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Impact of Climate Change on Health and Livelihoods of Pastoral Communities in Kenya: A Case of North Eastern Region

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ABSTRACT

The geospatial locale of the North Eastern Region naturally experiences dryness which when coupled with climate change poses a big threat to the livelihood and health of the communities therein. The region has of late experienced prolonged drought with serious ramifications on the health of the surrounding communities together with their livestock. The purpose of this paper is to assess the effect of climate change on the livelihoods and health of the Pastoral communities in N.E Kenya. The objectives of the study were: to establish how climate change affects the livelihoods of the pastoral communities; to establish the effect of climate change on the health of the pastoral communities in Kenya and to establish the appropriate intervention measures that could be put in place to address the climate change issues with its ramifications on the pastoralists in Kenya. The findings show that climate change has negative impacts on the health and socio-economic livelihoods of the pastoralists. The study used an empirical literature review adopting a meta-analytical approach. The study has implications on the policy directions on how to deal with the impacts of climate change on pastoralists, towards helping them adapt to the situation with resilience, while ensuring their welfare is guaranteed.

INTRODUCTION

The socio-economic contributions of Pastoralists in different parts of the world need not be overlooked. They not only practice agropastoralism at the domestic level but too their practice contribute towards the national income of the respective nations where they are practiced. Naturally, pastoralists across the globe seem to be having a common practice of raring traditional livestock whose products seem to be of low value, due to the traditional cultural orientation of having a very close attachment to the animals without taking into consideration the value of their produce. The pastoralists also tend to largely occupy environmentally challenged space, the situation which is true in Africa where they tend to occupy the Arid and Semi-Arid Lands (ASALs). Their stocks are also usually large in numbers and traditional. High incidences of diseases and pests are common among the pastoralists' livestock.

The phenomena of climate change have been of great concern across the entire world and its impacts on human activities are a concern. Consequently, studies have been done on the effects of climate change on the socio-economic livelihoods of pastoralists in different parts of the world. Extreme weather events like a prolonged drought for over three years in North Eastern Kenyan Counties like in the resent past Wajir has witnessed the decimation of livestock, hence making the pastoralist communities of that area so poor to the extent that affordability of daily livelihoods become a nightmare. This extreme weather situation not only adds to the poverty level of the already environmentally challenged communities leading to high school dropout rates. This climate change-induced vulnerability has pushed many poverty-stricken members community to marry off young girls to some old men as a means of raising money for the repurchase of livestock to replenish the otherwise decimated

livestock and as a means of reconstructing their livelihoods, while assuming that all will be well with the weather so they can move on (Citizen Television, 22nd October, 2023). Yet in the event of rainstorms, such ASALs suffer serious floods that are not only disastrous to humans but also to the already weak livestock from previously raging droughts (Citizen Television on 25th, October 2023).

Despite providing value, pastoralist areas in East African countries tend to have the highest incidence of poverty and the least access to basic services. Their changes can be classified as; climate change, political and economic marginalization, inappropriate development policies, and increasing resource competition. Climate change is indeed a reality for the pastoralists and the Intergovernmental Panel on climate change's models of East Africa show an increase of up to 2-4 degrees centigrade by 2080s, with more intense rain predicted to fall in the short rains (October-December) over much of Kenya, Uganda and Northern Tanzania in the 2020s, and becoming more pronounced in the following decades. Pastoralists could benefit in the form such as; more rainfall could result in more dry-season pasture and longer access to wet-season pasture. It could also result in less frequent droughts, which could mean more people to rebuild their assets between lean times. However, there are also significant negative consequences including loss of livestock through heat stress, loss of land to agricultural encroachment as the rise in rainfall raises the productive potential of arid areas, an increase in frequency of flooding, and spread of human and livestock diseases that thrive during the wet season.

Studies indicate that the biggest challenge to the pastoralists in Kenya are increase in dryness has not only led to severe economic but also poverty, food insecurity, and health challenges. Moreover, recent scientific studies indicate that: climate variability and change are expected to further exacerbate the variability in rainfall temperatures in the ASALs. The dry N.E. Region of Kenya has been experiencing repeated recurrence of drought for example 1960/1961, 1973/1974, 1979, 1980/1981, 1983/84, 1990/1992, 1995/1996, 1999-2000, 2004/2006, 2005-2009, 2010/2011 and 2022/2023 (ICRAF, 2023).

Climate change adaptation has been attempted in the N.E Region at Individual level, household level, community level, at private and public sector concerns. Adaptation can reduce vulnerability by strengthening the existing coping and adaptation strategies. The traditional approaches to coping with climate change like observation of clouds, the behavior of livestock, wildlife, and local flora are no longer reliable due extreme variability in climatic events. Climate change has led to extreme water scarcity, increase of livestock diseases, and increased distance to grazing lands, erratic and reduced rainfall amounts, rise in temperatures and prolonged dry spells. It has also led to armed conflicts, with sometimes sophisticated weapons like AK-47 Gun that are nearly wiping out the livelihoods of the pastoral communities in N.E. Kenya.

Intervention measures include drilling boreholes that can supply water for irrigation but for small-scale farming amongst the pastoralists to stimulate economic empowerment. To establish skills training centers to provide youth empowerment through vocational training in selected local skills development to contribute toward a diversified source of livelihood. Promote youth income-generating activities (IGAs) and integrate them with community mobilization savings and loan schemes. Provide funds to support youth-friendly community stabilization projects like drilling of and rehabilitating boreholes. Profile youth groups from pastoral areas involved in innovative work as a marketing strategy. Build capacity of the community on livestock health and production, crop production, wealth creation, and management. Support small-scale trading businesses. Support the development of community partnerships for the management of natural resources harnessing within across districts.

This will be ensured through the enhancement of water accessibility: construction of dams, pans, and boreholes. Establish fresh produce centers /animal cell yards to enhance market-focused production. Encourage where appropriate, a gradual change in land use and alternative means of livelihoods to adapt to climate change. This will be achieved through diversification of agri-business activities including agro-farming, trade, fish farming, arts and crafts tourism promotion especially in areas with-human animal conflict over water points to provide water facilities for schools, other institutions of learning, livestock, and

domestic use. Some of these development projects have been initiated and implemented by the county governments like for example sinking of the boreholes, however, these holes are spatially far apart and deficient, especially when extremes of weather patterns are exacerbated by the phenomenon of climate change. Also, intercommunity conflicts coming due either cattle rustling and many a time over pasture and water interventions have been proposed apart from the traditional strategies, including the following: identification of intra-district mobility and cross border campaigns among pastoralist youths; establishing four youth-friendly (one in each location) to mitigate cross border conflict through dialogue, promotion of peace, cultural awareness and harmony. Identifying youth organizations and community stakeholders and establishing community networks for the promotion of peace and reconciliation as the key to livelihood sustainability.

