change refers to the magnitude in which a system is susceptible to, and not able to cope with the negative effects of climate change (climate variability and weather shocks). Vulnerability of agriculture to climate change is mainly caused by exposure to weather related shocks, the sensitivity of crops yields due to shocks and the ability of the farmers to adapt to the shocks.

Sensitivity, exposure and adaptive capacity are among the determinants of community vulnerability to climate change (Parry *et al.*, 2005). Community Sensitivity to climatic change is generally high when their livelihoods entirely depend on environment and natural resources (IPCC, 2017). The increasing frequency of climate change threats such as drought and diseases and even their impacts compromises the ability of pastoralist communities in West Pokot to cope with its effects such as death of animals, increased heat stress, new diseases etc, (ILRA, 2007).

As a result of documented vulnerability of pastoralists to climate change, many stakeholders and development partners are interested in intervention activities that can reduce the impact of climate change on productivity, environmental conservation and general welfare of the livestock dependent communities (Ospina *et al.*, 2010). The impact of climate change is highly dependent on household endowments in resources such as economic and environmental assets, as well as institutional arrangements. Adaptation processes are important in guaranteeing major development outcomes in pastoral communities.

A population is vulnerable if it is exposed to a shock and sensitive to the effects of such shock and at the same time has only limited capacity to adapt. Exposure is the manner and degree to which a system is exposed to significant climate shock (stimulus). According to (IPCC, 2007), sensitivity refers to the responsiveness of a system to climatic related shock. A sensitive system is one that is highly responsive to a climate shock (one that is significantly affected by small climate related shocks). (Glwadys *et al.*, 2010) documented the sensitivity of a system on a five-point, irrigation rate, land degradation, Rural population density, small-scale farming and Crop diversification. Sufficient access to irrigation technologies by farmers can increase their resilience to climate

variability and change impacts. In the same way, less inhabited areas are less sensitive to climate shocks compared to densely populated areas. Different crops respond differently to climate shocks with greater diversification leading to less vulnerability against climate shocks. Vulnerability against climate related shocks was associated with socioeconomic factors such as farm sizes, farm capitalization, technology adoption (ILRA, 2007).

Adaptive capacity of systems refers to their ability to adjust to potential climate related harm, taking advantage of the opportunities or responding to consequences (Gallopín, 2006). Vulnerability was the ultimate impact after adaptation has taken place (Edger, 2006). The more adaptive a system is with respect to its capacity, the greater was its likelihood to adjust and therefore, the lesser is its vulnerability to climate change. Vulnerability is found to be context-specific (Brooks, 2005). Factors that made a system vulnerable to climate change depend on the system itself as well as the type of effect in consideration.

2.4.2 Impacts of Climate Change on the Livelihood of Pastoralists

It has been noted through various extreme events of climate change in the ASALs of Africa, such as droughts and wild fires, that their occurrences in most cases turns to be severe and leads to loss of lives and properties through food insecurities as a disaster.

The commonly known climate change disaster in west Pokot and other ASAL counties is that of drought but the landslides of 2019 brought a mix of thoughts. According to article published by (Schlögél et al.,2020,), the 2019 landslides experienced in west Kenya was disastrous and in west Pokot county in Tapach ward where torrential of rain turned to be fatal and claimed over 53 lives and many infrastructures were destroyed like the Kitale–Lodwar highway. This event was one of the unexpected challenges of climate change and variability, especially on the pastoralists who were already struggling with the impacts of droughts and unpredictable rainfall patterns.

According to Mutimba *et al.* (2010), pastoralism is the mainstay of the people living in Arid and Semi-arid Lands (ASALs). Pastoralism was negatively affected by climate variability and change for example Kenya has frequently experienced droughts in the years 1999-2001, 2002, 2003, 2004-2006, 2007 and 2008-2011. As a result, most households in ASALs were rendered poor and millions of people in the ASALs became dependent on relief food because their only source of livelihood gets disturbed by the frequent and continuous droughts. Frequent outbreaks of diseases

such as Rift Valley Fever (RVF) are associated with climate change (Wildlife Conservation Society, 2008).

Pastoralism is characterized by seasonal movement of livestock. During such a movement, the responsibilities of women (who are already vulnerable) was often increased as reflected through changes in workload (Mutimba *et al.*, 2010). Pastoralism was also labor intensive (especially, family labour). As a result, most young boys do not attend school. (IPCC, 2001) predicted that livestock productivity was expected to deteriorate in years to come due to increasing schooling trends among the pastoral communities.

2.5. Adaptation and Mitigation Strategies of Pastoralists

In response to the impacts of climate change and variability, pastoral communities use various adaptation and coping strategies. Most adaptation and mitigation strategies was heavily dependent on the indigenous knowledge generated over a long period of time within the communities (Mongi *et al.*, 2010).

Climate variability has stimulated the emergence of numerous adaptation strategies (Herrer *et al.*, 2016; Thornton *et al.*, 2006). The adaptive capacities of pastoral communities enable them to maintain biodiversity in many environments which has sometimes emerged as a tourism attraction scene (Jonathan, 2008). Some of the adaptation strategies implemented to reduce the adverse impacts of climate change in West Pokot County included livestock off-take during drought. In times of drought, households migrate to other areas in search of food and water (Opiyo, *et al.*, 2015). Diversification of herd composition is also an important adaptation strategy (Speranza, 2010; Jonathan & Michele, 2008).

2.5.1 Pastoralists Adaptation Strategies for Climate Change

The IPCC third assessment report noted that Adaptation was essential, particularly because even the most beneficial mitigation efforts would not avoid further impacts of climate change (IPCC, 2007). This is because climate change is an equivocal and therefore while mitigation is taking place in some areas, it doesn't solve the impacts of climate change instantly, therefore there is the serious need to adapt to its effects. Good adaptation options should reduce vulnerability to future

climate change (Knittel, 2016). Countries with less investment in climate change mitigation and adaptation are more vulnerable to climate shocks.

Pastoralists are mostly located in dry lands and they have different coping mechanisms that help them survive in the harsh environment. Common coping strategies include seasonal mobility during dry and wet seasons. The movement is mostly caused by many factors such as disease outbreak, conflicts and insecurity and drought. Other adaptation strategies as noted by (Deborah, 2018) include sale of livestock, herd splitting, diversifying herd composition and shifting to agro pastoralism. Adaptation strategies undertaken in most pastoral communities included extending in crop cultivation, engagement in business, search of loans, engaging in paid employment, migrating to other areas, invading farmlands and tourist areas, and selling weak cattle (Mutimba *et al.*, 2010; Mwakaje, 2013). Some of the adaptation strategies are however likely to have other serious adverse impacts (soil erosion, deforestation, poor water retention, eroded natural resource base). Most of the popular adaptation strategies are unsustainable and likely to lead to negative effects on the pastoralists' livelihoods.

2.5.2 Community-Based Adaptation

The most persistent manifestations of climate change among pastoral communities include drought, increased temperature, expanded desertification and increased incidences of pests/diseases. Climate change was mainly experienced through reduced livestock productivity, food insecurity, and challenges in input acquisition, low profitability and increased environmental degradation (Mohammed, 2010). Some of the adaptive strategies common in pastoral communities included spatial mobility, water conservation and adoption of new breeds. (Macharia *et al.*, 2010). The effects of climate change can be classified based on social, economic and political dimensions. Some of the modern coping strategies such as livestock insurance are not ideal to smallholder farmers who are mostly poor and more vulnerable (Hannah *et al.*, 2010).

Indigenous knowledge are very key in pastoral livelihood resilience because it helps to influence the way the environment and production systems are managed (Ramoeketsi, 2010). As local communities adapt to the challenge of climate change, indigenous knowledge could be tapped, to enhance their resilience to various risks and shocks that could threaten their livelihoods (Mistry

and Berardi, 2016). Adaptation practices that were matched with the available indigenous knowledge were also known to be widely accepted and applied (Ajani *et al.*, 2013).

2.6 Conceptual Framework

This study made use of the DPSIR (Driver, Pressure, State, Impact and Response) approach to explain the cause-effect on how pastoralists' livelihoods are affected by climate variability and change (Figure 2.1). The associated extreme climate events results to various pastoralists livelihoods stresses such as livestock diseases emergence and re-emergence, death of livestock that lead to reduction of herds which are a pride of the community hereby leads to resource-based conflict, as the community seek to restock the lost animals and as they struggle for the scarce resources such as water and pasture, and impacts of environmental degradation. This continuous interlinked relationship of population increase, informal settlement with influence of climate change threats sums up to the famous concept of the 'tragedy of the commons' which was developed by Garret Hardins in 1968. Resources such as rangelands that were individually used but collectively owned were prone to overuse.

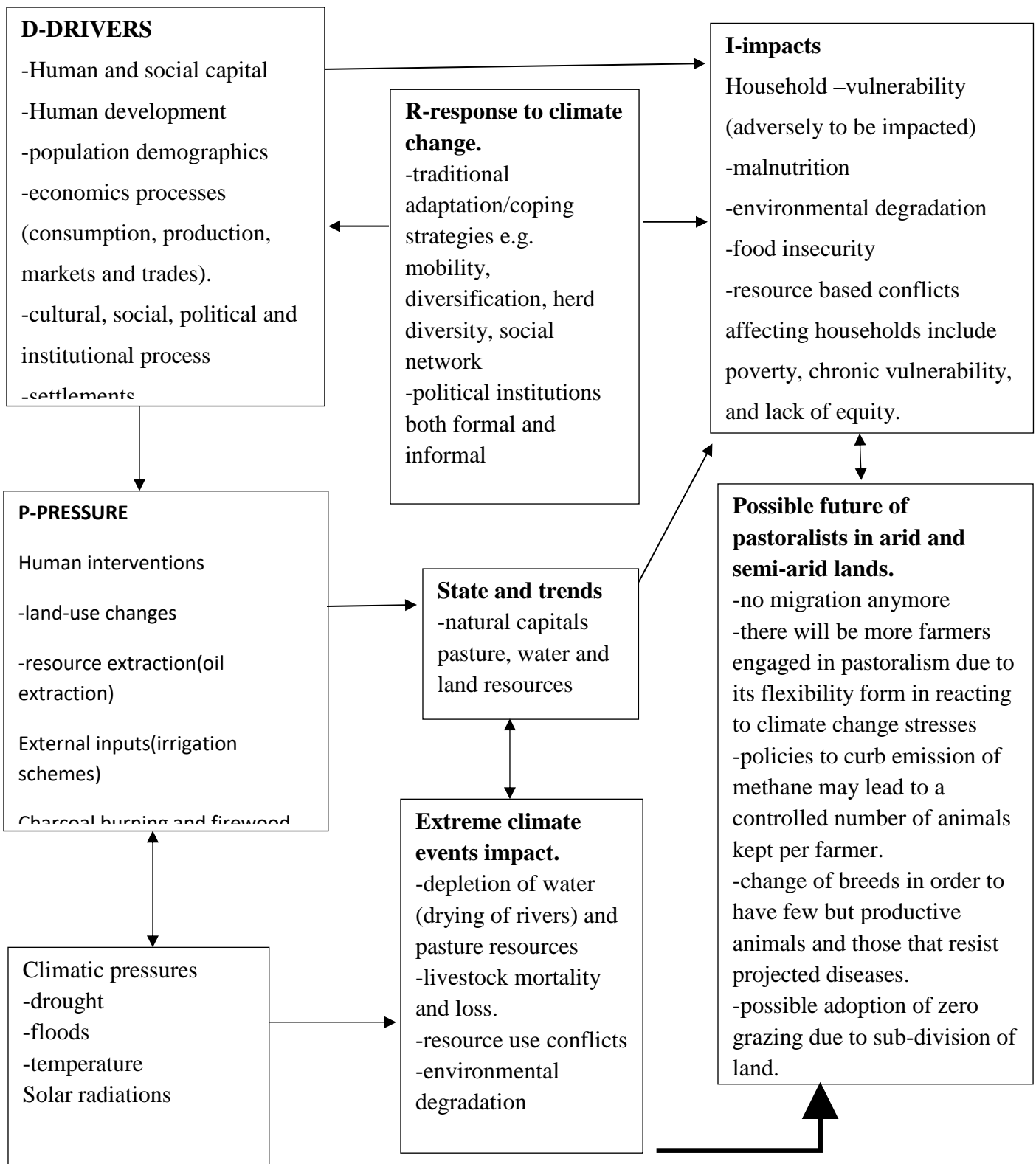


Figure 2. 1: Conceptual Framework

The cause– effects relationship of climate change and variability among the pastoral communities - DPSIR model modified from Omondi's work (2014).

CHAPTER THREE

3.0 DATA AND METHODOLOGY

3.1 Introduction

This chapter presents the data and methodology used for the analysis of the specific objectives of this study. The sections described in the chapter include, data, study design, population and the sampling strategy. The data collection instruments included methods of maintaining validity, reliability of the data collection instruments, primary and secondary data are also presented.

3.2 Area of Study

West Pokot County is situated in the North-Western part of Kenya.

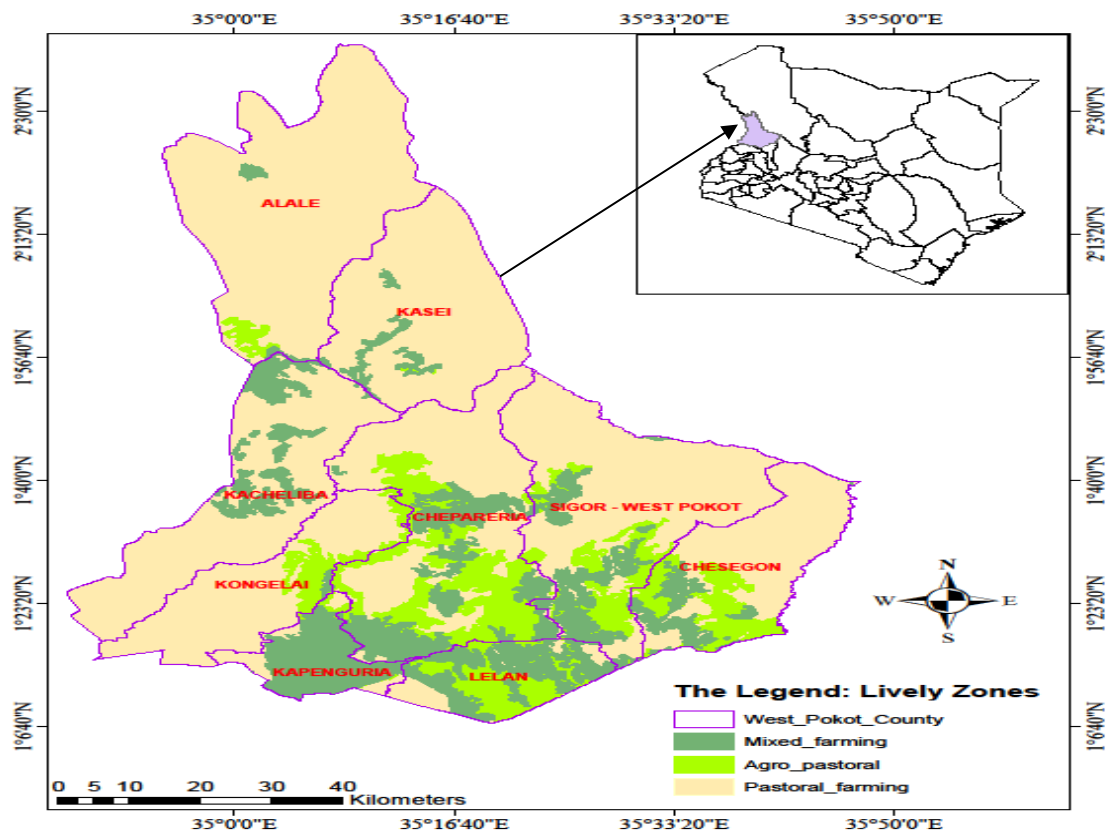


Figure 3. 1: Ecological zones in West Pokot County (source county integrated development plan 2018-2022)

According to (CIDP,2018), West Pokot is located $10^{\circ} 10'N$ and $30^{\circ} 40'N$ (latitudes) and $34^{\circ} 50'E$ and $35^{\circ} 50'E$ (longitudes). The four administrative sub-counties of West Pokot County include: Pokot South, Pokot West, Pokot Central and Pokot North. The approximate surface area of West Pokot is $9,169.4 \text{ Km}^2$ (West Pokot County CIDP, 2018-2022). Fig.3.1. shows the map of West Pokot County, (West Pokot County CIDP, 2018).The county borders Turkana County (north), Trans Nzoia County (south), Elgeyo-Marakwet County (south), Uganda (west) and Baringo County (east). The major tribe in the county is Pokot. The county's population is 621,241; projected to 1,326,847 persons in 2030 (KNBS, 2019).

The county poverty index stands at 69.7 per cent. This is an indicator that most people in the county cannot afford the minimum basic nutritional needs. High population growth rate poses a big problem and is steadily adding to the high unemployment rate in the county. Coupled with climate change impacts, the county faces a myriad of challenges ranging from insecurity along the three borders, Marakwet/Pokot border, Turkana/Pokot border and Karamojong/Pokot border. This exposes the community to various risks such as diseases and malnutrition. Mutegi and Korir, (2016),

3.3 Data Collection Procedures

The data used in this study were the primary data collected through household survey, secondary data which were complemented by information from focused group discussion (FGD), key informant interviews and observation which were then coded and analyzed. The results are then presented in the form of tables and charts.

3.3.1 Primary data

Using a standard questionnaire, primary data was collected through household surveys. Questionnaires targeted the household heads. The design of the data collection tool aimed at capturing such information as socio-economic factors (level of educational, marital status, household size, age, sex, income sources, and indigenous knowledge) as well as local perception about climate change, adaptation and coping strategies. The questionnaires contained both open-ended and closed-ended questions. Open-ended questions sought to get in-depth response about

the survey issues while closed-ended items facilitated getting of information that aided in data classification and analysis.

3.3.2 Secondary Data

Secondary data collected through documents provided by key-informants and through literature review. Previously collected and compiled data for temperature and rainfall were used to explore trends and changes over time. The secondary data were collected from reports from Climate change and adaptation and drought management stakeholders and line ministries.

3.3.3 Focus Group Discussion

The household survey was triangulated with participatory assessments and field observations. Participatory assessments included FGDs and round-table discussions with stakeholders at the Village level and institutions or organizations. The FGDs consisted of multi-sectorial and interdisciplinary representation composed of participants drawn from the development sectors, organization Governments (county and national) and institutions. The participants were selected randomly among the households, the sectors, organizations, county and national Government and institutions I order to develop deep insights on the communities' pastoral livelihood activities, vulnerability to climate change and climate change mitigation, adaptation and coping mechanisms. FGDs also discussed major sources of income and livelihood options and how these have changed over time.

3.3.4 Key Informant Interviews

Based on the objectives of the study, key informants were selected purposefully because of their perceived ability to contribute to the objectives of the study. The interviews were conducted at the informants' offices and villages. These included National drought management authority (NDMA), meteorological department in the county, Water resource management authority (WRMA), Department of Environment, Water and Natural resources, agriculture, livestock, pastoral economy, dairy farmers cooperatives and milk cooperatives (milk coolers). A standard interview guide for the key informants was prepared ahead of the interviews.

3.3.5 Observation

Field observation was also made to capture and crosscheck issues raised in the FGDs and key informant interviews such as livelihood activities, adaptation, coping mechanism practices to climate change.

Observations were made in order to aid in the verification of information generated through the main survey. Through observation, the key mitigation, and coping strategies in the area were noted. The investments being implemented as well as the available social services/infrastructures were verified.

3.3.6 Rainfall and Temperature Time-Series Data

Seasonal data on rainfall and temperature were sourced from the Kenya Meteorological Department (KMD) in West Pokot and the national headquarters in Nairobi for use in this study. This was to help analyze rainfall and temperature trends and patterns between the year 1981 and 2019.

3.4 Research design

West Pokot County was purposely sampled because of the dominant livelihoods in the county and the frequency of drought episodes that turns to be disasters that affects pastoralists' livelihoods. West Pokot has four sub counties namely; Pokot north, Pokot South, West Pokot and Pokot Central sub counties. Pokot north sub-county is purely pastoral livelihood; the other three sub-counties have some parts which are agro pastoral and others which are mixed farming. This research focused on the pastoralist in West Pokot County who are hard struck by droughts each year. A mixed research approach was employed in this study. Qualitative and quantitative research methods helped in exploring the research problem in this study. The Quantitative method focused on temperature and rainfall data as well as on their effects on livestock production systems, while the Qualitative method focused on pastoralists' perceptions about climate change and the associated effect on the livestock production systems. Triangulation was applied during data collection in order to increase the validity and reliability of the study results (Creswell, 2008).

Table 3.1 Research design on corresponding variables and indicators for each specific objective.

Specific Objectives	Variables/Indicators	Research design
To analyze the spatial-temporal variability of climate in west Pokot County.	- temperature -Rainfall pattern.	Descriptive
To determine the characteristics of pastoralists in west Pokot County.	-Food insecurity -main Source of income -monthly income -Frequency of Conflicts -Loss of livestock -Level of education -Population increase/household size	Survey
To determine the vulnerability of pastoralists in west Pokot County.	Exposure-environmental degradation, ASAL, key livelihoods Sensitivity- death of animals, number of affected people due to disasters Adaptive capacity. Monthly income, education, main source of income	Evaluation
To evaluate the existing adaptation and mitigation strategies of pastoralists in west Pokot County.	-assessing pastoralists response to climate shocks	evaluation

3.5 Target population

The target population were pastoralists in west Pokot County who were above 40 years of age and prone to seasonal movement with their livestock in search of water and pasture. This population was preferred because the researcher wanted to do trend analysis and older people were able to tell what was happening 30 years as compared to the situation in livestock keeping and made it possible

to tell what will happen in future in the livestock sector. Through department of pastoral economy and the census reports, the researcher was able to establish 3,000 pastoralists.

3.5.1 Sampling Procedure and Sample Size

This study involved three sampling stages with the first stage being selecting the wards in the three ecological zones e.g pastoral zone, agro-pastoral zone and mixed farming zone, using judgmental sampling. Second stage involved the selection of the locations in the selected wards (in stage two) and the last stage was the selection of the households based on the number of households in each location (KNBS,2019).

3.5.2 Sample Size

The study adopted the formula proposed by Yamane (1967) for sample size.

Equation 1

$$n = \frac{N}{1+(e)^2}$$

Where: N= target population or the number of households in the study area.

n=sample size

e=desired margin of error

According to KNBS 2019, West Pokot County has a total of 621,241 with 20 wards. Most of the people living in those wards are pastoralist with a slight diversification to other forms of farming. This research sampled six wards from each ecological zone and how it is hit by climate related extremes, specifically extreme precipitation (too much rain) to low precipitation (droughts).

Target population of the sampled Wards =3,000

E=0.05

Equation 2

Using the formula

$$n = \frac{3000}{1+3000(0.05)^2}$$

=352.9

n=353

3.6. Reliability of the Instruments

Reliability refers to the quality of measurement, that is, if the instrument is used several times it should give similar results. To ensure the accuracy of the instruments, this study administered 10% of the total questionnaires before the real data collection commenced. This helped to test the accuracy of the research instrument as suggested by Mugenda and Mugenda (2003) that a 10% sample size is ideal in piloting for descriptive study. Piloting helped in ascertaining the validity and reliability of instruments.

3.7 Data analysis tools

Data analysis mainly composed of information on changes in climate variables, characteristics of pastoralists in west Pokot, pastoralist vulnerability and community-based adaptation measures. The study used statistical package for social science (SPSS) version 25 and Microsoft excel software to analyze all the quantitative data collected as presented for each objective as listed below and further summarized and presented in tables, charts, graphs, and figures.

3.7.1 Analysis of spatial temporal variability of climate

This analysis was done using the data for temperature and rainfall for main seasons of the year (MAM and OND) for the period 1981-2019 using trend analysis and variation. The data was analyzed using SPSS software.

3.7.2 Determination of the characteristics of pastoralists in west Pokot County

To achieve this objective, the study used household survey, FGD, key informant and observation in order to get the inside of pastoralists in west Pokot that makes them vulnerable such that each year there seems to be a repeating outcry for death of animals and consequently food shortage due to drought. The data was coded and then analyzed using SPSS software to get the portion of the respondents in different categories as per the questionnaire.

3.7.3 Vulnerability of pastoralists to the climate change impacts.

Through the findings of the livelihood characteristics of pastoralists, the vulnerability of different sub counties to the effects of climate change was revealed. Their cultural binding with animals that prevents them from taking actions that helps reduces death of animals.

3.7.4 Evaluating existing adaptation strategies

For better understanding of the pastoralists in west Pokot County, it was important to find out how the pastoralists adapted to the crisis brought by climate change. This was possible through field survey and the responses from elders in community FGD were recorded and described.

3.8 Ethical Consideration

According to Resnik (2015), observing the principles of ethics earned the research study the following benefits: -

- Promotion of aims and objectives of the study through avoidance of errors, revelation of truth and knowledge.
- Stakeholders' collaboration and coordination among many participants by increasing confidence, promoting accountability and ensuring parties respect and fairness.
- Helps in ensuring researchers' accountability to the public through adherence to research policies and code of conduct.

This research was strictly keen in observing ethical principles of seeking participant's consent before an interview especially on seeking information on sensitive issues. The due honesty of the researcher in writing the research report is also a matter of concern. Ethics relating to both the researcher and the participants were highly respected and the objectives of the study were the guide.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter has four different parts. The first part presents the results for spatial-temporal variability of climate in west Pokot County while the second presents the results of the analysis of the livelihood characteristics of the respondents and the third part discusses vulnerability of pastoralists in west Pokot County to climate variability and change. The last part explores the adaptation strategies used by pastoralists to respond to the devastating effects of climate change. The findings were presented by use of pictures, graphs, charts and tables.

4.2 Spatial-temporal variability of climate in West Pokot County.

Findings revealed that, for the last few years;-the trends have been on an increase with some noted variation over the years in the county. The study also revealed that there was a significant increase in mean temperature during the MAM seasons as compared to OND seasons (figures 4.1 and 4.2) respectively.

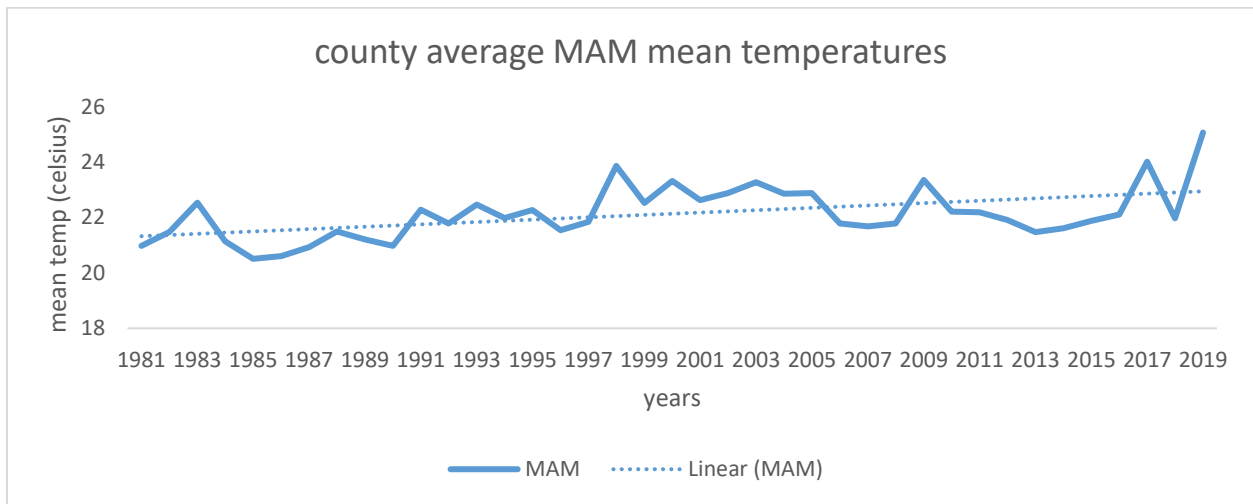


Figure 4. 1 mean temperature for the entire county for MAM season for the period 1981-2019.

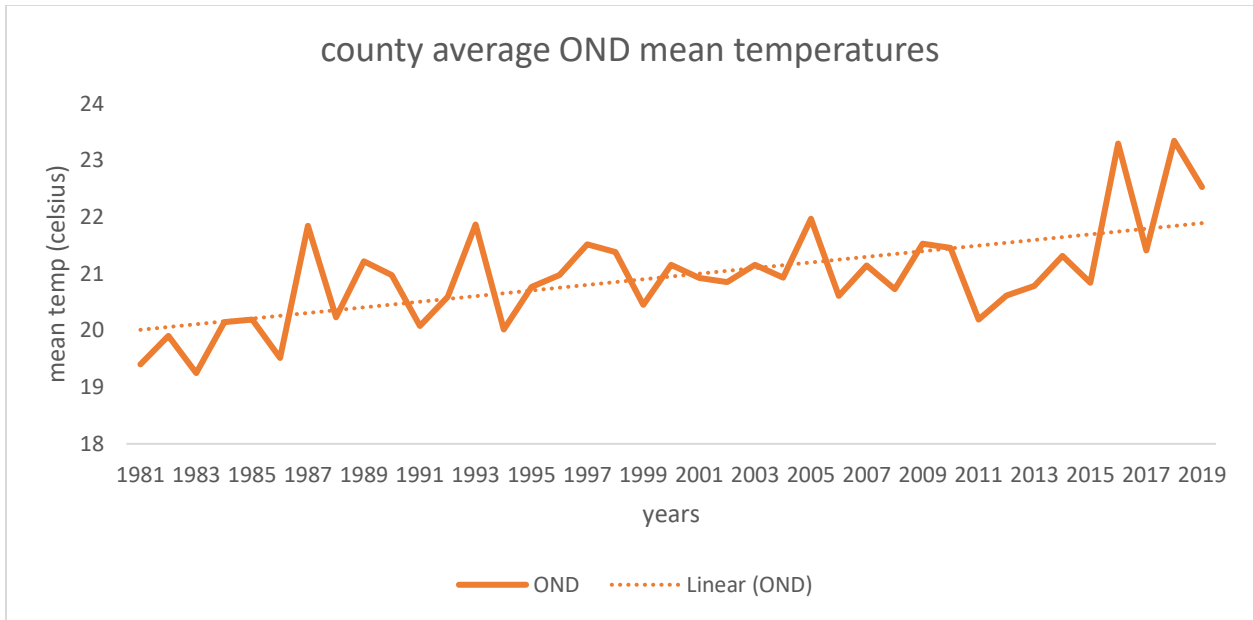


Figure 4. 2 mean temperatures for the entire county for OND season for the period 1981-2019.

Figure 4.3 and 4.4 presents the results for minimum temperature for MAM and OND seasons respectively.

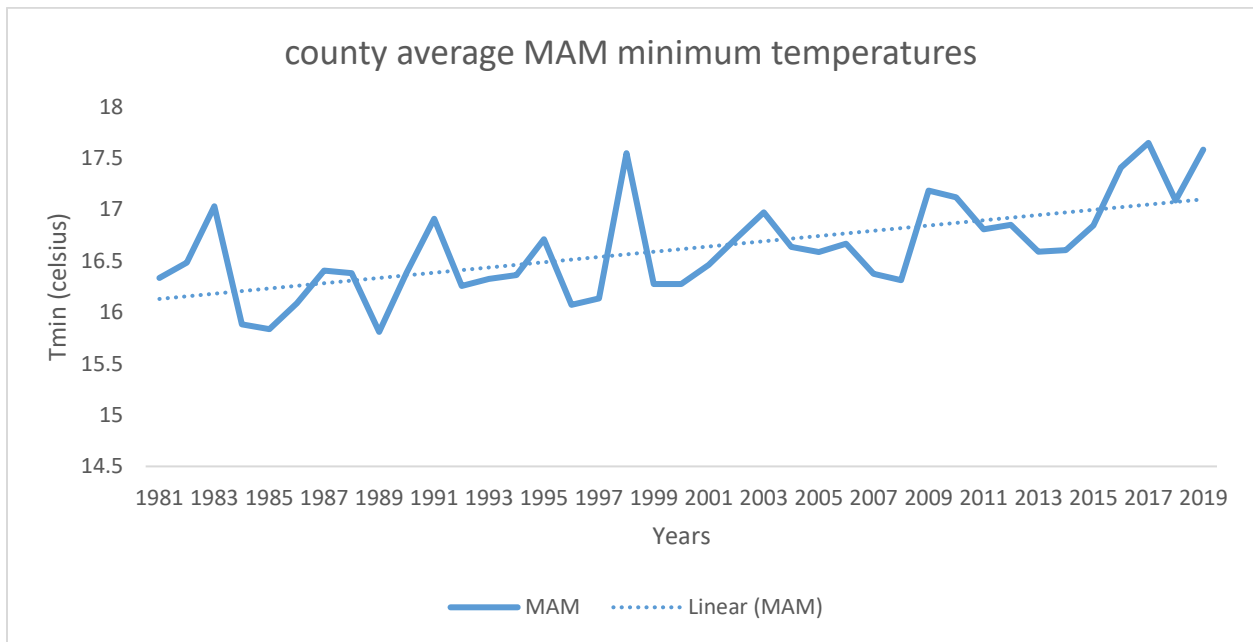


Figure 4. 3 minimum temperatures for the entire county for MAM season for the period 1981-2019.

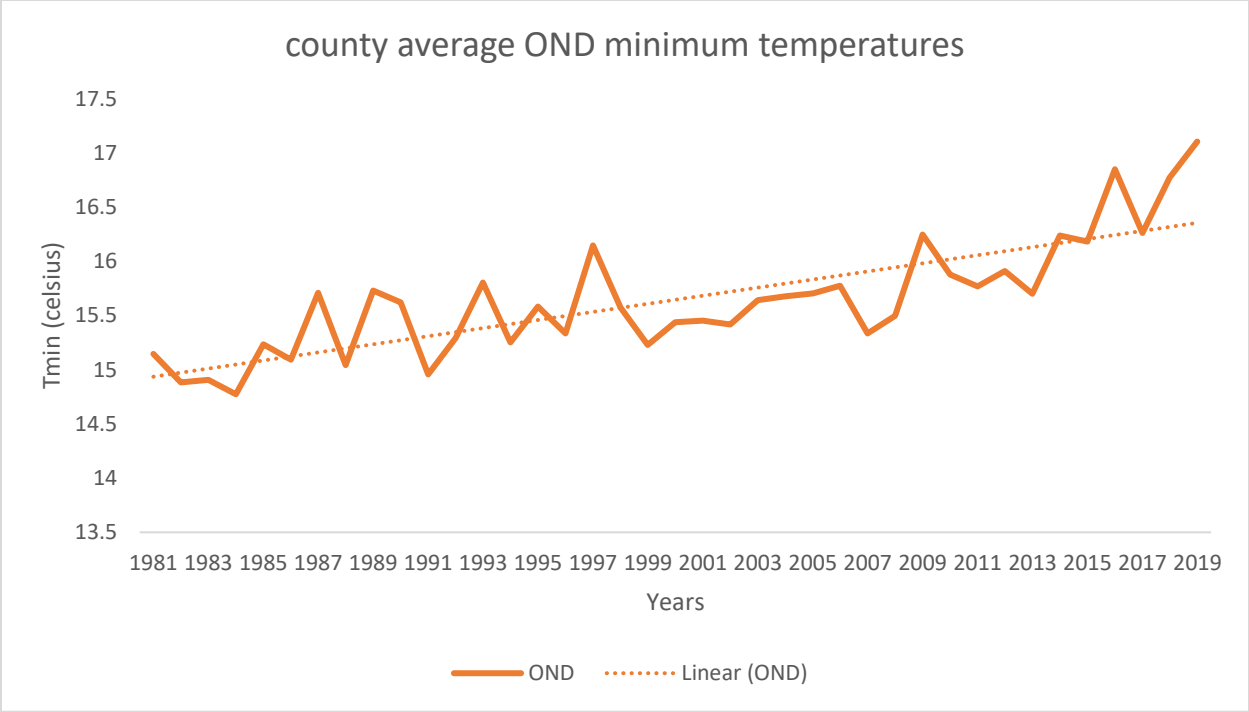


Figure 4. 4 minimum temperature for the entire county for OND season for the period 1981-2019.

Similar observation was also made in maximum temperatures for both OND and MAM seasons as shown in the figure 4.5 and 4.6 respectively.