Establishing a variety of peace-building activities such as sports and games for peace initiatives, peace matches, and peace walks, amongst others, for youth mobilization to address resource-based conflicts and interethnic/cross-border conflict situations through the promotion of solidarity among the conflicting communities.

Awareness of raising and building capacity through training of local authorities, provincial administrators, immigration officers, and partners on basic concepts of understanding the risk factors of irregular migration, incorporating peaceful coexistence and conflict prevention through the provision of alternative livelihoods (IOM International Organization for Migration-Kenya,2011). Mitigating the impact of climate change amongst pastoralist communities in Kenya aims to minimize resource-based conflict among pastoral communities in Northern Kenya by strengthening the youth's capacities to adapt to climate change. On mitigating against climate variability and change, OXFAM (2008) provides the following issues: that NGOs in East Africa must recognize and protect pastoralists' land and resource entitlement; guaranteeing women equal rights to men and being cognizance of pastoralists' practice of *transhumance*. Putting into practice appropriate development policies that are accommodative of the pastoralists, include borehole drilling, and assignment of grazing lands to pastoralists. Creation of positive socio-economic diversification to e-pastoralists through investment in education for women and men towards salaried employment.

Acknowledgment of the needs and interests of pastoralists who may not reenter the enterprise. Provision of welfare support services to pastoralists including financial provision in place of food, healthcare, and educational services. Putting in place intercommunity conflict mediation mechanisms, to enable early warning of imminent conflicts and rapid response through provision of adequate funding resources to build traditional conflict resolution mechanisms. To negotiate appropriate mechanisms within East Africa to develop a pastoralism policy coordinated framework, with consideration of concerns such as livestock movement. The variability and climate change could affect food production in several ways including the following: crop production, drought and floods, cooler environs leading to prolonged crop growing season, and changes in market food prices. Climatic changes shocks and their implications on food production and health (Peter et al., 2005).

The studies by scholars have addressed how climate variability and change have not only affected the socio-economic livelihoods and health concerns of the vulnerable pastoralists in northern Kenya but too mitigation issues on the phenomena and the community varied pathways to interventions matrix has been complicated by the varied spatial resource endowments (Okoti et al., 2017; Borgerhoff et al., 2010; Teresiah & Todd, 2020; Government of Kenya, 2015).

Effects of climate change are multiple including the following: more severe droughts, floods, loss of species, decimation of livestock due to severity of drought, more health risks, poverty, and displacement. A study by Henri (2014) on the impacts of climate change on the livelihoods of Loita Pastoral Maasai Community, adopted a survey technique to collect data. The researcher, in the context of the study, maintains the Maasai's cultural practices largely revolve around their immediate environment from where they draw herbs, whereas some are herbalists, some collect firewood, some are involved in the construction industry, pastoral activities as the main engagement. The researcher maintains that the effects of climate

change varies according to specific locales and ecosystems. That accelerated climate change makes the local communities basically vulnerable. Climate change impact negatively on food production leading to food Insecurity, decline in biodiversity, livestock withering, and sometimes decimation, especially during severe dryness, it negatively affects the socio-economic livelihoods of the pastoralists, famine, water scarcity, loss of culture, and loss of land amongst others. The purpose of this research was to assess the effect of climate change on the livelihoods and health of the Pastoral communities in North Eastern Kenya.

MATERIALS AND METHODS

The research involved a review of the empirical literature on the effects of climate change on the socio-economic livelihood of the pastoralists. Below is a map of Kenya showing the location of the North Eastern region shaded in red.

Counties of North Eastern Kenya, their codes, spatial areas in square kilometers, Total Population, and headquarters according to the 2009 Kenya National Population Census Report were captured as in the table below.

Table 1. Land Surface Area, Total Populations, and Headquarters of the Three Counties of N.E. Kenya

Code	County	Area in Square Km	Total Population	Headquarters
7.	Garissa	45,720.2	623,060	Garissa
8.	Wajir	55,840.6	661,941	Wajir
9.	Mandera	25,797.7	1,02576	Mandera
Total		127,358.5	2,310,717	

Source: KNBS (2009).

The area of the study is the North Eastern Region of Kenya which in essence consists of Garissa; Mandera and Wajir Counties. According to the 2019 Kenya National Population Census survey, the region covers a total land surface of about 12,385 square kilometers and has a total population of 3,510,757 persons (Kenya National Bureau of Statistics, August 2019)

The research methodology involved the use of meta-analysis through which the data from a number of independent studies that used different tools and approaches but addressed the same theme were utilized to determine the overall trends. The main reason for using the meta-analysis technique is to help combine the results of a number of different reports addressing a single common theme to create a more precise estimate of an effect (Ferrer, 1998).

Some of the methods used by various researchers whose work was analyzed include Descriptive survey design; Descriptive statistics and Heckman PR obit Model; Mixed method approach; Heckman Sample selective model; Focus group discussions; Participatory and Epidemiological methods; Consensus model; Qualitative and quantitative approaches and Literature review design.

RESULTS AND DISCUSSION

On Establishment on How the Climate Change Affects the Socio-economic Livelihood of the Pastoral Communities

Studies have been done by scholars in Laikipia County, Kenya addressing the subject of climate change and its effects on the socioeconomic livelihoods of the pastoralist communities in the

area and their adaptation strategies towards the phenomena (Kirimi et.al, 2013; Ndiritu, 2021).

The study by Quandt and Kimathi (2017) on perception of the effects of floods and droughts on livelihoods: Lessons from Arid Kenya purposed to establish how people practice natural resource – based livelihood in Kenya perceive how their livelihoods are being affected by floods and droughts and how to integrate these local perceptions of impacts into mainstream adaptation strategies and policies. The study was carried out from amongst 270 households in Isiolo County, Kenya. A Focus group consisting of 6 people participated in the study, interviews were also carried out and document review became handy in the data collection process. The study established that: Pastoralism was the main source of livelihood practiced in Isiolo County forming accounting for 71% according to the responses. However agricultural and non-agro pastoral activities played a critical role towards livelihoods with 53% reporting practicing more than one type of livelihood. That droughts weigh heavily on crop and animal husbandries in Isiolo. Most of the people in Isiolo County are livestock farmers and more so cattle keeping. The paper provided a specific example of climate change adaptation initiatives and integration of local perceptions of the impacts of floods and droughts into mainstream livelihood-focused interventions.

Kirui et.al (2022) on Pastoralists' livelihood pathways transition in Northern Kenya: The process and Impact of drought underscore the recurrent droughts and long-term changes to climate, social structures and the economy in the word's ASALs have impacted on livelihoods of the pastoralists over the years resulting into different livelihood pathways. Some pastoralists continue to use their traditional strategies of herd accumulation and frequent engagement in livestock markets and value addition practices and others are dropping out of pastoralism. Using the information collected for over 6 years from 924 households in Northern Kenya and applying a generalized structural dynamics multinomial logit Model.

Volpato and King (2019) in their study 'from cattle to camels: trajectories of livelihood adaptation and socioecological resilience in a Kenyan Pastoralist Community underscore the traditionally engineered climate adaptation strategies that are contingent on individual households' adaptive capacity as well as broader socioeconomic, political and environmental contexts. The study examined a 30-year novel adoption of camel husbandry by a group of Kenyan pastoralists using a five-staged analytical approach that disaggregated dynamics in three ways: camel adoption at the individual level, camel adoption and processual level, and temporal level by assessing a change in broader socioecological contexts that occurred for over 30 years. The study established that: based on the multi-dimensional vulnerability framework, there are inequalities in the households that affect access to assets which weaken the social norms of reciprocity and social cohesion. The livelihood adaptation is generating contradictory effects on household and community level resilience to climate change phenomenon.

Moenga et. al, (2013) on the impact of climate change on the incidence of cattle disease in a Pastoral area in Kenya used participatory and epidemiological methods to establish Local communities' perceptions and livestock owners' knowledge, attitudes, practices (KAPs) of risk factors of climate variability. The seasonal variations in incidences of livestock diseases, vectors, intermediate dryness, and rainfall affect the incidence of cattle diseases amongst the pastoralists in the Rift Valley region of Kenya. The factors affected by climate change that could impact cattle diseases include; Molecular Biology of Pathogen, vectors (if any), farming practice and land use, and zoological and environmental factors. Establishment of new microenvironments and microclimates.

The study established that East Coast Fever (ECF) recorded high rates of morbidity of 68% of all the five diseases analyzed. Foot and Mouth Disease (FMD) was second highest in livestock morbidity of 52%. The interaction of these factors was significant in forecasting how livestock diseases particularly ECF and FMD occur. The study indicated that the future of the pastoralists who are wholly dependent on the natural environment and controls that are currently rendered unpredictable due to the climate change variables. That risk assessment focuses on looking for a combination of factors that are indirectly affected by climate change. The changes in human activities such as land use for example

deforestation, transportation, movement of animals. Policy measures to mitigate the impact of climate change on the incidence of diseases amongst livestock of pastoralists be checked.

Gentle and Thwaite (2016) on Transhumant Pastoralism in the context of socio-economic and climate change in the Mountains of Nepal established that: the pastoralists of the Mountains of Nepal had indigenous knowledge and feelings of cultural identities and have collective membership, mutual benefits, income have motivated them into their transhumance practice within the mountain region. The study established that the impact of climate change has not only affected the mountain ecosystem but too affected their socio-economic livelihoods manifested in the market influence, migration, low motivation of the Local people, and conflict between the pastoralists especially when scarcity of resources such as water and pasture induced by climate change.

The study recommends for an institutional framework to help the pastoralists adapt to climate change and Government Policy support for the pastoralists regarding their livestock and the climate change phenomena.

Xi et.al (2022) in their study 'Agro pastoralists' perception of climate change and adaptation in Qilan Mountains on North Western China' used a survey study design in which 554 were sampled to participate in the study. They were drawn form 4 Counties of Gansu Province of China. A Probits model was used to analyze respondents' understanding of climate change and its associated socio-economic and demographic variables such as gender, framing experience, level of education, level of cultivated land size, grassland size, agricultural income, and association membership. Village cadre had a high impact on agropastoralists' adaptation to climate change. The study findings will go a long way in assisting government agencies, decision-makers, and ASAL dwellers to build sustainable adaptation measures under the framework of climate change. The study recommends for institutions targeting households' livelihoods improvement and making decisions about climate change adaptation and that information regarding climate change adaptation strategies could be diffused through mass media and digital platforms. Other climate change coping strategies such as the adoption of agricultural extension services by the Ministry of Agriculture towards improved and productive livestock raring practice, improved land irrigation ventures towards the improvement of food production, and provision of loans and credit to the agro-pastoralists towards improving their livestock raring with value addition.

Sinteyehu et.al (2020) on impacts of climate change on the current and future invasion of *Prosipus Juliflora* in Ethiopia: Environmental and Socioeconomic implications are concerned about the invasion of *Prosipus Juliflora* in Ethiopia that has negative ecological and economic damage more so on the pastoralists, consequently. The study was underpinned by a consensus model derived from five modeling approaches to examine the current and the future (2050 and 2070) climatic suitability for Prosipus Juliflora under two climatic scenarios in Ethiopia namely: RCP 4.5 and RCP 8.5. This plant is projected to increase from between 55.6% to 63.6% by 2050 and moderately from between 33.3% to 42.9% under RCP 4.5 and RCP 8.5, respectively, and by 2070 it is projected to occupy a total land surface area of 3.43 million hectares. This rapid spread of the plant is a big threat to the rangelands and livestock in Ethiopia and that is a great threat to socioeconomic livelihoods of the pastoralists in Ethiopia. The study recommends a sustainable management of the control of the rapid spread of *Prosipus Juliflora* the study examines the potential invasion dynamics of *Prosipus Juliflora* and how it can be managed.

Another study in Ethiopia by Ayele et.al, (2020) on the impact of climate change on pastoralists' livelihoods in Ethiopia: A review underscores the significant role of the pastoralists toward Africa's Gross Domestic Product (GDP) and also being the main source of livelihood of the pastoralists. That 10 million Ethiopians are pastoralism dependent as a source of wealth and livelihood as traditionally the case of typical pastoralists. Pastoralism accounts for 20% of Ethiopia's GDP This great venture has drawn concerns of the stakeholders including the Government of Ethiopia and Non-Governmental Organizations (NGOs). These pastoralists operate in an already environmentally challenged are in the ASALs, and the overstocking and consequently overgrazing of this fragile environment complicate the environmental matrix.