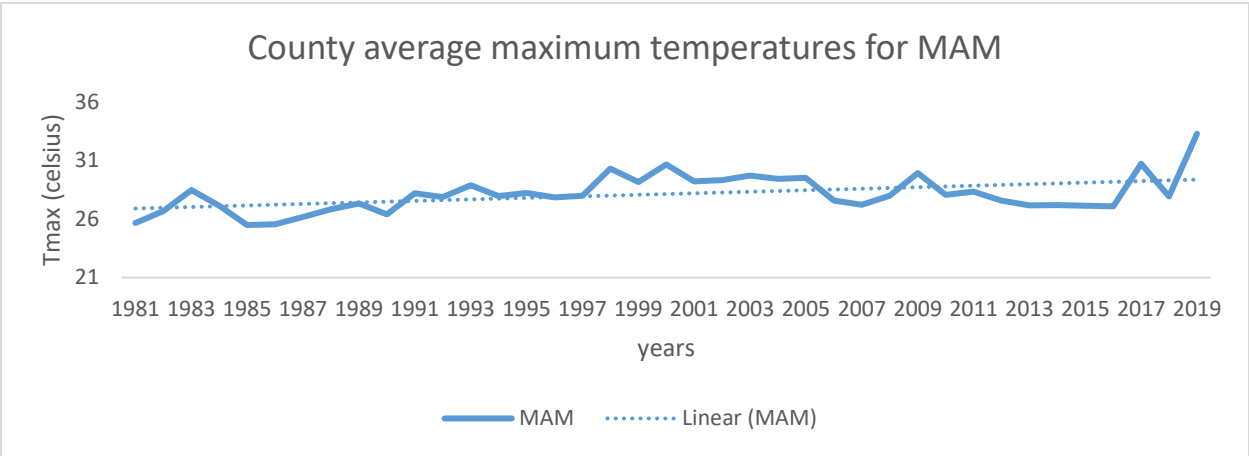


Figure 4. 5 maximum temperatures for the entire county for MAM season for the period 1981-2019.

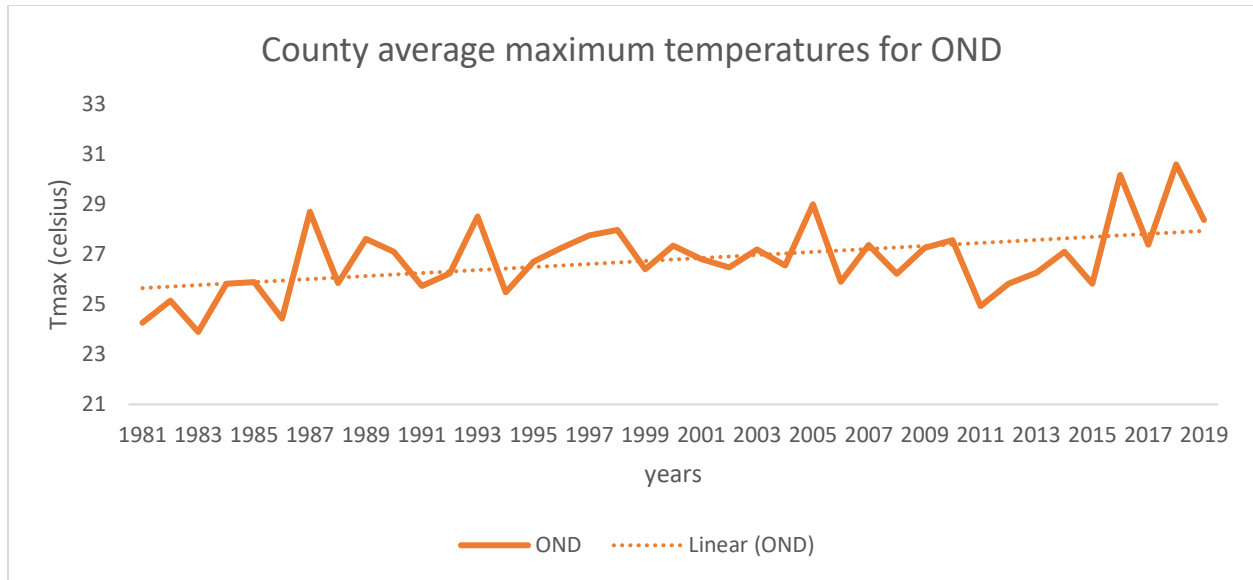


Figure 4. 6 maximum temperature for the entire county for OND season for the period 1981-2019.

These suggests that OND marks the beginning of hot season which goes a long way to January-February-march (JFM) season. These findings agree with (Williams *et al.*, 2012) who found out that for the last 50 years, it has been observed that there was an increase in the mean seasonal temperature in many areas of the eastern equatorial countries like Kenya and many others. In addition, (Vincent *et al.*, 2011) indicated that there has been an observed increase in the surface temperatures as well as an increase in the frequency of extreme climate events in most countries which are adjacent to the western side of Indian Ocean in the period 1961 to 2008. Furthermore, research done by (Hulme *et al.*, 2001) stated the rate of warming has been increasing since 19900 at approximately 0.5 °C per century in the entire Africa. This point was supported by the paper published by (Husseini, 2011) which argued that Africa experienced an overall warming of 0.7 °C during the same period.

Figures 4.7, 4.8, 4.9 and 4.10 presents the results for observed trends and variations for Pokot north (Kacheliba), Pokot central (Sigor), West Pokot and Pokot South respectively in OND maximum temperatures.

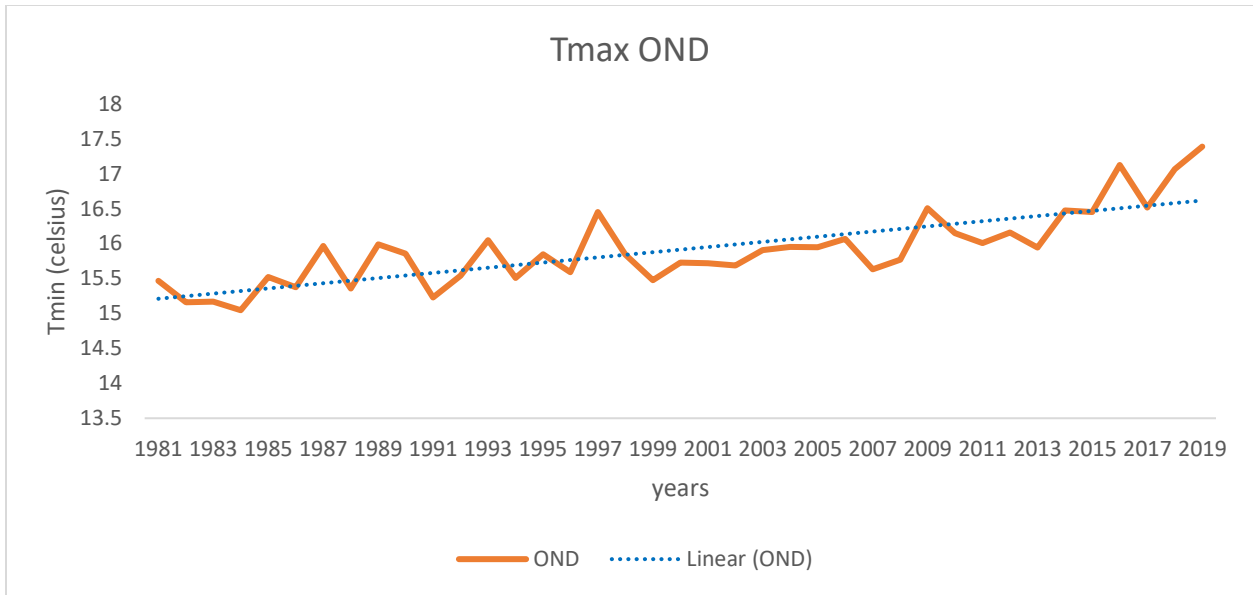


Figure 4.7 Maximum temperature OND season for Sigor constituency (Pokot central sub county) for the period 1981-2019.

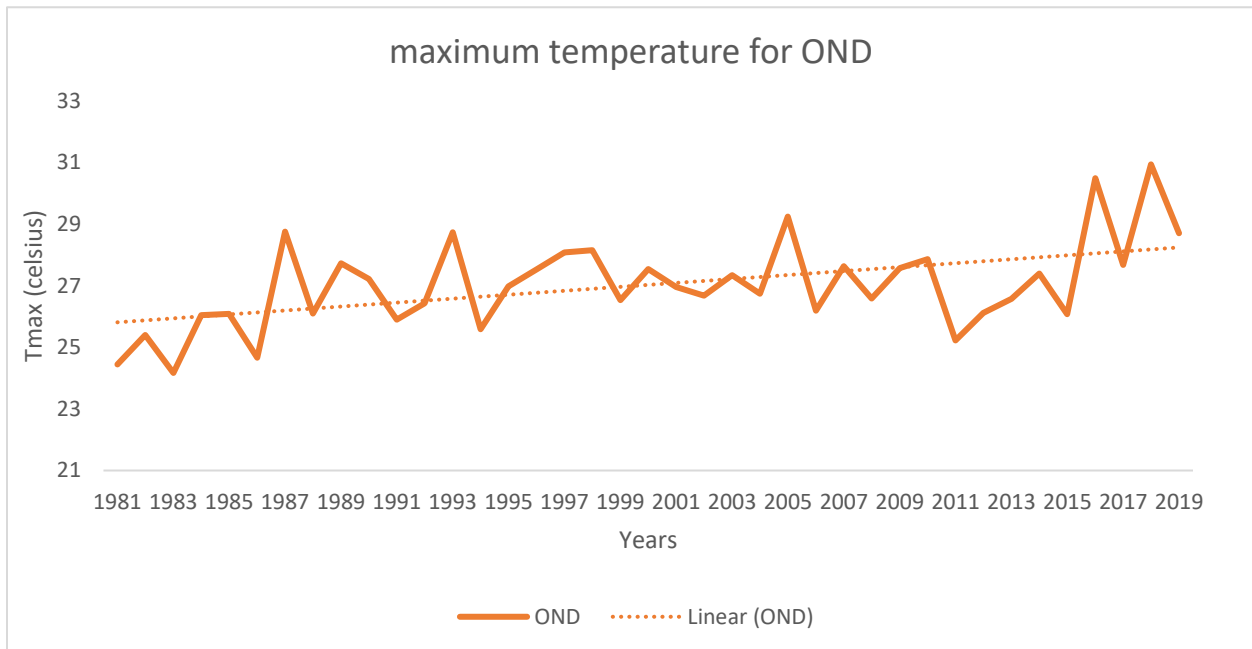


Figure 4. 8 maximum temperature for Kacheliba constituency (Pokot North subcounty) for the period 1981-2019.

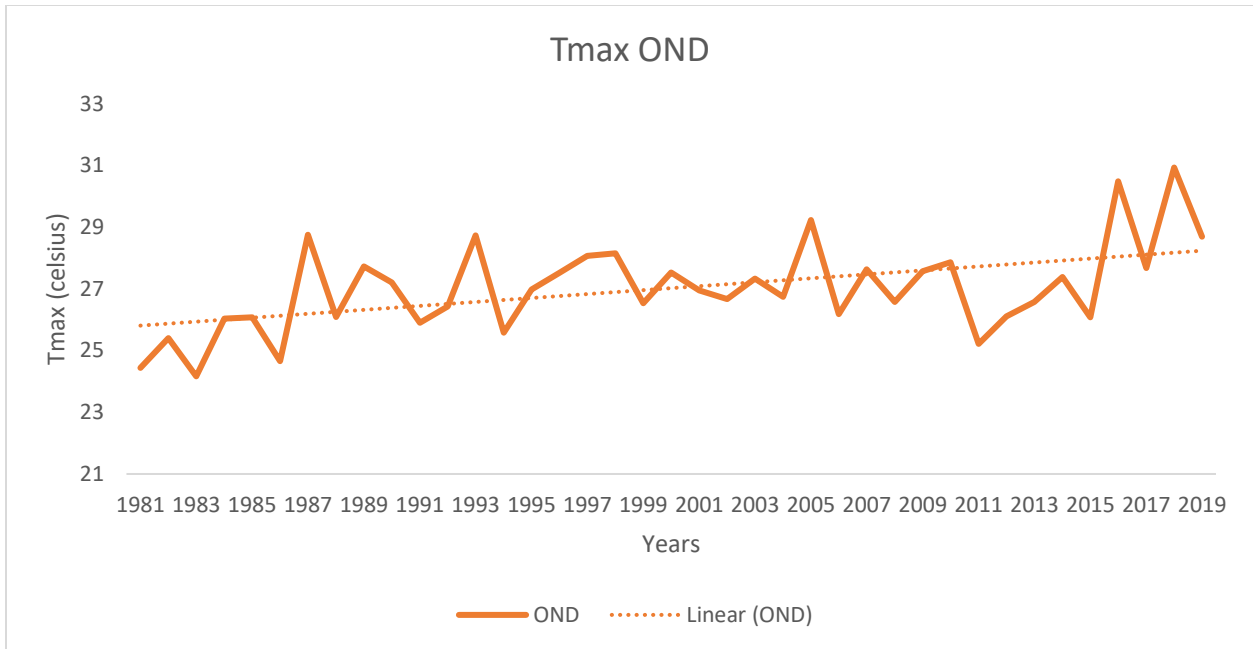


Figure 4.9 Maximum temperature OND for kapenguria constituency (west pokot subcounty) for the period 1981-2019

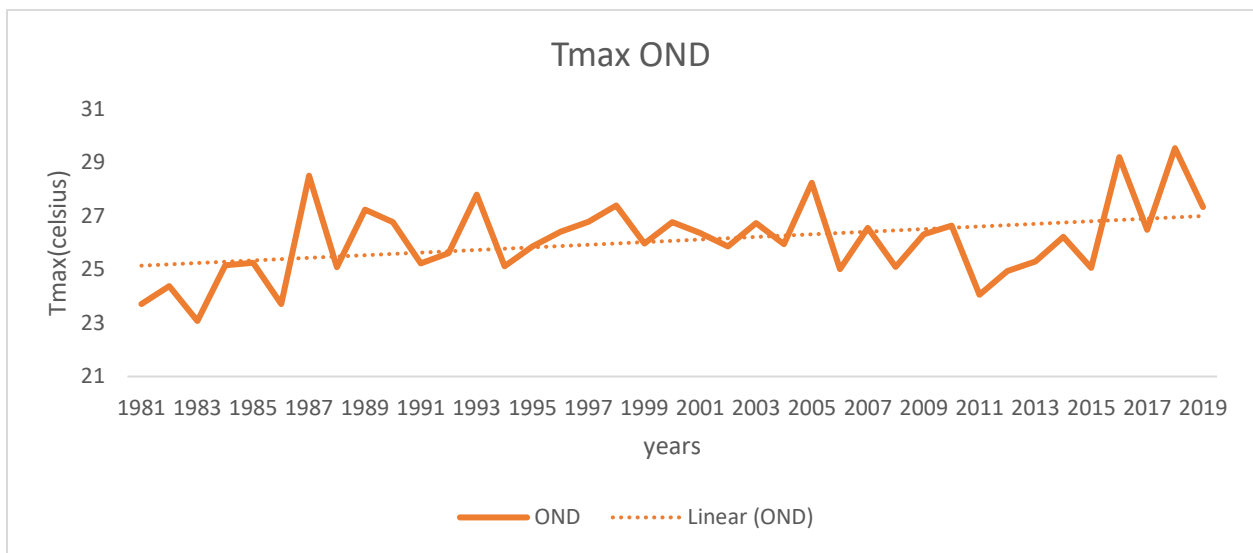


Figure 4.10 maximum temperature OND for pokot South subcounty) for the period 1981-2019.

The above figures show a significant increase in minimum and maximum temperature in OND which points out to the reason why pasture in the ground disappears faster and by end of February each year, the ground in pastoral part of west Pokot County was noted to be bare as argued in the FGD. According to Chepkiruk women group, boma Rhodes does well in the semi-arid lands of

west Pokot county, but towards December of the year 2021, the grass was drying up and was being consumed very fast by termites and by January there was absolutely nothing in the farm which gave a lesson to the group members to harvest the grass early. The study agrees with Brooks (2006) who noted that the two climate variables (temperature and rainfall) were essential to livestock grazing and that they were the factors influencing critical decision-making, and were also strategic in shaping pastoral production systems. A key informant from Kenya meteorological department indicated that temperature has increased with increased greenhouse gases and result into global warming. It was further noted that amount and timing of rainfall also had fluctuated, thus resulting into long-term impacts on livestock sector including extended drought resulting into high mortality of animals. Paavola, (2008) noted that the predicted changes in rainfall may interfere with the quality of drinking water due to decreased water levels and would easily expose many people to risks of contaminated water. This means that, decrease in the availability of water affects water access and reduces water thus increasing the incidences of water borne diseases.

4.2. Spatial-temporal distribution of Rainfall in West Pokot

Figure 4.11 and 4.12 Presents trends of rainfall for MAM and OND respectively for west Pokot County for the period 1981-2019.

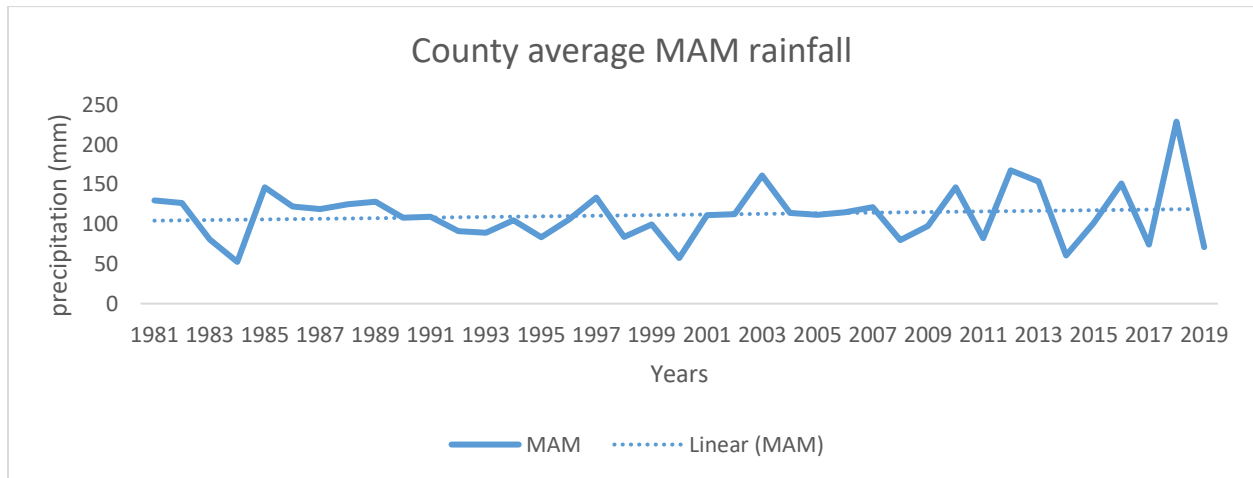


Figure 4.11 rainfall trends and variation for MAM for the period 1981-2019.