The study established that: pastoralists in Ethiopia engage in a variety of economic livelihoods toward their livelihoods. These include; livestock rearing, crop farming, petty trade, wood and charcoal sale, and casual employment. Climatic changes have negatively impacted on pasture and water which are ever on the decline due to climate changes, high incidence of human and livestock diseases, conflict over scarce water and pasture, and poor climate change and variability adaptation strategies. The study recommends interventions through sensitization of the pastoralists through some diversified livelihoods within the sustainable development framework, and that active engagement of the pastoralists towards water and land management and conservation within the mainstream sustainable environmental management concerns becomes handy.

On the Effect or Impact of Climate Change on Health of the Pastoralists

Studies have been conducted by various scholars about Maasai Pastoralist in East Africa (Kenya, Uganda, and Tanzania) concerning the impact of climate change on their health, variability, vulnerability, adaptability strategies, and the general effects on their socioeconomic livelihoods (Theodory & Malipula, 2014; Korir, 2019; Mukuna, 2013; Bobadoye et.al, & Ole Saitabu, 2017).

A study by Dube et.al, (2016) on the impact of climate change on agro-ecological based livelihoods in Africa: A review an appraisal on the topic across African regions that is: Eastern, Southern, Western, and the Sahel. The study established that: the impact on climate change is invariably negative across the entire African continent, leading to a decline in agricultural production and biodiversity reduction hence negatively impacting on health of the pastoralists and their livestock. The study therefore recommends support for livelihood diversification strategies as a sustainable means of continued livelihoods and strategies of rural development especially amongst poor vulnerable communities that have suffered from the climate change-induced vagaries with consequences on household livelihoods.

A study by Schmidt and Pearson (2016) entitled 'Pastoralists Livelihoods under Pressure: Ecological, Political and Socio-economic transitions in Afar, Ethiopia acknowledges that the Ethiopian pastoralists in the Afar region occupy an ASAL area that naturally suffer hot temperatures, water deficit, pastoral gaps and high incidences of diseases, overstocking amongst their livestock and the general poverty that characterize these vulnerable communities. Climate change-induced conditions put these pastoralists into a more vulnerable condition as rangelands and natural resources are affected by frequently occurring droughts, overgrazing, erosion, alien plant invasion, and government land policies that put the pastoralists to more challenging conditions. The study focused on households of pastoralists in four sampled villages in the Afar region of Ethiopia. That the scenario at the Afar weighs heavily on their socio-economic livelihoods by not only negatively affecting the heath of their livestock but too the health of the pastoralists and their income in general. The study recommends sustainable climate change adaptation strategies including the government's early warning systems of impending droughts and how to navigate through them with the livestock, improved livestock breeds, destocking to check on soil erosion, diversification of socio-economic ventures, empowering women through giving them educational opportunities toward career development.

Research by Zampligre et.al, (2014) on climate change variability: Perceptions and adaptation strategies of Pastoralists and agro-pastoralists across different zones of Burkina Faso underscore the overdependence of the pastoralists on the natural environmental controls that put them to a situation of vulnerability to the vagaries of climate change impacting negatively on the health of pastoralists. The study used a descriptive survey design in which 162 farmers were individually interviewed. Perceptions of the farmers about the temperature and rainfall patterns in the region were compared with the available empirical data recorded by the Nation Bureau of Statistics between 1998 and 2008. The study established a departure from farmers' perceptions about climate change from the rainfall and temperature statistics recorded by the Government. The most important climate change adaptation strategies were diversified crops and improvement on livestock breeds and environmental management and conservation. Cereal farming could be an alternative to livestock rearing. The study recommends sustainable climate change adaptation strategies through strengthened

institutional and policy framework on the same coupled by sensitization of the farmers on the insurance guaranteed in a diversified livelihood as compared to mono-dependent sources of livelihoods that are constantly under threat by climate change.

A study in Namibia by Inman et.al (2020) on 'No Safety Net in the face of climate change: The Case of Pastoralists in Kunene Region maintains that in the previous ten years, Pastoralists in this region in Central Africa had endured climate change induced recurrent drought and flood events that have led to the loss of their main source of livelihood-the livestock impacting negatively on their health. Many members of the pastoralist communities have consequently become poorer. Ecosystem-based Adaptation (EbA) approaches have been acknowledged for their potential to help pastoralists adapt to climate change. Specifically, a pastoralist community called the Himba was studied to establish their perceptions, and experiences regarding climate change and its associated effects on their livestock.

The study adopted a mixed methods approach in which structured interviews were used to collect relevant information from among the participants. The interview results indicated that: the pastoralists lacked scientific knowhow of climate change and had to access to climate change information. The study also established that the Himba pastoralists had climate change adaptation strategies at the community level such as making gardens and alternative engagement in fishing, amongst others. However, these traditional adaptation strategies suffer from climatic pattern uncertainties and changes that persist. Moreover, the pastoralists no longer get benefits from the environment such as food, fodder despite this, there are currently no biodiversity interventions at the community level to address the climate change phenomenon. The pastoralists have pointed out their adaption needs in particular through the provision of water for growing food, this is an open avenue to explore EbA approaches specifically, ecological restoration, while addressing the need to develop new practical adaptation strategies, including restoration of options that will expedite the adaptive capacity.

On Climate Change Adaptation or Coping Strategies

A study by Opiyo et.al (2016) on determinants of perceptions of climate change and adaptation among the Turkana pastoral community of North Western Kenya underscores the growing concern over climate change and variability, coupled with environmental, social, and political pressures may overwhelm the resilience of pastoralist system of local adaptation strategies are not strengthened. Consequently, understanding pastoralists' perceptions of and responses to climate change is critical for the attainment of sustainable development strategies. The purposive sampling technique was used to sample 302 household participants in Turkana County, Kenya. Descriptive statistics and the Heckman Prohibit Model were used to analyze the data.

The results indicated that most of the pastoralist households perceived the increase in temperatures and rainfall variability of the last 30 years as a great threat to the thrival of pastoralism. The pastoralists' perception of climate change was significant at ($p<0.05$), associated with the gender of household head, livestock ownership, herd size, and access to extension services. Heckman's sample selectivity model indicated that: factors influencing pastoralists' choice in the climate change adaptation included gender, level of education, household head, household size, household wealth in terms of livestock ownership, distribution of market, and access to credit facilities and extension services.

Lekapana (2013) researched on socioeconomic impacts of climate change on pastoralists, their coping strategies and Government interventions in Marsabit County, Kenya focused on the investigation of the impacts of drought on pastoralists and their coping strategies in Loiyagalani Division of Marsabit County. The study adopted both qualitative and quantitative approaches. A multistage sampling technique was used. To explain the drought perceptions data on rainfall between 1970-2008 were analyzed. Pastoralists in the Loiyagalani Division perceived drought as a lack of water or rainfall, livestock weakening and dying due to prolonged dry spell, human morbidity, food insecurity, reduction in livestock prices, conflicts over water and pasture, a general increase in food prices were amongst some of the socioeconomic impacts of drought on the community Coping/adaptation strategies included: hard/splitting/merging sales of livestock and livelihoods, diversification of livelihoods.

Findings of the study indicated that: Government intervention has been in the form of providing famine relief food. The government needs to put in place a sustainable policy framework and strong institutional framework to steer the realization of sustainable climate change adaptation strategies in Isiolo County. Governments of Kenya should establish health facilities, the agricultural extension officers to be engaged in guaranteeing sustainable implementation of appropriate livestock policies that would ensure value addition of the livestock within the framework of sensitization and provision of relevant information towards resilience climate change adaptation strategies amongst the pastoralists of Isiolo County, Kenya.

Aida et.al (2019) on perceptions in adaptation in Montane Kenya maintains that the montane ecosystem. The study was carried out in Marsabit County. The participants raised concern about they indicated changes in historical data about rainfall patterns in the area of Marsabit. Accurate climatic data need to be collected form the tropical montane and hence require more research regarding montane and climate change. This paper examines the effects of climate change on the livelihoods of the pastoralists in Kenya with a focus on the North Eastern Region.

The North Eastern (N.E.) of Kenya is Geographically vast but largely a dry area described as arid and semi-arid land (ASAL). The very causation of the dryness is naturally the dry N.E. Winds that have blown through the dry Somali Land and also probably human activities like overgrazing of the already fragile land by the pastoralists contribute towards adding to the dryness (Ojany and Ogendo, 1973).

The Pastoralists that traverse this wide area with their animals on *transhumance,* include Somali, Rindeli, Borana, Samburu, and Turkana who are grounded on keeping livestock for their socio-economic livelihoods. These communities tend to hold the animals so high in their socio-economic ventures, inconsiderate of the quality issues of the animals. The animals raised usually include camels, sheep, goats, and cattle. The extreme weather conditions largely dryness, occasioned by flash floods during the rainy seasons usually ravage the livestock of these communities whose socio-economic livelihoods revolve. During the prolonged dry spell in the recent past witnessed animals getting too thin to a degree that a whole mature cow could be sold for as low as Kenya Shillings 1,500 (one thousand Five hundred, Daily Nation of 15th, February 2023).

The carcass of dead animals and the associated stench and health issues ravaged by extreme dryness is the ugly scene that characterizes the North Eastern Region. This usually makes worse the socio-economic situation of the communities who by the virtue of their environment are already too dilapidated. That climate change issue which is now a global concern is largely responsible for the extreme dryness with its ravaging effects on the socio-economic livelihoods of the pastoralists. Worse still the extreme dryness and its associated pasture and water scarcities usually results in conflicts over scarce resources sometimes culminating into intercommunity physical fights, over the same. The practice of cattle rustling amongst these communities is not uncommon and this too catalyzes conflicts among the communities. This naturally dry region has in the recent past suffered serious extreme dryness never witnessed before in history. The region is categorized as Arid and Semi-Arid Lands (ASALS). Generally in Kenya, the ASALs have vast land surface area covering about 80% of the total land surface area in Kenya (Ojany and Ogendo, 1973).

A study by Filho et.al, (2020) on introducing experience for African Pastoralists' commitment to cope with climate change risks, hazards, and extremes: Fostering poverty reduction maintains that: pastoralists all over Africa are bedeviled with a plethora of challenges including socioeconomic as well as climate change induced risks, hazards. They have also suffered climate change and extreme events alongside a variety of weather and climatic threats that are thorny to the herders. The pastoralists are many times abound by the Government Policies regarding their livestock of which they are not part in the formulation. Such policies could include climate change coping strategies. The study was done amongst pastoral households from amongst the pastoralists of a total of 550 who were randomly sampled from five countries of Africa namely: Kenya. Ethiopia, Malawi, Uganda, and Zimbabwe, where from each country a total of 110 participants were sampled amongst the pastoralists to participate in the study.

The study established that the sustainability of the socio-economic livelihood of the pastoralists in these countries is under a serious threat brought about by climate change and associated hazards which worsen the poverty situation of the already environmentally vulnerable communities who largely dwell in the ASAL areas of Africa. When hit by climate change especially prolonged droughts, their animals' health not only deteriorates but too gets decimated in extreme weather circumstances, a matrix that is complicated by the fact that the communities tend to be attached to their livestock culturally and consequently reluctant to sell them even in the face their weakening health due to climate change concerns.

A study by Ng'ang'a et.al (2020) on the propensity to adapt to climate change is a reality in the African ASALs. Pastoralists are engaging and embracing a wide range of climate change adaptation strategies including irrigation, livestock migration, fodder production, improved livestock breeds, rainwater harvesting, and storage, use of agricultural extension officers to sensitize the agro-pastoralists on the best practices of livestock raring and management, demonstration of households' abilities to diversity as a climate change adaptive strategy. The household asset base, particularly social capital represented by the government's assistance stands as it is positively influenced by the uptake of 4 out of 5 climate change adaptation strategies namely irrigation, livestock manure, fodder production, and improved livestock breeds. Literature supports the climate change adaptation processes as they influence all the five adaptation processes therein. However, it has heterogeneous effects, supporting the households either to adopt or reject a strategy. Crop-based information positively determines the uptake of yield-enhancing strategies while relevant information for livestock activities contributes toward the uptake of livestock-focused strategies. The study findings suggest that: mainstreaming agricultural innovation, building household asset base, and facilitating access to agronomic climatic information through for example early warning systems in future expected climatic patterns will enable the pastoralist to prepare for it so that the adverse effects may not be realized as could be case where there is no early prior information of the impending climate change.