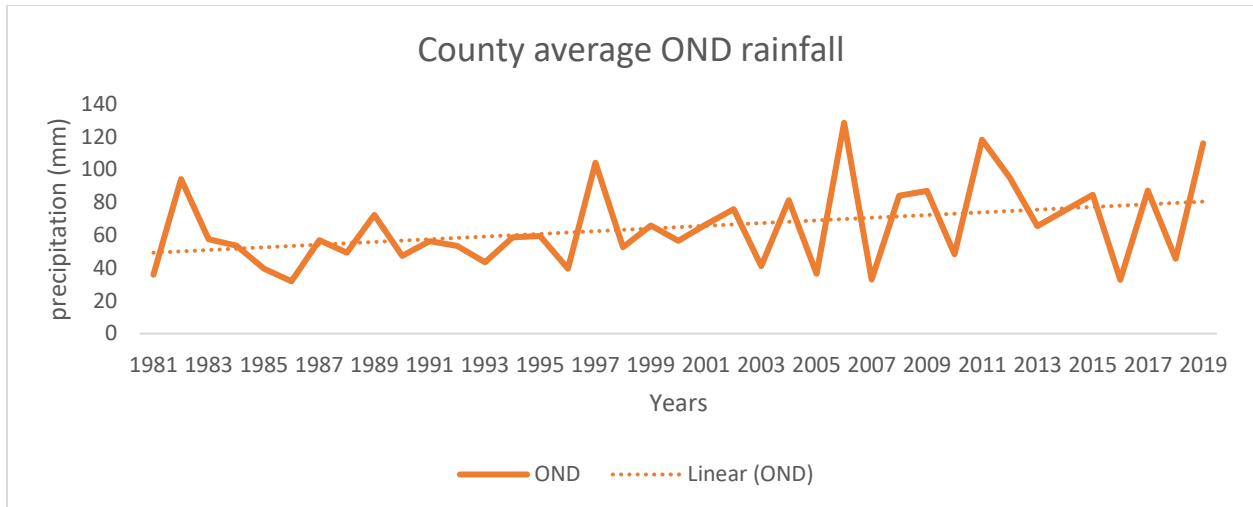


Figure 4.12 county average OND rainfall for the period 1981-2019.

The study further found that rainfall patterns kept on fluctuating with depressed rainfall being experienced in most cases, more so in pure pastoral and agro-pastoral areas. During FGD it was noted that drought cycle has of late been reduced to almost a year due to climatic variability, attributed to climate change. Rainfall variability with unreliable rainfall onset has affected pastoralists in decision making.

The variability was noted to be high while the trend shows that rainfall was decreasing especially for MAM season. Increasing trend was noted during OND season. The FGD, with Chepiruk women group members noted that the onset of rainfall had changed completely from early march to late April each year and had turned to be so violent and erratic. Coupled with bare ground, it could easily cause harm by washing away fertile soil due to soil erosion. This observation agrees with the research conducted by Obwocha *et al.*(2022) that indicated that onset of rainfall in recent years had shifted to April.

Figures 4.13, 4.14, 4.15 and 4.16 presents results for trends and variations in rainfall both for MAM and OND respectively in pastoral and mixed farming ecological zones..

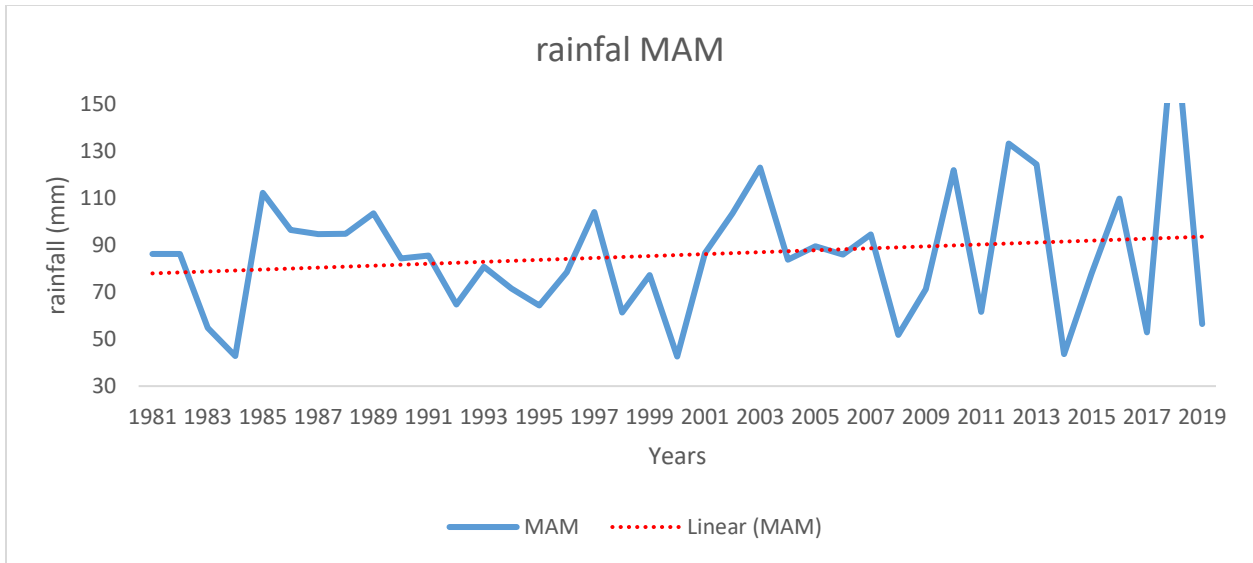


Figure 4.13 trends and variations of rainfall for MAM seasons in pastoral ecological zones for the period 1981-2019.

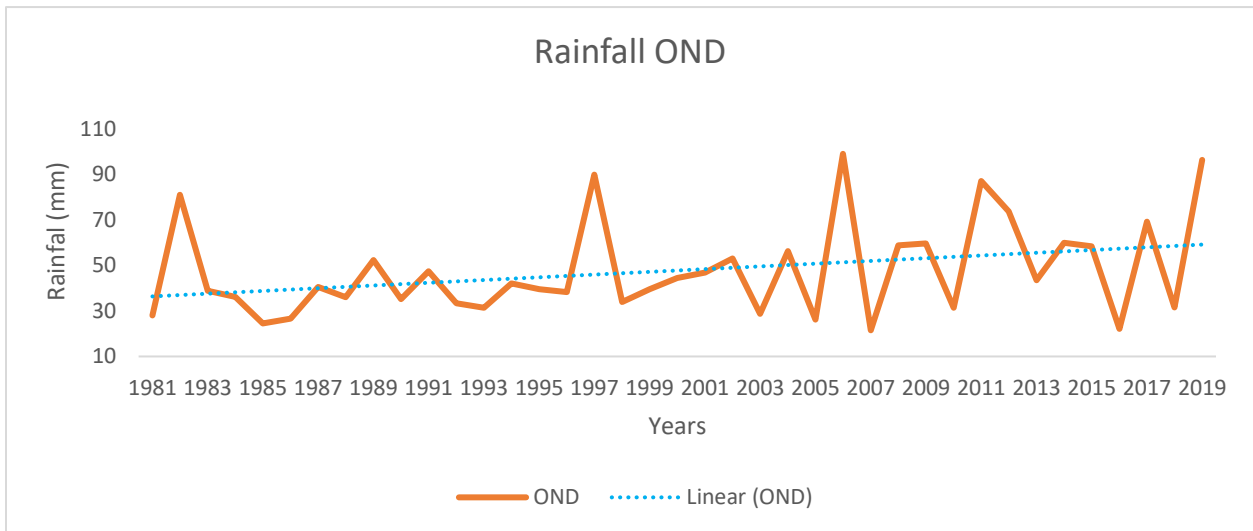


Figure 4.14 rainfall trends and variations for OND seasons pastoral zones for the period 1981-2019.

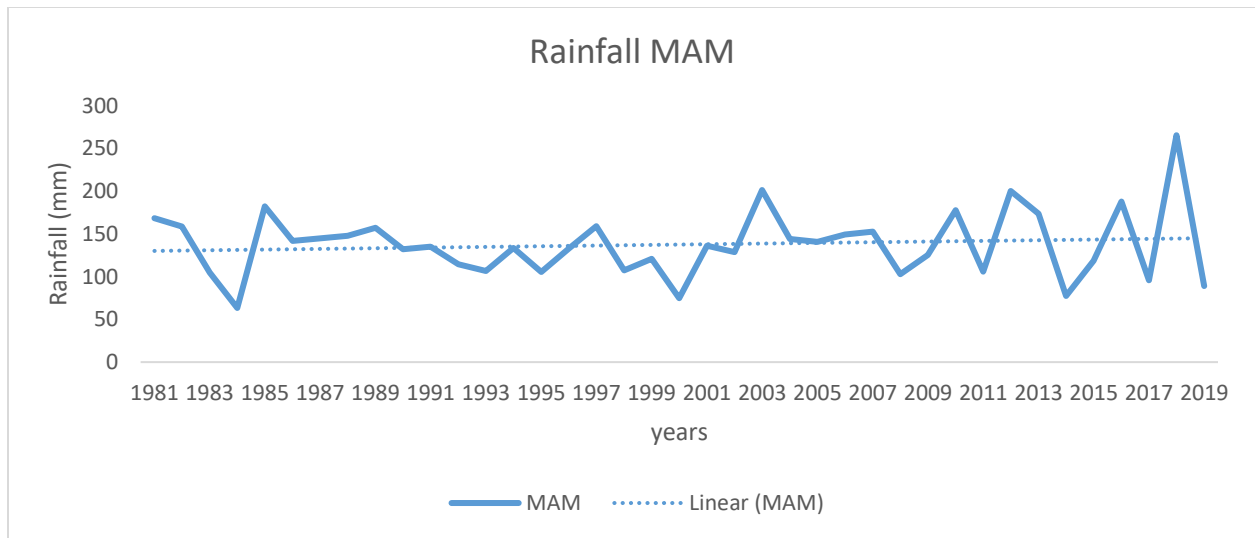


Figure 4.15 trends and variability of rainfall for MAM seasons in mixed farming ecological zones for the period 1981-2019.

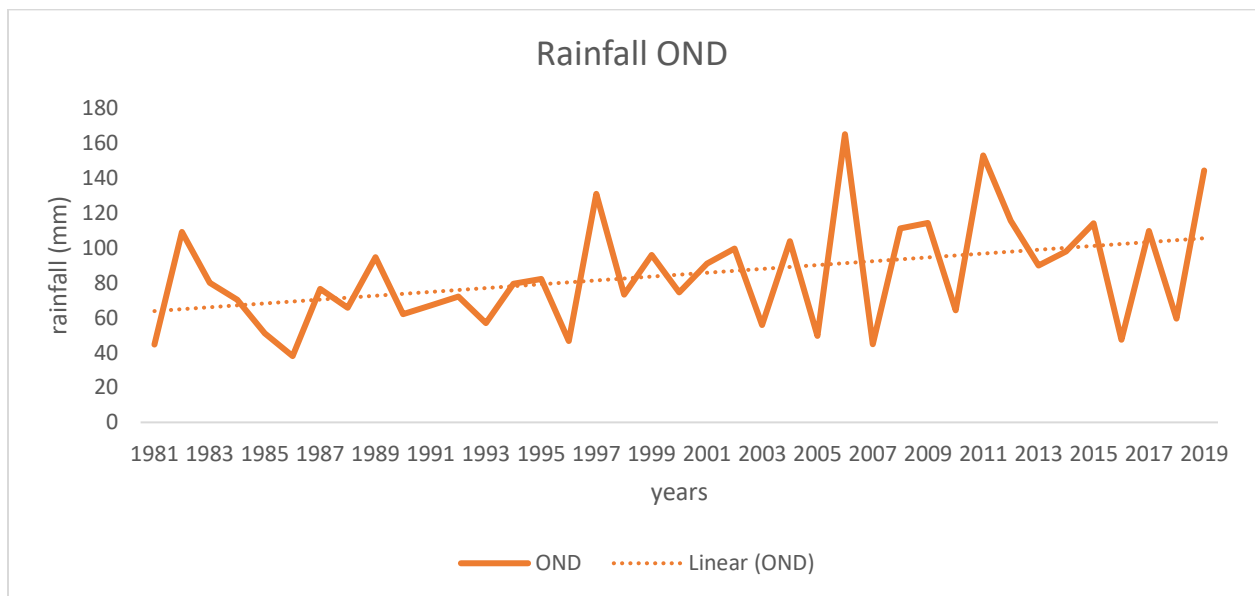


Figure 4.16 trends and variability of rainfall in OND seasons in mixed farming zones for the period 1981-2019.

These results indicated that there was a noted difference in rainfall variation in the four sub counties. The purely pastoral sub counties showed similar trend in OND and MAM seasons while in agro-pastoral and mixed farming it showed a slight increasing trend.

The study agrees with NDMA (2017) that drought was the most livelihood threatening natural disaster, that has become more frequent or experienced on yearly basis in ASAL counties.

Figure 4.17 revealed that pure pastoral zone experiences depressed rainfall, the findings further indicated rainfall patterns vary across the study area and more so the livelihood zones. Less to trace rainfall was noted in Pokot North (part of Kacheliba) and Pokot Central (Sigor). The agro-pastoral area is indicated to receive moderate rainfall. During FGD, it was found that rainfall in the West varied with distinct zoned ecology. For instance, pastoral, agro-pastoral and mixed farming, from the mixed farming zone received extreme rainfall although it covers a small part of the study area. The pastoral zone that mainly covers two Sub-counties (Pokot North and Pokot Central) and the agro-pastoral that covers a small part of West Pokot and South Pokot) received moderate rainfall.

All distributions (1981-2020) West Pokot county 35°0'0"E

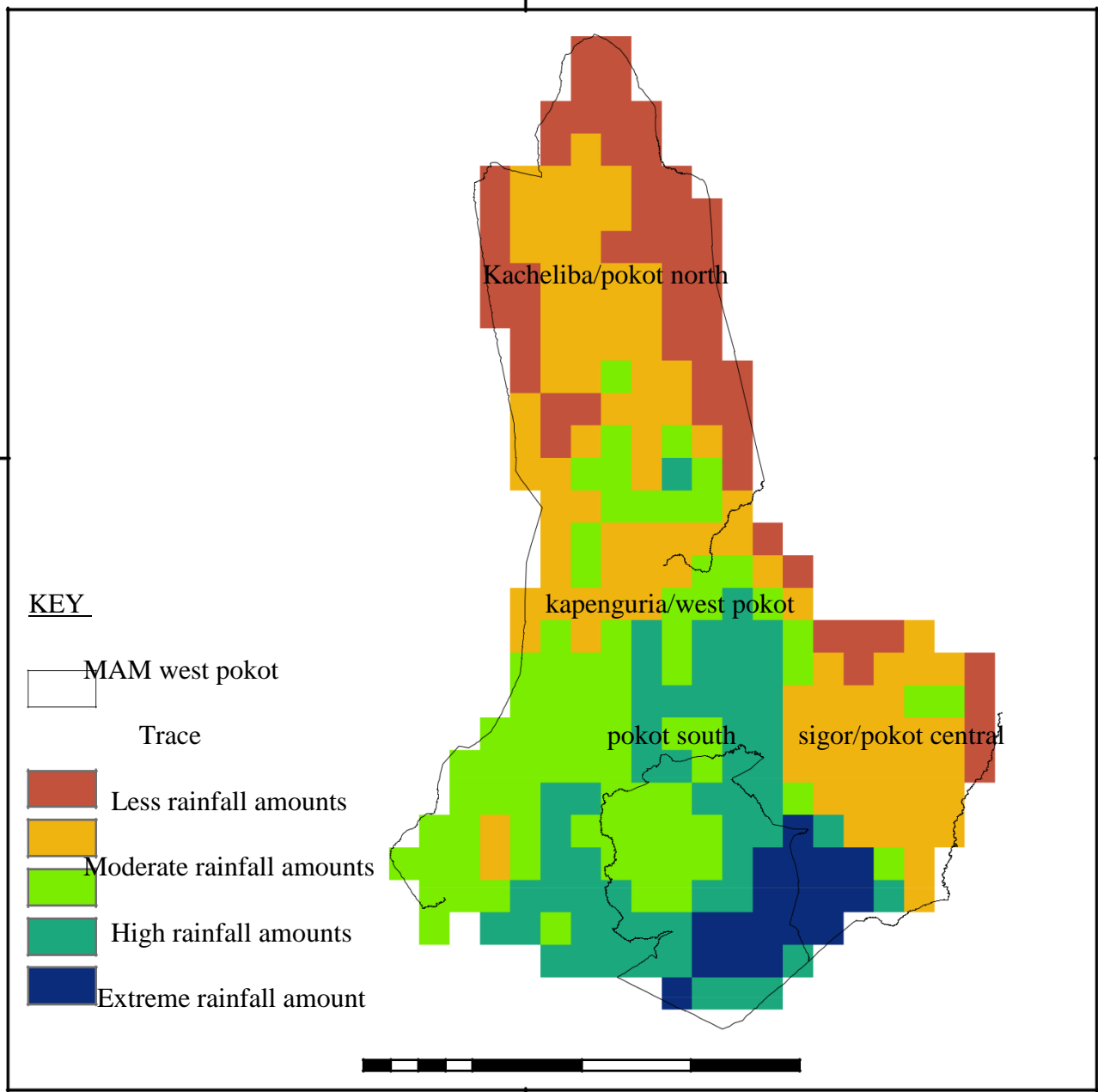


Figure 4.17 spatial variability of rainfall in west Pokot County

From Figure 4.17, it was evident that different sub-counties revealed different levels of rainfall patterns. This was also revealed during Key informant interview with the director meteorological services west Pokot County who reported that highland areas may suffer more than lowland areas where low performance of rainfall has been common and the area has been used to frequent

drought, but in highlands, decreased rainfall was an emerging problem being experienced by communities living in those sub-counties, thus making them more vulnerable to emerging climate variability. The FGD discussions revealed that all the sub-counties indicated fluctuation of rainfall trends across the livelihoods and sub-counties. This was supported by the results portrayed by the data from the meteorology department as it indicated a noted variability of rainfall in the four sub-counties.