They established that climate change especially that characterized by prolonged droughts usually has negative socio-economic effects on the pastoralists including leading to starvation, lack of water, dietary deficits related to sicknesses, and general hunger coupled with poverty that is sometimes too acute to a degree calling for the intervention of provision of famine relief support from renowned bodies such as Red Cross towards humanitarian support in coordination with the National Governments' interventions. Climate change-induced starvation usually affects the health of the children and the mothers acutely. Unfortunately, even access to health facilities is usually a nightmare given the remoteness and vastness of the pastoralist spaces, this usually makes the otherwise climate change-induced sickness weaken those living in the ASALs.

Studies on the impact of climate change on the livelihoods of the pastoralists and crop farmers and sustainable adaptation strategies in Northern Nigeria have been done by varied scholars (Ayanda, 2013; Majekodunmi et.al, 2014; Okunola & Ikuomola, 2016; Terdoo &Adekola, 2014).

The study quantitatively determined the transition livelihood categories conditional on drought resilience. From the findings, there are considerable and frequent transitions between livelihood pathways within a panel period (2009-2015). Notably, many households that started in low-cash-income, large herd size dropped out, and categories with high-cash-income and small size moved out, indicating that: moving out was the only way out of poverty. Also, an increase in vegetation index from drought season where the index was at 10% level to a good season where the index was 90% decreased the likelihood of households dropping out from a predicted probability of 37.9% to 28.7% and increased the likelihood of households moving up and moving out from 22.2% to 25.0% and 22.6% to 34.3%, respectively, unconditionally. Implications of the study findings that livelihood interventions aimed at poverty reduction amongst pastoralists should support the transition to market-oriented relatively successful pathways and also protect households from falling back.

According to Ng'ang'a and Crane (2020) on social differentiation in climate change adaptation: One community Multiple pathways in transition among Kenyan Pastoralists maintain that: climate

change literature in pastoralism usually embrace a systems approach that uses segregated analysis leading to a false assumption of community homogeneity. It assumes pastoralist communities are coherent units, an assumption that does not adequately capture the increasingly differentiated pathways taken by the pastoralists due to climate change variables. It is held that today, climate change and variability adaptation pathways are more of a political process that is highly negotiated by the elements of social differentiation, and individual actors' adaptation opportunities are substantially shaped by their social positions. In addition, a case is made for using adaptation practices as a focal point of adaptation pathways research because this methodological choice allows unpacking who, why, and how questions in the uptake of emerging technical adaptation practices, especially how they are influenced by an individual's position in the society as manifested by wealth regarding the level of livestock ownership, age, gender, level of education amongst others.

A study by Tawane and Wakhungu (2018) on the Risks of Climate Change to Agro Pastoralists Development in Mandera County, Kenya agrees that climate change is indeed an issue in a global scenario regarding livestock raring. However, Africa remains the most challenged with their livestock amongst the pastoralists because of their overdependence on the natural environment in their day-to-day socio-economic livelihoods built around pastoralism. The pastoralism matrix is complicated by the frequent climate change concerns and the extreme events that generally characterize it this puts them in a situation of vulnerability to the climate change-induced challenges that usually threaten the socioeconomic livelihoods of these great communities of Africa. Yet their trouble is made worse by the fact that they generally dwell and oscillate through transhumance in places that are largely ASALs with their biting challenges.

Other challenges in the African environment include the poor institutional capacity to mitigate climate change and variabilities, frequent prolonged droughts, high incidence of livestock diseases amongst the pastoralists, fragile ASALs in which the pastoralists dwell, high incidence of human diseases, armed conflicts over pasture and water and livestock rustling, amongst others. Mandera County lies in the Kenyan ASALs in the northern region that naturally suffers from aridity. Households were sampled to participate in the study drawn from the rural and urban zones. A sample size of 384 households and 72 key informants participated in the research. The participants while responding to the question stated any one effect of climate change in their locale, the responses were quantified in percentages as follows: 82 respondents (21.4%) expressed livestock decimation, while 71 (18.5%) stated scarcity of water and pasture, 45 (11.7%) stated crop failure, 47 (12.2%) expressed decline in livestock market price and 27 (7.0%) expressed both animal and human disease outbreaks and 66 (17.2%) expressed climate change induced conflicts. Some of the most common livestock diseases include East Coast Fever (ECF) 14.1%, Foot and Mouth Disease (FMD) 18.2%, Cattle bloat (CB) 12.2%, AND Vector bone disease 10.7%. Conclusion climate change brings a challenge to agro-pastoralists of Mandera ranging from the decimation of livestock, prolonged droughts, flash floods in case of rains, high incidence of animal and human disease, decline in crop production, water deficit, limited pastures, animal wildlife conflicts in the arrangements, livestock rustling and the associated conflicts, acute vulnerability and more entrenched poverty amongst the pastoralists of Mandera County.

Kagunyu (2014) on the effects of climate vulnerability on the livelihoods and coping strategies of the Borane community in Isiolo County, Kenya focused on certain essential study guiding questions including: How has climate variability affected the livelihoods of the Borana community? How has the climate variability affected the Borana community's coping strategies? Data was collected from secondary sources. Structured interviews and focus group discussions were held with the key informants. Direct observation means of data collection too proved handy in the study. The findings of the study that climate variability affects the socioeconomic livelihoods of the Borana community in that: death of livestock due to extreme weather conditions, displacement of people, crop failures, reduced food security, high poverty levels, high incidence of livestock and human diseases and change of gender-based roles, frequent recurrent of floods and droughts have weakened the climate variabilities' adoption strategies. There are traditional early

warning systems. However, these have been challenged by unpredictable weather conditions.

Omolo et.al (2019) on Gender and Social Capital and adaptive capacity to climate variability: A Case of Pastoralists in the ASALs of Kenya. The study adopted a literature review design. Included in the study were key informants through focus group discussions. Findings showed that: Vulnerability is influenced by age, gender, educational level, and disability. Elderly women were found to be the most vulnerable, followed by elderly men, the disabled, female-headed households, married women, men, and finally the youths. The study also established that less than 30% of men and women in both the Loima and Katilu villages were able to read and write. Cross-tabulated statistical data indicated that: the extent of vulnerability amongst members of the community depended on gender, age, and educational level at a significant level. Recommendations for improved institutional and policy framework should be put in place by both County and National Governments to check communities' vulnerability to climate change and variability in Kenya.

A study by Herrero et.al. (2016) on Climate Change and Pastoralism: Impacts consequences and adaptation focuses on the major impacts of climate change on pastoralists on rangeland, livestock, and other natural resources and their extended repercussions on food security, incomes, and vulnerability. In higher latitudes, climate change might lead to increased pasture due to the removal of temperature-related constraints and improved livestock production. However, in the tropics, impacts are highly locational and specific but are largely negative. The concern here is adaptive strategies towards sustainable development like the implementation of new technical practices, diversification of income sources, the establishment of effective institutional framework, and to introduction of new livestock market mechanisms that guarantee value addition into to elevate the societies. Practical and flexible policies and sustainable adaptation strategies that would favorably enhance adaptation.

The livelihoods of the inhabitants of this vast region largely revolve around traditional livestock raring-pastoralism. Pastoralism is predominantly practiced in the ASALs which are characterized by hot and dry climate, with low and erratic rainfall. A variety of domestic animals are reared including the following cattle, sheep, goats, camels, and to an extent donkeys. The impact of climate change and variability in Kenya has introduced a new dimension to the external fights against food insecurity and poverty. This situation is exacerbated by the fact that the Kenyan communities are largely dependent on primary production towards the attainment of their day-to-day socio-economic livelihoods, especially on agriculture which includes traditional systems like pastoralism, which in the occurrence of extreme weather events due to climate change that has not brought a challenge to the food issues, poverty but too the overall socio-economic orientation of the communities, as to such the global concerns about the phenomenon and possible measures to counteract it, towards achievement of sustainable utilization of resources and development. The North Eastern Region of Kenya characteristically consists of counties such as Garissa, Wajir, and Mandera.

The ASALs have been utilized by Government to establish rangelands which are economically viable in this vast region with low population density (ICRAF, 2006). Studies have shown that climate change and variability, characterized by extreme weather events especially prolonged dryness never witnessed in the N.E Region before, this has not only affected the biophysical but too the socio-economic livelihoods of the pastoralists to a scale never experienced before, consequently this has led to disasters and calamities and extreme poverty, amongst communities who by the virtue of the naturally dry environment are already impoverished. This has not only led to the decimation of their major source of livelihood- the livestock but too affected their health. Whereas peoples' health is made worse by weather extremes, to attain health services to many is an up-hill task due to the scarcity to the dispensaries/and or hospitals which are largely spatially located in a radius of 25 Kilometers to 50 Kilometers to seek medical attention to many residents of this region. The movement through road transit is also an uphill task because high levels of underdevelopment in the region with not only a few but too bad roads that may sometimes not be passable especially during the rainy season (County, Government of Wajir Integrated Development Report, 2021/2022).

The extreme weather events due to climate change in the ASALs of Kenya has not only done socio-economic ramifications, but health challenges too. Economic development Report 2021/2022 in Kenya showed that livestock production accounted for 26% of the total national agricultural production and that 75% of wildlife in Kenya are found in the ASALs. Economically, pastoralism significantly contributes to Gross Domestic Product (GDP) in many East African countries (around 10% in Kenya); it provides most of meet consumed in those countries; and provide livelihoods for tens of millions of people who live there. Pastoralists are the custodians of dryland environments, providing services through rangeland management including biodiversity conservation, and wildlife and tourism . According to the Kenya National Bureau of statistics (KNBS, 2010), ASALs cover about 80% of Kenya's total land surface area and this area supports one-third of Kenya's total population. That the ASALs of Kenya had a total cattle population of 1.3 million, 25 million goats, 14.9 million sheep and 1.7 million donkeys. According to Food and Agricultural Organization (FAO, 2005) Pastoralists livestock contribute 12% of Gross National Product (GNP), with livestock contributing to 90% of employment in the region. That Garissa forms the largest livestock market (Kenya Institute of Public Policy Research Analysis, 2007).

Summary of the Findings

Climate change and variability, coupled with extreme events have so posed serious challenges that have not only weakened the socioeconomic livelihoods of the already environmentally disadvantaged communities of Northern Kenya but too pushed them to the situation of vulnerability especially in the face of prolonged droughts and increase in temperatures.

The scenario is where livestock get decimated and or of ill-health and hence fetching very low buying values at the market systems. The prolonged droughts even affect the whole socio-cultural and economic livelihoods of the pastoralists; whose children too usually drop out of school due to the deplorable conditions which are climatically induced. This scenario has been witnessed in counties like Wajir that has been experienced prolonged droughts for the last three years.

The traditional practices of typical pastoralist communities of overstocking, the wealth by determined by the number of livestock that one owns, irrespective of their quality/products, high incidence of diseases amongst the livestock like East Coast Fever, Red Water, and other livestock diseases that not only make the animals weak but too lead to death of the livestock, negatively impacting onto the socioeconomic livelihoods of the pastoralists. In addition, there are also high incidence of human disease that are climate change and variability induced and worse still is that such vast area of the North Eastern is largely underdeveloped in term of infrastructure and insecurity and cattle rustling is the order of the day in such regions. There are traditional climate change resilience/adaptation/coping strategies that are however, challenged due to the ever-changing and consequently unpredictable weather patterns which are generally extreme and consequently both sustainable climate change coping strategies must be integrated with the modern approaches towards ensuring sustainable socioeconomic livelihoods amongst the pastoralists in North Eastern Kenya.

The modern climate change and variability coping strategies could include effective institutional policies on livestock and food production be put in place with both the devolved and the national governments toward sustainable livelihoods amongst the pastoralists in Northern Kenya.

From the study findings, it is worth concluding that: the phenomenon of climate change has impacted largely negatively on the health of the pastoralists in the N.E. Region of Kenya. Climate change in the form of prolonged dryness has not only led to scarcity of pasture and water onto which the livelihoods of the livestock thrive, consequently the animals tend to have bad health and hence fetch very low market value if they are to be sold. Such a scenario makes worse the poverty levels amongst the already impoverished and environmentally disadvantaged communities. That there are traditional climate change adaptation strategies that the pastoralists have in place, however they need financial resource support to help them sustainably realize them. But too new approaches towards adaptation towards climate change from the stakeholder perspective should also be embraced but through necessary support. Sustainable pastoralism towards meeting sustainable development goals and Kenya Vision 2030 are

slowly being embraced within the pastoralism practice.