4.3 Livelihood Characteristics of Pastoralists in West Pokot

The demographic characteristics of the respondents indicated that individuals were affected by climate change differently and therefore the individuals become susceptible to adverse effects of climate change because the impacts of climate change was directly interfering with livelihoods and this informs the vulnerability level.

4.3.1 Education Level of Respondents

Figure 4.18 represents the percentages of the respondents corresponding to the level of education. The study found that the education level of the respondents was as follows; 66.7%, 10.2%, 11% and 12.1 % had no education, had primary education, had secondary education, and had university/College, respectively.

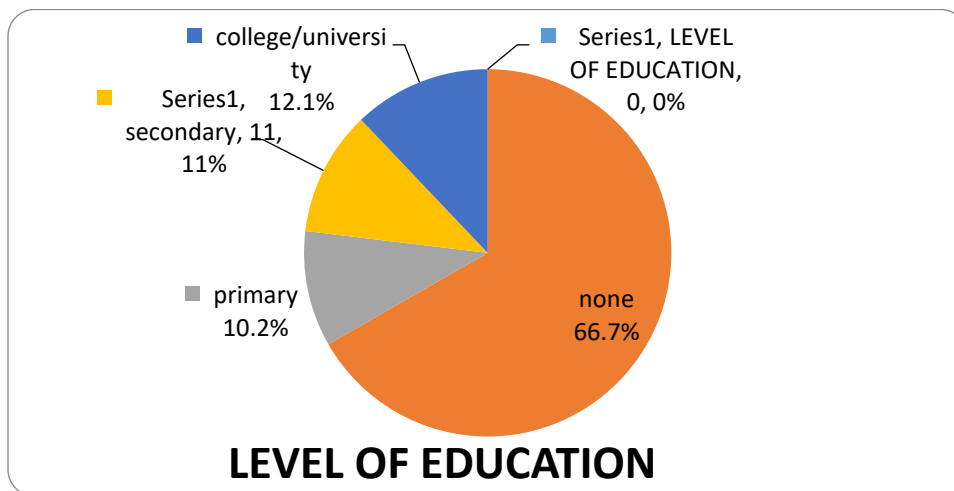


Figure 4.18 Education level of the respondents

Education being a basic measure of one's vulnerability or adaptive capacity and the status of an individual, the researcher determined the education levels of study participants. this therefore justify that communities in this area are vulnerable to climate extremes with relatively low adaptive capacity to impacts of climate change because the education level of the respondents predicts the decision and actions to be taken in relation to climate change adaptation measure.

4.3.2 Occupation of Respondents

The findings showed that most of the respondents were livestock keepers with 72.9%, 13.6%, 8.2%, 1.4%, 4% for crop farming, business, casual labor, Employed respectively. (Figure 4.19).

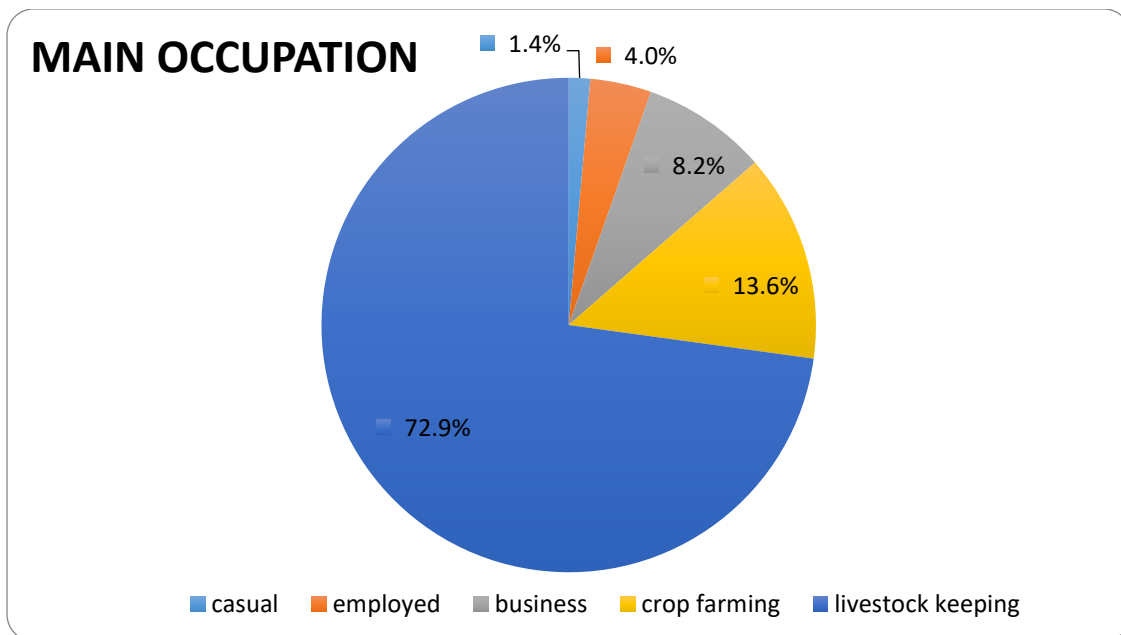


Figure 4.19 Main Occupation of Respondents.

These findings revealed that livestock keeping is the main source of living in the study area, and this therefore justifies that West Pokot County is mainly Pastoralist County. This mean that the livelihood of residents of West Pokot is threatened by climate change, because during drought period, the area experience water crisis and shortage of pasture that directly impacts livestock sector and the few that practice agricultural farming solely relies

on rain fed agriculture that is threatened by unpredicted rainfall and chronic drought in arid and semi-arid Counties like West Pokot.

4.3.3 Economic Level of the Respondents

The study revealed that most people in the study area are self-employed (54.2%), with 38.7% and 7.1% being unemployed and employed, respectively (Figure 4.20).

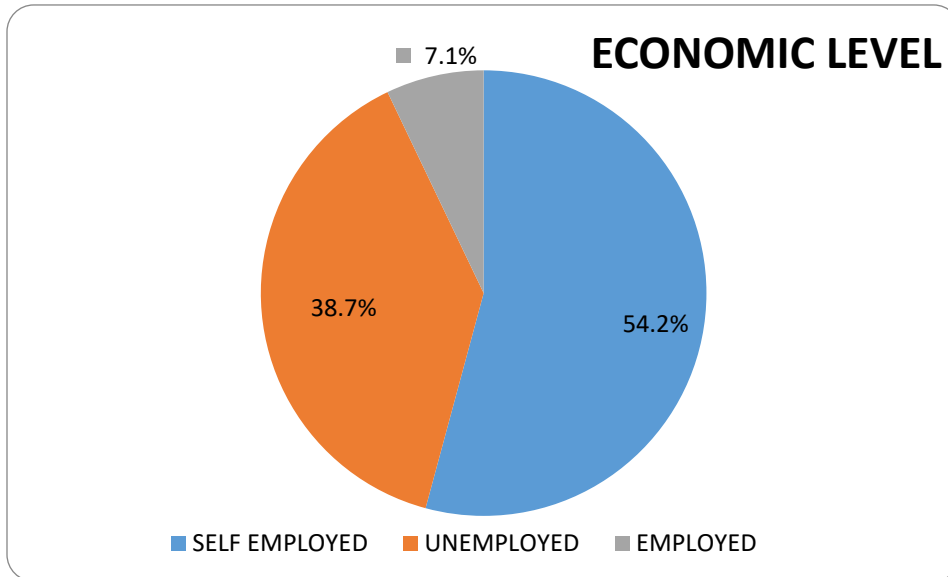


Figure 4.20 Economic level of the residents

This indicates that very few people have bargaining power during climate extremes such as drought that require resources in addressing food security needs, when food security is compromised thus resulting in famine and hunger. The main self-employing sector was noted to be livestock rearing, crop farming and charcoal burning. These kinds of employment are sensitive to climate change, more livestock and crop farming are more exposed to effects of climate variability, for example when drought strikes, the affected sectors are livestock and agriculture (crop farming). The percentage of unemployed people was noted to be also high, almost half of the population.

4.3.4 Household Size

The study noted that most of the household size in West Pokot County is between 6-10 people, which is 58.6%, 1-5 was 25.5% and above 10 was 15.9%,(Table 4.3).

Table 4.1: Household size of the respondents

Size of household	Frequency	Percent
1 – 5	90	25.5
6 – 10	207	58.6
Above 10	56	15.9
Total	353	100.0

This study indicates that residents of West Pokot have high household size that increases community vulnerability to effects of climate change, the bargaining power of households is compromised by the household size. The study indicates that households with higher size are more vulnerable compared to households with smaller size, therefore size of household influences community vulnerability.

4.3.5 Main Source of Income

The main source of income for West Pokot residents is livestock rearing and poultry with 56%, crop farming 28.5%, small scale business/trader 8.0%, formal employment 3.6%, casual security benefits 2%, social assistant (cash transfer GOK) 2%. (Table 4.4).

Table 4.2: Respondents' source of income

Main Sources of Income	Responses	
	Number of respondents	Percent
Livestock Rearing / Poultry	198	56.1%
Crop Farming	101	28.6%
Small Scale business/trader	28	8.2%
Formal employment (salaried)	13	3.7%
Casual employment	8	2.3%
Rent from rented property (land, housing)	2	0.7%
Social security benefits	1	0.2%
Social assistance (cash transfer, Government)	1	0.2%
Total	353	100.0%

The source of income for the community influences community adaptive capacity and its resilience to impacts of climate change; therefore, if the source of income is more prone and sensitive to changes in climate then the community is more vulnerable to climate change related shocks. From the findings it was found that livestock rearing was the main source of income of the community in West Pokot county and animals rearing depends heavily on natural resources which are sensitive changes in climate, therefore it is one of the value chains that is more exposed to climate change and variability. This therefore indicates that majority of the people (56%) in west Pokot County are more at risk in relation to the climate change impacts.

4.3.6 Monthly Income of the Respondents

Table 4.3 presents the findings that reveal that most of the respondents earn between Ksh1,000-5,000 and a few people were found to be earning between Ksh 15,000-30,000.

Table 4.3: Respondents monthly income

Average Monthly Income	Frequency	Percent
Less 1,000	61	17.2
Between 1,001-5,000	185	52.5
Between 5,001-10,000	46	13.0
Between 10,001-15,000	17	4.8
Between 15,001-30,000	13	3.7
More than 30,000	14	4.0
Don't Know	17	4.8
Total	353	100.0

Average earnings among the residents of West Pokot were within the low limit of a poor person that is living below one dollar per day translating to earning below ksh.3500 in a month as described by wafula p.(2020). Since the financial status of a community serves as an indicator of resilience and adaptive capacity of a community, majority (52.5%) of west Pokot residents are incapacitated and they are therefore vulnerable. The reverse is true, where few people are earning more than Ksh 30,000, which could not help support community initiatives in building resilience. Watson and Binsbergen (2008) indicated that climate change results in social, economic, cultural, and environmental losses to the pastoralists, and the community spread risks and uncertainty

through herd mobility to maximize the utilization of their heterogeneous landscapes and keep a mix of livestock species in addition to restocking and destocking.

4.4 Pastoralists vulnerability to climate change effects.

Vulnerability is a function of exposure, sensitivity, and adaptive capacity. This study analyzed the livelihood characteristics of pastoral community that reflected its level of vulnerability by considering how the community was exposed for example, the ASAL nature of west Pokot and dependence on one value chain-livestock rearing and on other side considering how are these effects of climate change e.g through the death of animals and even number of affected people due to disasters, and finally the adaptive capacity, that is, whether the pastoral community can adjust to the climate change effects which can be measured by the Monthly income, level of education and main source of income.

4.4.1 Exposure of pastoral livelihoods to the impacts of Climate change and variability.

The study investigated climate variability in the study area in relation to pastoral livelihoods and as presented in the results for temperature and rainfall, it was evident that there was serious variation of rainfall, and that temperature was increasing especially during OND season. The decline in rainfall was evidence that drought was almost annual. This findings revealed that climate variability negatively impacts on water sector, due to its sensitivity to climatic variability, the study agree with Muricho (2018) who found that Pastoralism was the main livelihood activity in the arid and semi-arid lands (ASAL's) of Sub-Saharan Africa (SSA) and Pastoralists heavily depend on the natural water and pastures for the wellbeing of their livestock, therefore pastoral livelihoods are threatened since Natural resources in the ASAL have been on the decline due to land degradation, burgeoning population growth that has led to human encroachment of grazing lands. This vulnerable situation was found to be worsened by the negative impacts of climate-change induced shocks, such as droughts. In addition, pastoralists were vulnerable to the extremes of climate change and variability as they derive most of their food and income from livestock. The findings from FGD indicated that the water crisis has been a chronic problem in West Pokot. The study further found that water and pasture were very sensitive natural resources that support the livestock sector, thus exposing communities who depend on livestock as the only source of livelihood at high risk. A key informant from water sector revealed that during the dry season, water trucking for livestock were initiated to help reduce impacts of acute water crisis.

The majority of the respondents indicated a decrease of 84.2% while 14.1% and 1.7% of the respondents indicated an increase and no change, respectively as seen in the (table 4.4.)

Table 4.4 Status of sectors in relation to Climatic Change

Sector	Status in relation to climate changes					
	Increased		No Change		Decreased	
	Count	%	Count	%	Count	%
Water	126	35.6	10	2.8	218	61.6
Vegetation	58	16.4	34	9.6	262	74.0
Animal Population	50	14.1	6	1.7	298	84.2
Livestock Production	42	11.9	22	6.2	290	81.9
Pasture	30	8.5	8	2.3	316	89.3
Milk Production	24	6.8	12	3.4	318	89.8

The study indicated that livestock population reduced due to increased outbreak of animal's disease triggered by climatic variability coupled with natural hazards such as drought. Focused group discussion members noted that if the trend continues, then people in West Pokot would have lesser and lesser number of animals and the sub sector will be in critical point of decline. During focus group discussion it was reported that migration during dry season increases livestock vulnerability to livestock diseases because concentration and overcrowding animals from different areas, thus exposing animals to many dangerous diseases. Adger (2006) also found that vulnerability was impacted by the limits to resilience which determines the households' ability to absorb stress and maintain similar structures, functions and feedback.

The results showed that 81.9% of those engaged in livestock production activities reported a huge decrease, while only 11.9% reported an increase in livestock population (table 4.4). The study indicated that livestock production decreased due to high heat attributed by frequent drought and rise in temperature. During an interview with a key informant with the county director of livestock production, reduced pasture and frequent water crisis has posed a serious threat to livestock production. Frequent outbreak of disease also affects animal production. Similarly, a majority engaged in milk production reported a decrease of 89.8% in their milk productivity while only

6.8% and 3.4% reported an increase and no change respectively (table 4.4). This inform that climate change has adverse impacts to many sectors that support pastoral livelihoods and therefore justify high level of exposure that pastoralists experience due to climate extreme events that pose serious threat to livestock rearing, thus putting at risk lives of those whose daily living depend on livestock as source of livelihood and mainstay.

During the Key informant interview it was reported that climate change and variability impacts negatively on various sectors of development and it poses a serious threat to realization of the sustainable development goals (SDGs). The study further noted that climate change coupled with natural hazards and changes in weather patterns exposes the pastoral communities to conflicts and violence with neighboring communities due to struggle for the limited resources such As water and pasture. The study agrees with Thornton (2006) whose findings suggest that tensions around water and pasture resources are caused by the increasing demand for these scarce resources. The researcher also determined that temperature and rainfall are critical determinants for productivity in the arid and semi-arid areas. Frankenberger (2012) also found that the foundation for communities and households to resiliently satisfy their demand for food depend on protection of livestock production from effects of climate extremes. This means that protection of the key livelihood support sector was key in reducing community vulnerability to climate change related shocks.

4.4.2 Sensitivity of Pastoral livelihoods to climate change impacts in West Pokot County

West Pokot was found to be inhabited mainly by the Pokot Community whose main livelihood was livestock rearing and were having main economic activity as that of keeping animals. The study revealed that West Pokot residents' main source of livelihood was in livestock rearing and that migration with animals during drought episodes was one of the common features of Pokot community. The area occupied by pastoralist was found to be mostly arid and semi-arid with harsh climatic condition that trigger frequent migration. This study was supported by Mutimba *et.al*, (2010), who stated that Pastoralism was the main form of livelihood for communities living in Arid and Semi-arid Lands (ASALs) of the country. This practice has faced challenges associated with climate variability and change that manifested through frequent, intense, and prolonged

droughts. For example, the country experienced droughts which occurred in 1999-2001, 2002, 2003, 2004-2006, 2007 and 2008-2011. (Mutimba *et al.*, 2010).

The study further noted that pastoralists lifestyles were characterized by seasonal movement with livestock, whereby the elders mostly decide where to migrate to and whether the whole household would have to move or not. In most cases women were left at home with a few animals for milk. This increases responsibility of women who are already vulnerable as changes in the workload suggests that disasters associated with climate change increases responsibilities of women in the domestic scene. This was supported by key informants who noted that pastoralists own large herd of animals, coupled with pastoralists being polygamous and large household size of between 6-10 members. A snapshot of 2019 landslide which happened in Tapach ward where it was reported that one family lost 6 members due to the landslide. This was a clear indication that the sensitivity of pastoralists to climate change impacts was high and detrimental. Area chief of Konyao noted that he lost 70 cows in 2017 due to starvation and being stolen by Karamojong bandits as they moved further to the interior part of Uganda in search of pasture.

It was further noted that pastoralist communities value livestock because of various functions they used it for, including source of food, cultural/ritual performance, and dowry. Majority of them kept animals, (figure 4.21).

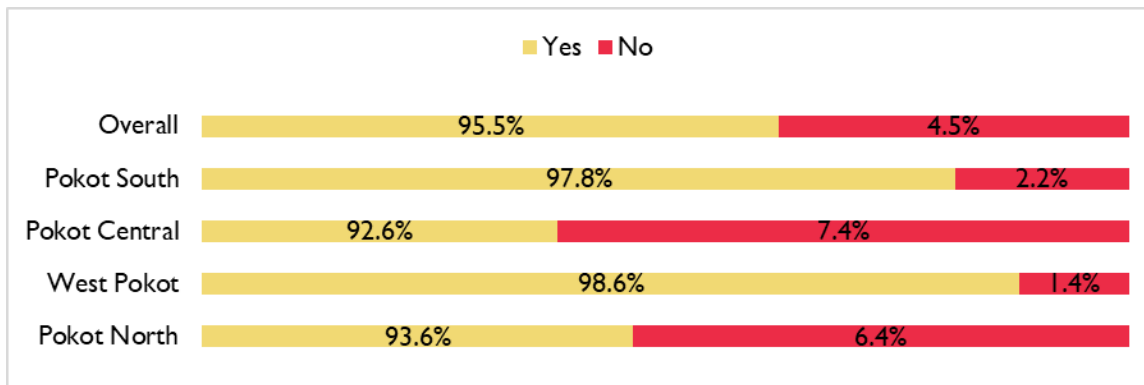


Figure 4.21 Proportion of Respondents with livestock

Overall, majority of the respondents (95.5%) reported that they kept animals while 4.5% reported that they do not keep animals. West Pokot sub-county had the highest number of respondents, (98.6%), who reported keeping livestock followed by Pokot South sub county (97.8%), then Pokot North sub county (93.6%) and finally Pokot Central at (92.6%), (figure 4.21). This informs that the number of residents affected in west Pokot due an occurrence of extremes of

climate change was high, for instance droughts, depletes the residents' main source of income. It was also noted through FGD that pastoralists were at cross roads of moving away from cattle rearing to other value chains but the nature of the area which was predominantly pastoral, limits other options of value chains.

4.5 Extreme Climate Events and livestock production

Figure 4.22 presents the results for the type of climate change extreme events experienced by the community of west Pokot county where Overall and majority of the respondents (71.4%) reported drought as the main climate extreme event in which Pokot North sub county (64.3%), West Pokot sub county (67.1%), Pokot Central sub county (87.0%) and Pokot South sub county (76.4%). Less than a tenth of the respondents reported floods to be an extreme climate event and less than a third (27.2%) reported livestock disease as one of the impacts of an extreme climate events. Drought was the most persistent climate event in the areas of West Pokot mainly affecting their livestock production and disturbing their way of life.

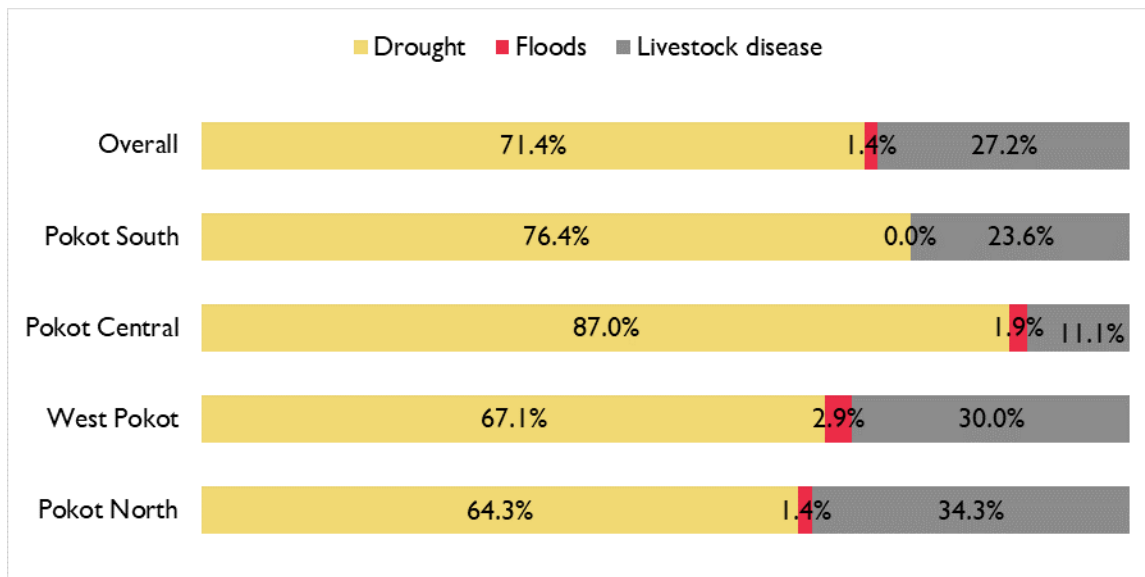


Figure 4.22 Proportion of respondents who reported climate extreme events in their area

Figure 4.23 presents the proportion of the respondents who felt that climate change affected their livestock production.

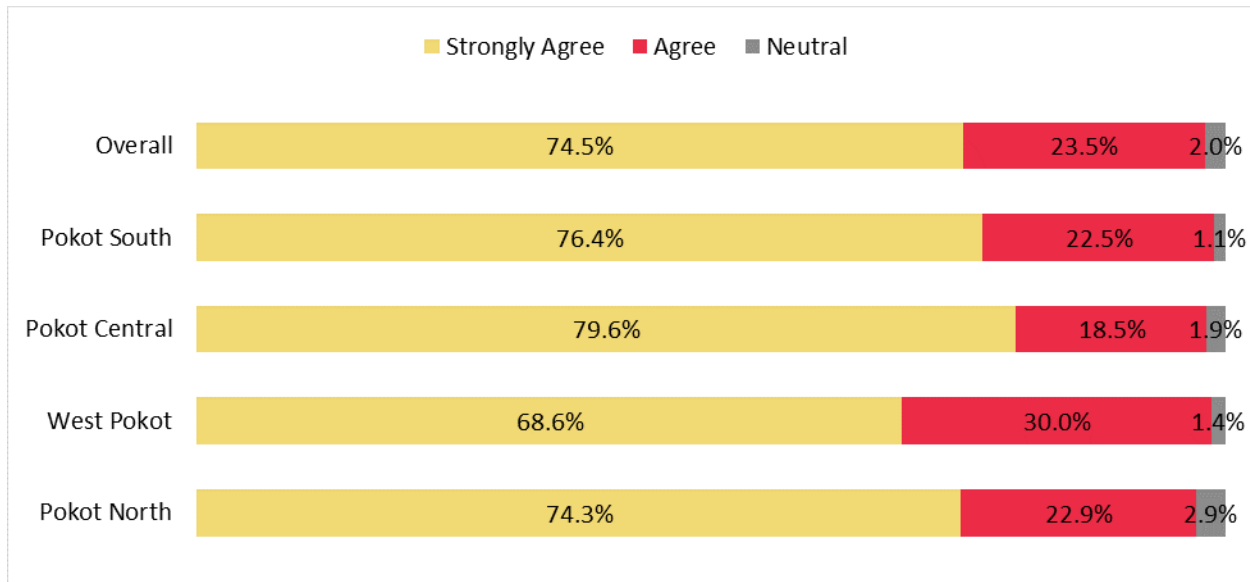


Figure 4.23 Proportion of respondents who confirmed whether climate change affected their livestock production

The study found that 74.5% of the respondents (Pokot North 74.3%, West Pokot 68.6%, Pokot Central 79.6% and Pokot South 76.4%) strongly agreed that climate change affected their livestock production whereas 23.5% agreed and 2.0% were neutral on the question whether the climate change affected their livestock production.

Drought was the most common extreme climate event in West Pokot County that poses serious threat to the livelihood of pastoralists. However, livestock disease was also reported by the respondents, with Pokot North Sub County indicating 34% of the respondents agreeing that livestock diseases were the most threatening hazards in the area.

It was further noted that hazards such as death of animals and food insecurity influences livestock production, in all sub-counties, which was directly influencing food security of the pastoralist community. This study is supported by the work of Mwakaje (2013), who said that climate change has a direct effect on natural resources which livestock sector depends on and over 90% of pastoralists in Tanzania recognize drought as the main constraints in livestock production. The study agrees with the study published by Henderson (2011), who found that livestock makes a key contribution to food security in the globe in terms of source of energy, proteins and nutrients in many countries which are rich in livestock like Ethiopia and Kenya, livestock play key role in rural poverty reduction since a good number of households receives direct income by selling animals while the urban residents earn income by selling livestock products.

Figure 4.24 presents Proportion of respondents who confirmed to have experienced drought in their locality in the past five years and overall, 86.1% majority of the respondents with Pokot North sub county (95.7%), West Pokot sub county (85.7%), Pokot Central sub county (81.5%) and Pokot South sub county (74.2%) while 13.9% of the respondents indicated not to have experienced or noticed any drought in their locality.

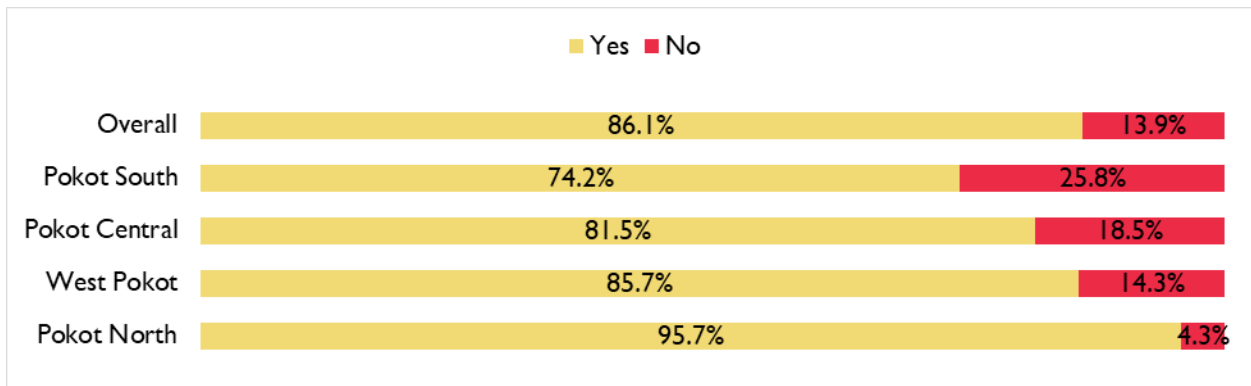


Figure 4.24: Proportion of respondents who confirmed drought in their locality in the past five years.

Therefore, this informs that climate change effects in West Pokot County was experienced by the residents, this was evidenced by the respondents reporting of drought being experienced for more than five times in five years. The studies Overall strongly agree that climate change directly affects their livestock production. This confirmed that livestock production was very sensitive to climate change. This study findings agreed with those of FDRE (2015), who found that climate change would result in a decrease in livestock productivity by up to 50% in 2050s compared to if the climate remained unchanged.

4.5.1 Impacts of Climate Change on livestock

Figure 4.25 presents the proportion of respondents who reported the impacts of climate change to their households.

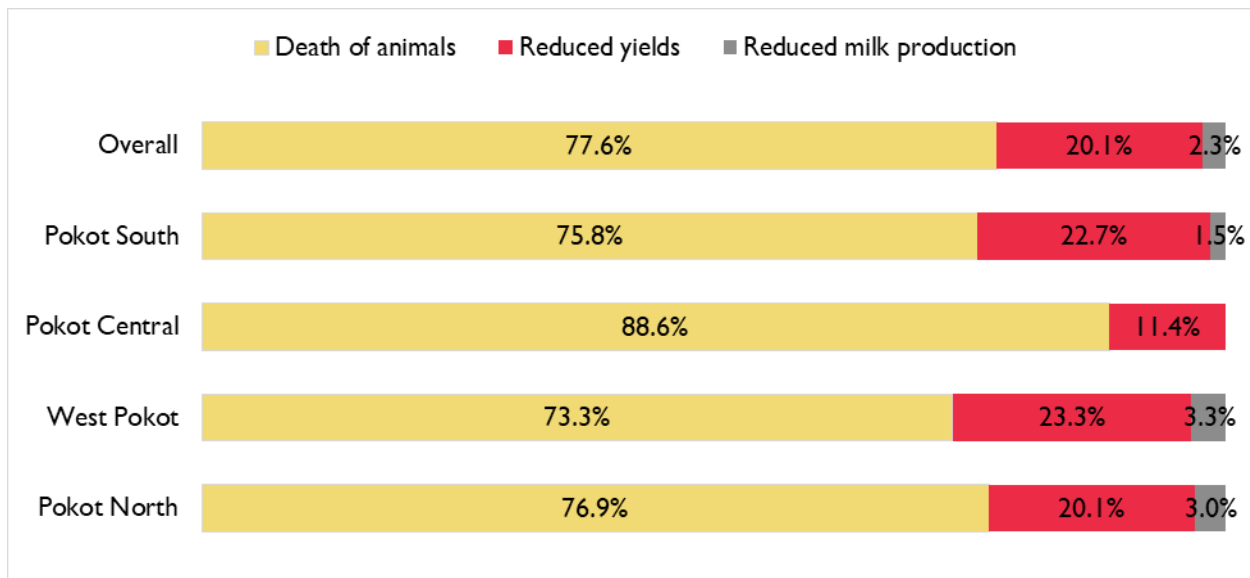


Figure 4.25: Proportion of respondents who reported the impacts of climate change to their household

Death of animals, reduced yields and reduced milk production were the impacts reported by the respondents to have had on their livestock. Most of the respondents in the entire county 77.6% reported to have experienced death of animals as the major impacts of climate change where Pokot North sub county (76.9%), West Pokot sub county (73.3%), Pokot Central sub county (88.6%) and Pokot South sub county (75.8%). The study indicated that animals' death was adversely reported in all the sub-counties of West Pokot County, reduced yield was also reported in West Pokot County, reduced yield and reduced milk production was also reported in many parts of West Pokot County. M. Herrer J., *et al.*, (2016) The impacts of climate change on livestock and pastoral system include changes in herbage growth, drying up of animal's water points and changes in the composition of pastures and in herbage quality.

4.6 Pastoralist adaptation measures

Table 4.5 presents the actions taken by pastoralists in response to the impacts of climate change extreme events in west Pokot County.

Table 4.5 Action taken to Livestock during the Drought Period

Sub-County	Action done to livestock during the drought period							
	Migrated		Cutting tree leaves for them		Off take		Other (Specify)	
	Count	%	Count	%	Count	%	Count	%
West Pokot	44	73.3%	15	25.0%	1	1.7%	0	0.0%
Pokot North	73	54.5%	48	35.8%	5	3.7%	8	6.0%
Pokot Central	23	52.3%	17	38.6%	0	0.0%	4	9.1%
Pokot South	32	48.5%	26	39.4%	4	6.1%	4	6.1%
Overall	172	56.6%	106	34.9%	10	3.3%	16	5.2%

Most of the respondents (56.6%) reported to have migrated during the drought where West Pokot Sub County (73.0%), Pokot North sub county (54.5%), Pokot Central sub county (52.3%) and Pokot South sub county (48.5%). Other measures included of the respondents reported to have cut tree leaves for their livestock during drought (34.9%), off-take (3.3%) and 5.3% of the respondents reported other issues such as purchased hay for the livestock. During FGD it was revealed that one common strategy for West Pokot and other pastoralist to drought was said to be migration to other area where pasture and water reported to be available and accessible. this study was further supported by Key informant from the department of livestock production indicated that during dry season, over 90% of livestock in West Pokot migrate to either Uganda, Turkana border and Transzoia, where animals access water and pasture and this has formed part of their normal drought risk reduction measures.

This study incorporated Chepkiruk women group to establish boma rhodes in one-and-a-half-acre farm. The results showed that boma rhodes does well and can be harvested twice in a year giving an average of 500 bales per harvest which was profitable to the group. This was a real proof that indeed boma rhodes does well in the arid and semi-arid lands and can help during starvation especially December-April dry period (figure 4.26 and 4.27).



Figure 4.26 Chepkiruk women group boma Rhodes farm in August 2021.full of healthy boma Rhodes grass.



Figure 4.27: Chepkiruk women group boma Rhodes farm in March, 2022.bare ground,no grass.

Figure 4.28 presents the proportion of respondents who owns land with title deeds.

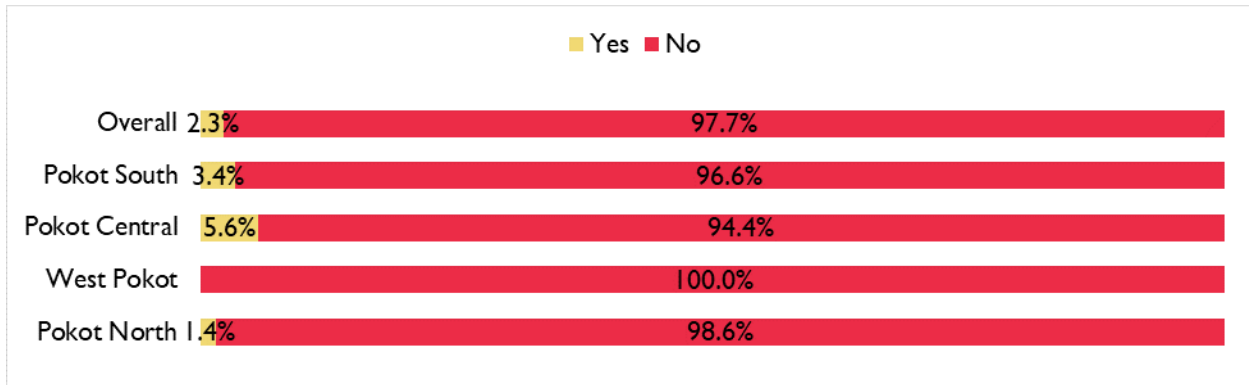


Figure 4.28 Proportion of respondents confirm to own a land with a title deed

A few (2.3%) of the respondents indicated to have land with a title deed while the majority of the respondents (97.7%) indicated to own land without title deed where, Pokot North sub county (98.6%), West Pokot west Pokot sub county (100.0%), Pokot Central (94.4%) And Pokot South sub county (96.6%). This Shows That the People in West Pokot County live in communal land since only a few of them own land with title deeds. There was a need for demarcation of land in West Pokot County to adopt an organized land ownership with title deed and use the title deed to borrow loans to buy food items and even use to establish projects that builds resilience for example growing of pasture, land enclosure and small scale irrigation projects.

Figure 4.6 presents the different distances travelled in search of water during dry season.

Table 4.6: Distance of tracking for water during Dry Period

Sub-County	How far do you truck for water during dry period in the village									
	0-1 km		1 -2 km		2 -3 km		3 - 4 km		5km	
	Count	%	Count	%	Count	%	Count	%	Count	%
Pokot North	31	22.1%	33	23.6%	55	39.3%	16	11.4%	5	3.6%
Pokot Central	9	16.7%	10	18.5%	12	22.2%	17	31.5%	6	11.1%
Pokot South	4	4.5%	4	4.5%	19	21.3%	38	42.7%	24	27.0%
West Pokot	3	4.3%	5	7.1%	24	34.3%	31	44.3%	7	10.0%
Overall	47	13.3%	52	14.7%	110	31.2%	102	28.9%	42	11.9%

Majority of the respondents (31.2%), and (28.9%) reported to track for water at 2-3km and 3-4 km respectively. On the other hand, during the rainy season, majority of the respondents (55.%) indicated that they use less than 1km distance to look for water followed by 34.3% who walked 1-2km while only 5% respondents reported to walk for more than 5km during the rainy season (table 4.7).

Table 4.7 Distance of tracking of water during rainy season

Sub-County	How far do you truck for water during rainy season in the village									
	0-1 km		1 -2 km		2 -3 km		3 - 4 km		5km	
	Count	%	Count	%	Count	%	Count	%	Count	%
Pokot Central	37	68.5%	15	27.8%	1	1.9%	0	0.0%	1	1.9%
Pokot North	84	60.0%	45	32.1%	9	6.4%	2	1.4%	0	0.0%
Pokot South	42	47.2%	28	31.5%	10	11.2%	5	5.6%	4	4.5%
West Pokot	31	44.3%	33	47.1%	4	5.7%	2	2.9%	0	0.0%
Overall	194	55.0%	121	34.3%	24	6.8%	9	2.5%	5	1.4%

Figure 4.29 illustrates the proportions of respondents who indicated having traditional reserved grazing areas in the community.

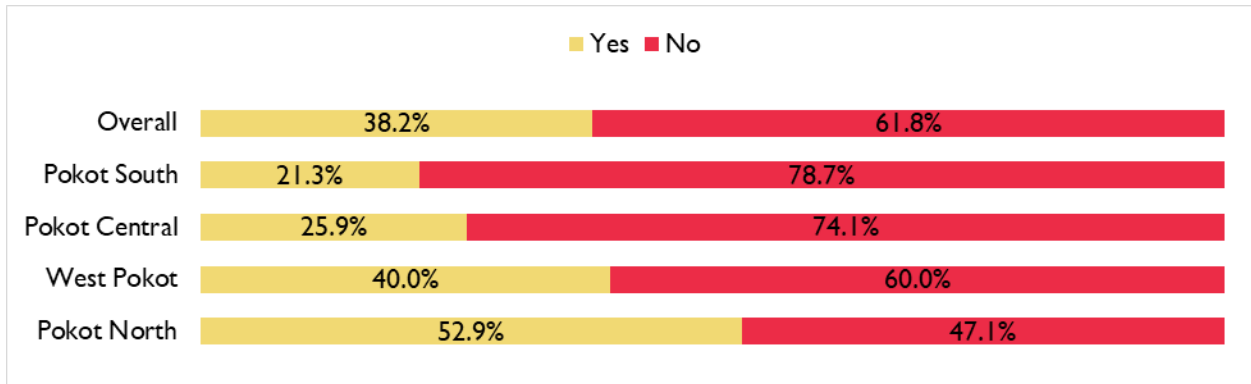


Figure 4.29: Proportion of respondents confirm to have traditional reserved grazing areas in the community.

Generally, 38.2% of the respondents had traditional reserved grazing areas in the with Pokot North sub county (52.9%), West Pokot sub county (40.0%), Pokot Central sub county (25.9%) and Pokot South sub county (21.3%). While most of the respondents 61.8% reported on the contrary.

4.7 Adaptation and Mitigation Strategies of Pastoralists in West Pokot County

4.7.1 Community-Based Adaptation Mechanisms

Figure 4.30 presents the proportion of respondents who know the community-based adaptation in the area.

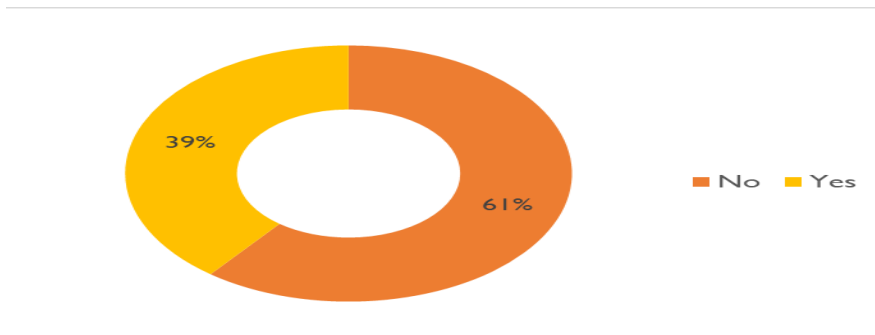


Figure 4.30: community-based adaptation mechanisms

The study findings indicated that only 39% knew the community-based adaptation mechanisms. These mechanisms included fencing of pasture lands, Migration, Cutting of tree leaves, Irrigation, Paddocking, and Reservation of grazing areas among others. 25% of the respondents reported that

they have traditional reserved grazing areas within the community. Those who reported migration as one of the mechanisms cited numerous challenge that they faced during migration. These challenges are death of animals, Insecurity/hostile communities, Attack by wild animals, Lack of food, Lack of extension services such as routine vaccination and Diseases.

4.7.2 Strategies for Adapting to Climate Change

Figure 4.31 presents the proportion of the respondents who were aware of the existing short term adaptation mechanisms to the effects of climate change.

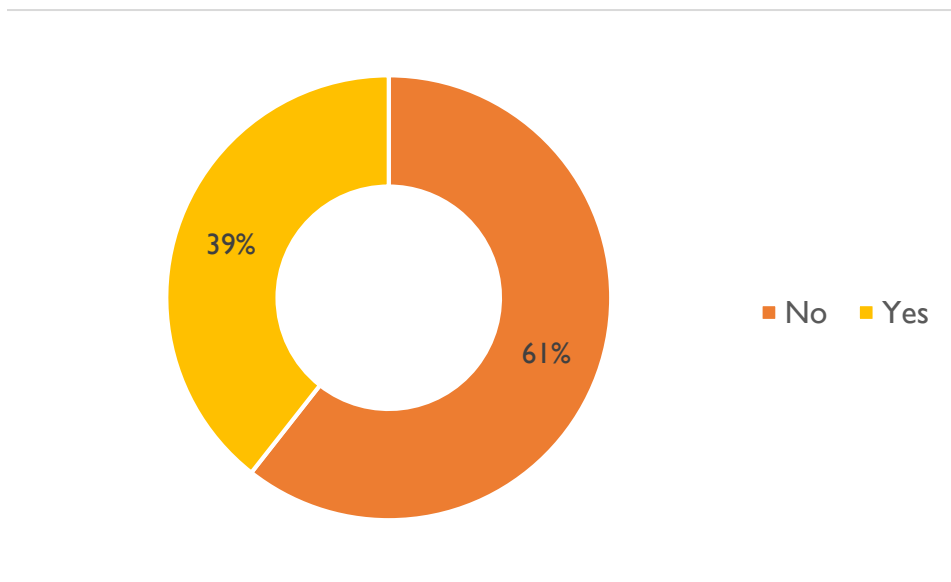


Figure 4.31: Existing Indigenous Short-Term Mechanisms on Climate Change

Findings indicated that 39% of the respondents reported to be knowledgeable of the mechanisms which included but were not limited to; Cutting trees/ leaves for livestock feeds, Conservation of vegetation cover, selling of animals, Migration, Constant vaccination, drilling of boreholes/ dams, planting drought resistant varieties of pastures, Storage of surplus feeds, Supplementation of reserved maize residues among others.

4.7.3 Mitigation measures

Further they were asked for their opinion on mitigation measures on effects of climate change in West Pokot County. Most respondents pointed out Planting of trees, Carrying out agroforestry practices, Drilling more boreholes and dams, Irrigation, Creating awareness on environmental

conservation to be the most effective measures that can be used to mitigate climate change effects for a better environment.

4.7.4 Livestock restocking

The respondents were asked more in-depth questions in order to understand their characteristics as pastoralists pertaining animal off-take and during focus group discussion it was revealed that animal's off-take was not embraced by the Pokot community as it was indicated that whoever sells animal through off-take was considered as deviant. It was further found that pastoralists generally don't embrace animal off-take as adaptation measure to climate extremes.

4.7.5 Use of Weather Forecasting information products

Figure 4.32 represents the proportion of the respondents who receive weather forecasting information products.

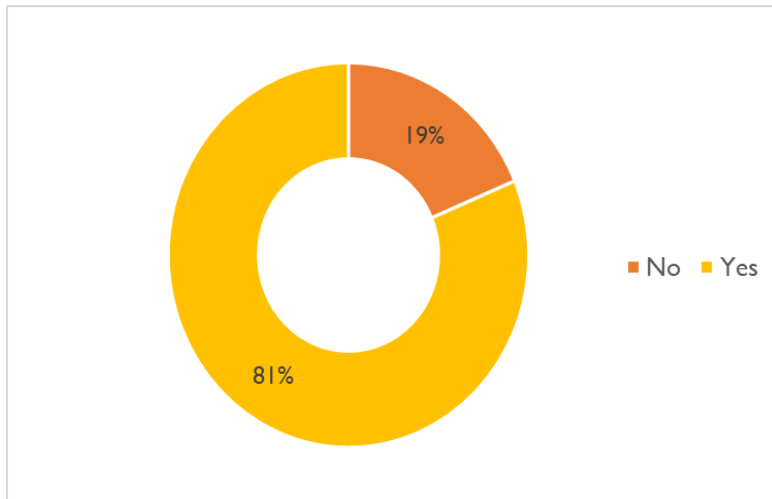


Figure 4.32: proportion of respondents who receive scientific weather forecasting

The findings showed that 81% of the respondents receive weather information from local radios such as kalya fm, north rift fm and kokwo fm which broadcast in local dialect as presented by county meteorological department while the other 19% indicated that they did not receive any of the information.

Figure 4.33 represents the proportion of the respondents who had confidence on the weather information products accuracy.

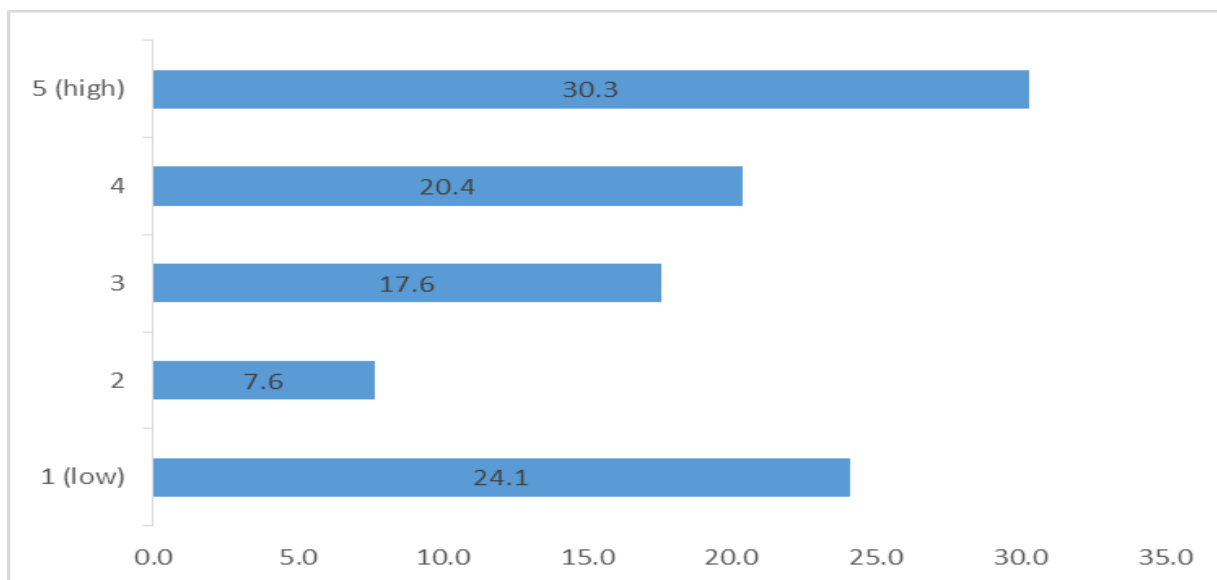


Figure 4.33: respondents' opinions on the accuracy of scientific weather forecasting.

The study findings noted that 30.3% rated the accuracy of scientific weather forecasting to be very high while 24.1% did not have confidence and they did not consider as a source of information to attract their attention.

The table 4.8 represents the action taken by pastoralists in west Pokot County in response to extremes of climate change.

Table 4.8 proportion of respondents' response to climate change shocks.

Practices used in response to climate change	Number	Percent
Migration	207	58.6
Cutting of tree leaves	82	23.2
Reserving of grazing areas	24	6.8
Stocking of maize scopes	8	2.3
Paddocking of grazing land	6	1.7
Irrigation	5	1.4
Planting of drought resistant varieties	5	1.4
Selling livestock	5	1.4
Government dams' provisions	4	1.1
Dam building	3	0.8
Fencing of pasture lands	3	0.6

Provisions of dams	1	0.3
Total	353	100.0

The respondents reported Migration (58.6 %) to be the common practice followed by cutting of tree leaves (23.2 %) and Reserving of grazing areas (6.8%).

4.7.6 Strategies in Response to Climate Change

Figure 4.34 represents the proportion of respondents who were aware of the impact of climate change responses.

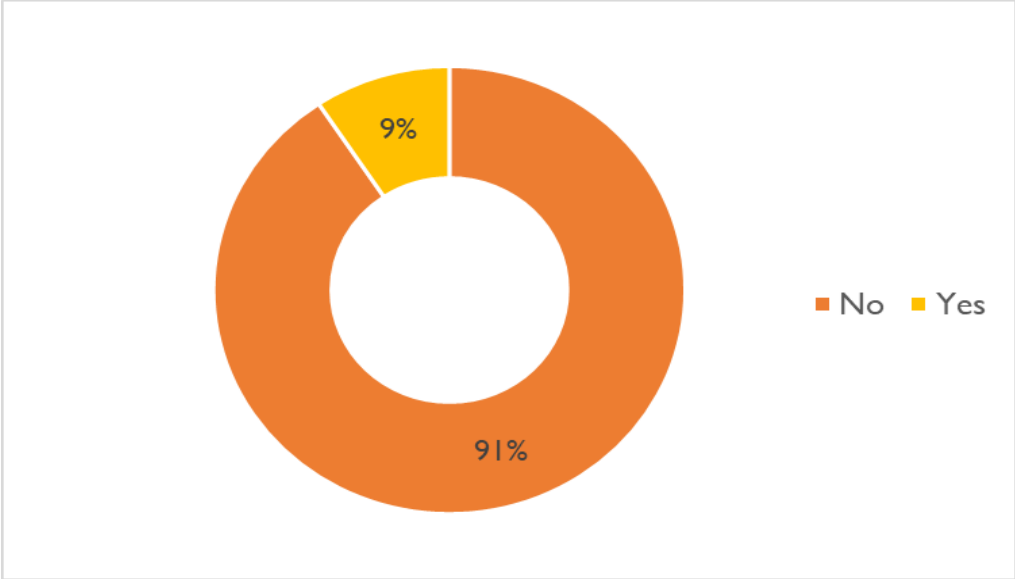


Figure 4.34: Proportion of respondents who were aware of climate change impact responses.

The study findings showed that, 9% of the respondents were aware of the strategies while 91% were not aware. The strategies included but not limited to Cutting of tree leaves, Tree conservation and soil conservation through gabion building, Use of crop residues, Migration, Preservation of feeds during rainy seasons for use during dry period, Planting of drought tolerant crops.

4.7.7 Approaches and Mechanisms mostly used by the pastoralists

Figure 4.35 Represents the proportion of respondents who have rely on the either the traditional approaches or scientific approaches when deciding on the action to take in coping with climate change extremes.

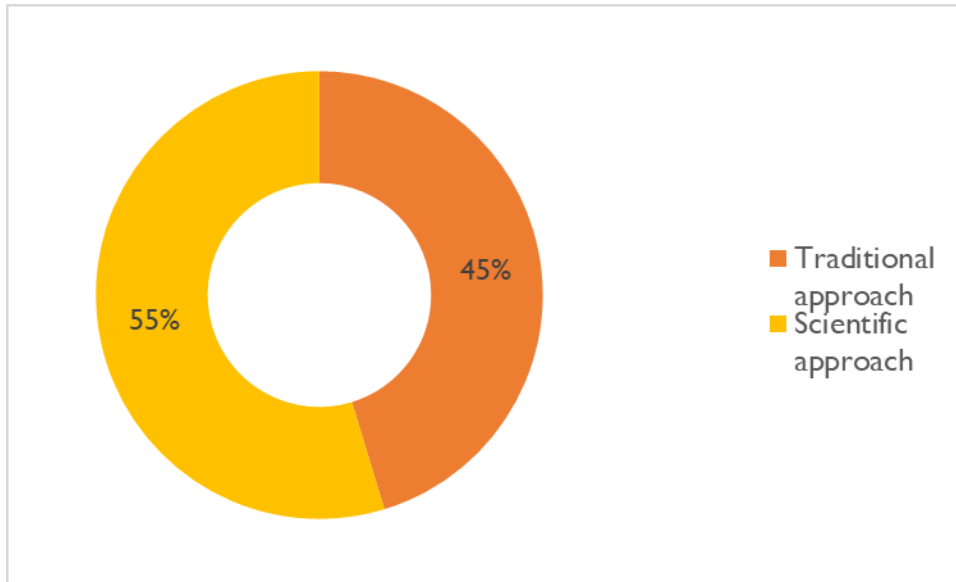


Figure 4.35: respondents' opinion on reliance on scientific approach when deciding on coping with climate change impact

Findings of this study indicated that 55% of the respondents indicated that they would rely on scientific approach when developing coping strategy. The other 45.0 percent said that they would still rely on a traditional approach. Some of the traditional approaches used were: Looking for stars, eating less food, position of hill-shadows especially in the morning and evening, Wind direction movement.

CHAPTER 5

CONCLUSIONS, RECOMMENDATIONS, AND SUGGESTIONS FOR FUTURE WORK

5.1 conclusions

This study revealed that pastoralists in west Pokot are generally vulnerable to climate change and variability attributed to their common characteristics that limit them to respond to the shocks. The main contributing factors to the vulnerability of pastoralists to climate change effects are socio-economic, existing environmental and climate risks exposure conditions. Temperature was noted to have increased significantly and manifested in time taken by pasture and general vegetation disappearance after the rains disappears especially in OND period. On the other hand, rainfall has decreased although its intensity has increased portraying an erratic nature that is destructive to vegetation and suddenly causes serious erosions and general destruction of properties. These extreme situations of the key climate variables made Pastoralists more vulnerable especially with the common characteristics of pastoralists having limited sources of income and mainly depending on livestock rearing which is sensitive to climate change.

Common features of pastoralists which makes them vulnerable to the effects of climate change include low level of education which compromises the level of decision to be taken in response to climate related stimuli and having their main source of income from livestock rearing, a sector which is much exposed to the effect of climate change and variability. The pastoralists in West Pokot are also culturally bound to animals to an extent that a cow for example is treated at a higher level that it could not be sold as an off-take strategy due to an anticipated drought striking the area. This cultural view of pastoralists is a serious issue that needs an attention because it contributes to an ignorant suffering because of climate change impacts since an individual who embraces animal off-take is considered deviant. The reason behind this virtue of pastoralists points out to the features of the animals kept for example, the animals might be a good breed in producing sufficient milk, or resistance to drought and diseases and therefore they believe that they might not get another animal of the same features. Due to this kind of inbuilt mentality of pastoralists makes them stay with the animals until they all die or when they wish to sell but too late when the animals would be already emaciated and unable to catch the eye to be valued in terms of money.

The sensitivity of pastoral livelihoods to climate change effects is high as many of the respondents experiences an increasing yearly death of animals as a result of starvation and disease outbreak since drought forces them to migrate as an adaptation option and they finally find themselves far from government and service providers' services such as vaccination and other services including deworming and even control of ticks.

The monthly income of pastoralists ranges from Ksh.1000-5000. This is seemingly far less as compared to the big household size of 6-10 persons. This scenario indicates the low level of adaptive capacity in terms of coping and adjusting to the effects of climate change. The pastoralist choice of migrating in search of water and pasture is a desperate move that may not solve their vulnerability to climate change effects but may even worsen the situation and lead to maladaptation.

In terms of vulnerability in the different sub counties in west Pokot County, Pokot central is the most vulnerable sub county to the effects of climate change. The underlying reasons behind this include the distance to water points during dry seasons which is between 3-4 kilometers, the death of animals due to drought (88%) of the residents experience an increasing death of animals and lastly the compromised adaptation of migration due to limited space to migrate to, coupled with the fierceness of the neighboring communities and low level of education. Pokot north is the second most vulnerable sub county due to the singularity of source of income in the entire sub county. West Pokot Sub County is the third as it is noted to have only two wards which are sensitive to climatic variations. Pokot south is fair, although the sub county experienced a unique disaster of landslides in 2019.

The existing community-based adaptation mechanisms adopted by the pastoralists are not the best but are taken because there is nothing else which can be done to save the situation. Some of the adaptations adopted exacerbates climate change, for example cutting of tree leaves especially the leaves of desert date (also known as *Balanites egyptiaca* also known as 'Tuyunwo' in Pokot dialect) which is directly destroying forest cover and directly reducing sequestration of carbon dioxide.



Figure 5. 1: *Balanites aegyptiaca* after its branches cut down for cattle to feed on the leaves.

Other adaptation strategies commonly practiced are storing maize stalks after harvesting (figure 5.2).



Figure 5. 2: maize stalks stored on a tree as preservation to be used during dry season.

5.2 Recommendations

- There is need for intervention on weather information system especially for the pastoralists whose percentage of low level of education was found to be high. It includes incorporation of the local knowledge on weather that predicts whether there will be plenty of rains or droughts with meteorological trends of rainfall and temperature. This would inform for early preparations to cope with the anticipated climate change risks. For example, taking a deliberate animal off-take and also preservation of hay.
- This study also recommends efforts to reduce the climate risks through interventions such as livestock insurance, diversification of livelihoods e.g engaging crop farming through establishment of small-scale irrigation schemes.
- There is need for interventions aimed at promoting women empowerment. Women have a crucial role to play in the resilience process, especially at the household level, whatever small activities they do it maintains the household in terms of food security and general wellbeing of the household.
- Livestock herd diversification with sustained emphasis on browsers, that is, goats and camels would be viable in promoting the resilience to drought and heat stress for pastoralists in West Pokot County.
- More resilient interventions such as increasing irrigation schemes to be implemented especially in Pokot central sub county.
- The study recommends animal (bulls) fattening as a lucrative business that can add income to household and help improve the household adaptive capacity.
- Encouraging livestock farmers to form cooperatives to help them in market aggregation and subsequently improve their bargaining power for prices of livestock.
- Intensive capacity building of the livestock keepers aimed at promoting climate smart livestock rearing and other modern technologies. This can be done through various social media e.g. local radio, barazas etc.
- Establishment of pasture so that it can be harvested and stored to be used during starvation of livestock.

5.3 Further Research

This study suggests further research aimed at increasing the level of adaptation and increasing resilience to the effects of climate change by pastoralists. The specific areas includes: -

1. The effects of cross border between Kenya and Uganda on issues with livestock keeping in west Pokot county.
2. The increasing rate of invasive species that limits the growth of pasture in west Pokot county is alarming especially pokot central Subcounty and Pokot north Subcounty e.g. dodder cuscuta and acacia reficiens. For acacia the community suspects that the raided animals could have brought the acacia from the deserts of Turkana, but it may also mean that the areas of west pokot are becoming more arid favoring the growth of the plant therefore, more research is needed on its control for sustainable pastoral livelihoods.
3. There is rapid farming along riverbanks of the main rivers in west pokot such as river Suam, River Chesra, River Weiwei, River Muruny, River Korio etc. This study recommends a research to assess its socio-economic and sustainability, especially with the problems of future climate events.

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APPENDICES

APPENDIX I: Introductory Letter to Respondents

SAMMY DAKTA DOMOKWANG,
P. O BOX 164-30600,
KAPENGURIA-KENYA.

RE: QUESTIONNAIRE

Dear respondent,

I am a post graduate student at the University of Nairobi undertaking a Masters course in CLIMATE CHANGE SCIENCE and as part of the course, I am undertaking research study on Assessment of the vulnerability of pastoralists to climate change, case study of west pokot county(suam ward, kodich ward, kachok and kiwawa ward, lelan ward and lomut 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,

SAMMY DAKTA DOMOKWANG

APPENDIX II: Household Questionnaire

RESPONDENTS BIO DATA

Please tick where appropriate / fill in as accurately as possible (To be filled by interviewer).

1. Which part of West Pokot County do you reside?

Pokot North West Pokot Pokot Central Pokot South

Age 18-25 26-35 36-45 46 and above

2. Gender =male =female

3. Education level primary secondary college/ university None

(To be filled by respondent or research assistant)

Ward-----location-----village

4. Marital status Married Single divorced

5. Economic level Employed Unemployed Self Employed

Objective one spatial-temporal variability of climate

1. What is the status of the following sectors in relation to climate changes? Tick where possible --

S/No	Sectors	Increased	Decreased	No change
i.	Water			
ii.	Pastures			
iii.	Milk production			
	Production			
iv.	Vegetation			
v.	Animals population			
vi.	Livestock production			

2.What is the trend of rainfall in West Pokot County?

i.Increasing

ii.Decreasing

3.in your own observation, What is the trend of temperature in West Pokot County?

iii. Increasing

iv. Decreasing

4. (a) In recent years (within the last 30 years), were there any changes in the production of your livestock? Yes No

4 (b), if yes, what was the trends

() Increase

() Decrease

5 When is the onset of long rain?

5b When is the onset of short?

Objective two characteristics of pastoralists

1 What is your household size? -----

2 What is your occupation?

i. Livestock keeping

ii. Business

iii. Employed

iv. Casual labour

v. Crop Farming

vi. Sand harvesting

3. Do you keep animals? () yes () no

3. If yes in (3), which animals do you keep? () cows () goats () sheep () any other specify.....

4 Do you do business of buying animals for stocking? Yes () no ()

4b If yes in (4) above, how many did you buy in 2017-2020?

5 How many did you manage to sell after maturity?

If less, explain i.e. Died of diseases, starvation etc

6 What is the estimate number of animals a wealthy person own in past (1980 and below

7 What is current estimate of number of animals a wealth person own (1990 and to date from the quiz 6 and 7, what can you say about variation

8 What are your main sources of income to your household? () livestock () growing maize for commercial purposes () formal employment () any other specify.....(tick many options if possible)

Objective three vulnerability of pastoralists

1. Which climate extreme events are common in your area? -----

Drought floods landslide livestock disease

2. Does Climate change affect livestock production in West Pokot

Agree strongly agree Disagree Strongly Disagree partially agrees.

3 (a) Have you experienced or/noticed any drought in your locality in the last 5 years? (1) Yes (2)

No

3(b) If Yes in 3(a) above, how many times does it strike each year twice thrice alternating

3(c) What were the impacts to your household? death of animals reduced yields reduce milk production or others (specify) _____

3(d) What did you do to your livestock during the drought period? migrated cutting tree leaves for them off-take any other specify.....

4. Which season of the year is prone to drought in your area and affects your animals severely? November–December Jan-April May-July any other specify.....

5. What are the main source of income in your household? livestock growing maize for commercial purposes formal employment any other specify..... (tick many options if possible)

6.0. Do you own a land with title deed? Yes no

6.1. If yes, have you used the title deed to borrow a loan yes no

7.0. In this village, how far do you truck for water during dry period? 1-2 km 2-3km 3-5km above 5km.

7.1. During rainy season 1-2 km 2-3km 3-5km above 5km.

Objective Four adaptation and mitigation strategies of pastoralists

1. (a) Are there community-based adaptation mechanisms to climate change in this area? Yes or No

1.(b). If yes list those mechanisms-----

2. Do you have traditional reserved grazing areas in this community? Yes (1) No (2).

3. What challenges do you face during migration.....

4. How do you withstand adverse effect of climate change -----?
5. (a) Are there strategies of adapting to climate change in your area? -----
- 5(b) Which are these strategies(rank them)
7. (a) Are livestock in West Pokot Resilience to climate change? Yes or No
- 7(b) briefly explain for any of the above answers -----
- 8 Which animal do you think is resilience to impacts of climate change-----
- () Cow () camel () goat () sheep
- 9.(a) Are there existing indigenous short term mechanisms that help in building community resilience to the effects of climate change? () yes () no
- 9(b) If Yes states those mechanisms-----
10. What do you think can help mitigate effects of climate change in West Pokot County?
11. (a) Are there indigenous knowledge on drought coping and adapting mechanism in this area (1) Yes (2) No
- 11(b). If yes, what kind of indigenous knowledge
- 11(c) Which one did you use during the previous drought?
- () Did nothing () Selling of livestock () Waiting for food () Participated in cash/food-for-work programmes () Eating less food () Collection of wild fruits () Seeking off-farm employment.
- 11(d) How is the knowledge helpful in coping and adapting to climate change?
-
-
- 11(e). Where did you get the knowledge from?
- 11(f). Would you recommend application of indigenous knowledge in livestock production as an adaptation and coping strategy against climate change and variability? () Yes () No
- 11(g) Are you able to forecast weather changes accurately through the use of indigenous knowledge? (1) Yes (2) No
- 11(h) How can indigenous knowledge on climate change adaptation be strengthened for adoption among the pastoralist?
- 11(i) Were any observable and non-observable traditional indicators available as a sign of drought disaster/hazard that year? Yes (1) No (2)
12. If yes to (11(i) above, which one?

13.0. Do you receive scientific weather forecasting? Yes no

13.1. If yes, from which source radio tv barazas any other specify.....

13.2. In a scale of 1-5 (where 1= low and 5 = high), how accurate is the scientific weather forecasting 1 2 3 4 5

13.3. What influences the adaptation and coping strategies of climate change?

Availability of climate information implementation cost Availability of labour Knowledge/skills Level of education Availability of alternatives Others (Specify)

Adaptation strategies

31.0. What practices are common in your locality as responses to climate change?

31.2. Which adaptation and coping strategies (mentioned above) do you apply?

31.2. Do you know other adaptation and coping strategies applicable in response to climate change? (1) Yes (2) no

31.3. If yes, which adaptation and coping strategies?

32.4. Which approach do you mostly rely on in adaptation and coping strategies?

(1) Traditional approach (2) Scientific approach

32.5. What is the reason for the choice of approach (listed above)?

33.0. List some of the traditional adaptation and coping strategies that you use?

34. Do you consider traditional coping strategies as effective? Yes (1) No (2)

APPENDIX III: 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. Over the last 5-30 years have you noticed any changes in weather patterns? (Onset rains, prolonged drought, erratic rains, etc)
2. What do you think is the cause of the change?
3. What are the main challenges faced by pastoral community in your area? How have these challenges evolved over the years?
4. Have you heard of —Climate changel? From which source?
5. Is this area prone to drought?
6. If yes, explain some notable drought years experienced in this community...(frequency of severe drought) What can you say about intensity/strength and frequency of climatic extremes (drought)
7. What was the effect in your household (or the community)?
8. Which group is mostly affected in this community? (orphans, widows, elderly and people living with disabilities)
9. What are your traditional or local indicators to realize that there might be a drought?
10. What has been the main impact of drought on livestock, water resources and pasture?
11. How has the climate change and variability affected livelihoods?
12. What coping and adaptation strategies do people in your community implement against climate change?
13. What are the key challenges to the coping strategies?
14. What are the key barriers/obstacles to adaptation strategies implemented by the community; how do community members try to overcome the obstacles?

APPENDIX IV: Questionnaires for National Drought Management Authority (NDMA)

I am conducting research on “*Assessment of Vulnerability of Pastoralists to Climate Change, a Case Study of West Pokot County, Kenya*”. The purpose of the study is to support me fulfill part of the requirement for my MSC studies at University of Nairobi. Your assistance by responding to this questionnaire will be highly appreciated. Please note that responses to this questionnaire will be held confidentially.

1. Do you think climate change is a threat to pastoralist (tick one choice)
(a) Agree (b) strongly agree (c) Disagree (d) Strongly Disagree (e) partially agrees
2. Are there climate change adaptation practiced in the context of livestock in this county?
Yes or No
2b if yes list those practices -----
3. What do you think can be solution to vulnerability of pastoralist to climate change-----

--
4. What are some of the local community adaptation strategies for climate change-----6.
Which of the following climate change coping strategies do you practice (rank them)
 - a. livestock diversification
 - b. livestock migration
 - c. Migration to urban centers
 - d. Engage on mining
 - e. Reduce number of meals
 - g. Charcoal burning
 - h. sand harvesting
 - i. Sale of allover a
 - i. Others
specify.....

APPENDIX V: Questionnaires for Department of Agriculture

I am conducting research on *Assessment of Vulnerability of Pastoralists to Climate Change, a Case Study of West Pokot County, Kenya*". The purpose of the study is to support me fulfill part of the requirement for my MSC studies at University of Nairobi. Your assistance by responding to this questionnaire will be highly appreciated. Please note that responses to this questionnaire will be held confidentially.

- 1. How pastoral are vulnerable to climate change -----
- 2. How is livestock production system affected by climate change? -----
- 3. Pastoral livelihood is the most vulnerable to climate change
 - a. (a) Agree (b) strongly agree (c) Disagree (d) Strongly Disagree (e) partially agrees

What do you think can be done in West Pokot to reduce pastoral vulnerability to impacts of climate? -----

Are there any relationship between Climate changes and livestock production? Yes No

If yes briefly explain -----

APPENDIX VI: Questionnaire for Department of Livestock

I am conducting research on *Assessment of Vulnerability of Pastoralists to Climate Change, a Case Study of West Pokot County, Kenya*. The purpose of the study is to support me fulfill part of the requirement for my MSC studies at University of Nairobi. Your assistance by responding to this questionnaire will be highly appreciated. Please note that responses to this questionnaire will be held confidentially.

1. Climate change is a threat to Pastoral livelihood? (Tick one choice)
a) Agree (b) strongly agree (c) Disagree (d) Strongly Disagree (e) partially agrees
2. Do your department have programmes on climate change adaptation and mitigation? Yes or No
2b if yes briefly state those programme -----
3. Do you think climate change is a threat to livestock production? (tick one choice) (a) Agree
(b) strongly agree (c) Disagree (d) Strongly Disagree (e) partially agrees
4. Pastoral livelihood is the most vulnerable to climate change (a) Agree (b) strongly agree (c) Disagree (d) Strongly Disagree (e) partially agrees
5. Are there climate change adaptation practiced in the context of livestock in this county? Yes or No

9b if yes list those practices -----
6. Are short term (coping) strategies for climate change risk reduction in West Pokot? -----
-----What do your think can be solution to climate change impacts on pastoralist in this county-----

7. What are some of the local community adaptation strategies for climate change-----

8. What do you think it increases vulnerability of pastoralist impacts of climate change-----

9. Are livestock bread reared in West Pokot Resilience to climate ----
Are livestock diseases associated with climate change? Yes or No
10. How can we address impacts of climate change on livestock production
11. How do you think pastoralist can cope with impacts of climate change?-----

12. How climate change affect livestock breeding?-----
13. Which animals is more resilience to climate change? Rank them
 - a. Cows
 - b. Goats
 - c. Sheep
 - d. Camels
14. Which of the following climate change coping strategies do you practice(rank them)
 - a. livestock diversification
 - b. livestock migration
 - c. Migration to urban centers
 - d. Engage on mining
 - e. Reduce number of meals
 - f. Engage on casual labour
 - g. Charcoal burning
 - h. Brewing of alcohol
 - i. Sale of allover a
 - i. Others specify.....

APPENDIX VIII: Interview Schedule for Metrological Department

I am conducting research on *Assessment of Vulnerability of Pastoralists to Climate Change, a Case Study of West Pokot County, Kenya*.. The purpose of the study is to support me fulfill part of the requirement for my MSC studies at University of Nairobi. Your assistance by responding to this questionnaire will be highly appreciated. Please note that responses to this questionnaire will be held confidentially.

1. What is the trend in rainfall in West Pokot County?

- i. Increasing
- ii. Decreasing

2. What is the trend in temperature in West Pokot County?

- i. Increasing
- ii. Decreasing

- 3 What do you think is the future scenario -----
- 4 what do you think can be done to cushion pastoralists from impacts of climate change in West Pokot County? -----
- 5 How is rainfall distribution in West Pokot County? -----

- 6 . What can you recommend to pastoralist on climate change adaptation?-----
7. In recent years (within the last 30 years), were there any changes in the production of your livestock? Yes No
- 1b If yes, what was the trend?
- i Increase
- ii Decrease
11. In your opinion, have there been changes in rainfall rates in recent years?
- i Yes
- ii No
12. If yes, what changes did you observe?
- I An Increase
- ii A Decrease
13. Please briefly explain the nature resulting to above observation -----
14. In your opinion, were there changes in temperature pattern in recent years? Yes or No
- If yes, what changes did you observe-----