The findings reveal that climate change has serious negative consequences on livelihoods of the pastoralists and on their health. That there are traditional mechanisms in place towards addressing climate change and or adaptation. Extreme dryness is a serious cause of weakening the livestock and to the extreme end leading to their decimations in numbers. This scenario was witnessed during the 2022/2023 calendar years. Adaptation and or mitigations in regard to climate change is usually being addressed from three fronts as follows: Community strategies, on-Governmental Organizations (NGOs) and Governments both at the devolved system and national government.

CONCLUSION

A more supportive approach to the pastoralists is necessary in terms of the provision of health services through the establishment of health facilities such as hospitals and dispensaries to help them get this basic dignified requirement, which has been made more vulnerable by the changing weather patterns and climate. This may be achieved through joint efforts of the National and County Governments of the respective counties that make up the N.E. Region and also support from other stakeholders such as the Non-Governmental Organizations (NGOs).

Necessary Education support to women and or men who have bowed out of pastoralism as a strategy towards diversification of means of livelihood from pastoralism to salaried employment. Support of pastoralists courses such as cognizance of their transhumance and granting them ownership of resources, with continuous support to them on how to effectively manage their resources towards gainful pastoralism. The drilling of boreholes and water harvesting during the rainy seasons to help alleviate water scarcity would become pertinent in this traditional pastoralist zone. Insurance policies on livestock against the vagaries of weather to guarantee compensation of the pastoralists in the event of loss of livestock due to extreme weather events. Youth empowerment and women empowerment initiatives are necessary amongst the pastoralists. Sensitization of the pastoralists to manage their livestock in the agri-business orientation becomes a necessity. Infrastructural establishment initiatives be put in place to enhance accessibility of the marketplaces by the pastoralists/ and or for rapid accessibility to these zones in case of necessary rapid response to rampant insecurity that characterizes the expanse N.E. Region of Kenya.

A study on the effects of climate change on the health of pastoral communities needs to be done. A study on possible ways of diversification of pastoralists' socio-economic livelihoods needs to be done. The Governments' interventions should go beyond the provision of relief food but that permanent solutions that will go a long way in ensuring some sustained livelihoods amongst the pastoralists. Climate change has not only negatively weighed on the health of the livestock of the pastoralists but also affected their human health due to the high incidences of diseases that come with climate change. Extreme situations even lead to the death of humans and animals. Overall the socio-economic livelihoods of the pastoralists are not only threatened but also poverty on the increase, and food insecurity, and climate change enhanced conflicts within the community and or between the pastoralists.

REFERENCES

Aida, C.S., Omeny, Pfeifer, Olaka, M., Mamo, B.M., Merchant, R., &Neil, D. (2019). Climate change and pastoralists' adaptation in Montane Kenya. *Climate and Development* 11(6), 513-524.

Aniwate, D. A. (2013). The influence of climate variability and change on land use and Lowlands in Kenya's Southern Rangelands. Unpublished Doctor of Philosophy *Dissertation*. Nairobi: University of Nairobi.

Ayanda, I. F. (2013). Assessment of effect of climate change on the Livelihoods of Pastoralists in Kwara State, Nigeria. *Journal of Development and Agricultural Economics* 5(10), 403-410.

Ayele, T., Detach, D., & Duba, D. (2020). Impact on climate change on Pasoralists'Livelihoods in Ethiopia: A Review. *Journal of Resource Development and Management* 63(5), 1-14.

Bobadaye, A.O., Ogara, W.O., & Onono, J.O. (2016). Assessing climate change adaptation strategies among rural Maasai Pastoralists in

Kenya. *American Journal of Rural Development*, 4(6),120-128.

Borgerhoff, M., Fazzio, M., Irons, I., Bowles, M., Bell, A., Hertz, T., Hazzah, L. (2010). Pastoralism and wealth inequality revisiting and old question curriculum. *Anthropol*, (5), 35-48.

Citizen Television (22nd October,2023). On Climate Change induced school dropout rates and Marriages of underage girls in Wajir County, Kenya. Nairobi: Citizen Media.

Citizen Television (25th, October, 2023). Citizen Television Report on the Rainstorm induced raging floods in Marsabit County, Kenya. Nairobi: Citizen Media.

County Government of Wajir: Integrated Development Report, 2021/2022 Financial Year.

Dube, T., Moyo, P., Ncube, M. & Nyathi, D. (2016). Impact of Climate change on agro-ecological based livelihoods in Africa: A Review. *Journal of Sustainable Development* 9(1), 256-267.

Ferrer, R. L (1998). Graphical methods for detecting bias in Meta-analysis. *Family Medicine-Kansas City* 30 (2), 579-583.

Filho, L.W., Taddese, H., Balehegn, M., Nzengya, D., Debela, N. & Amare. (2020). Introducing experiences from African Pastoralists' Commitment to cope with Climate Change risks, Hazards and extremes: Fostering Poverty Reduction. *International Journal of Disaster and Risk Reduction*, 50(2), 101-117.

Food and Agricultural Organization. (2023). Strengthening Self-Reliance amongst drought affected communities in East Africa. FAO.

Food and Agricultural Orgarnization. (2005). The socio-economic contributions of livestock form ASALs in Kenya.

Gentle, P. & Thwaites, R. (2016). Transhumant Pastoralism in the context of socioeconomic and Climate Change in the Mountains of Nepal. *Mountain Research and Development* 36(2), 173-182.

GoK. (2005). Millennium Development Goals. Nairobi. Government of Kenya (2015) Unlocking Our Full Potential for Realization of Kenya Vision 2030. National Policy for Sustainable Development of Northern Kenya and other Arid Lands. Ministry of Devolution and Planning.

GoK. (2013). Government of Kenya: Integrated County Development Plan 2013-2017, County Government of Kajiado.

Government of Kenya (GOK). (2015). Unlocking on full potential for realization of Kenya Vision 2030. National Policy for Sustainable Development on Northern Kenya and the Arid Lands: Ministry of Devolution and Planning.

Henri, O.S. (2014). *Impacts of climate change on livelihoods of Loita Maasai* and related indigenous knowledge on adaptation and mitigation. Nairobi: Oxford.

Inman, N.E., Hobbs, J.R. & Tsvuura, Z. (2020). No safety net in the face of climate change: The case of Pastoralists in Kunene Region, Namibia. *PloS one*, 15(9), 238-248.

IPCC. (2001). *Climate change 2001*: *Impacts*, *Adaptations*, *and Vulnerability Report on working Group II Synthesis Report*. Cambridge: Cambridge University Press.

Janepeter, S., Francis, E.O.O. & Jurgen, S. (2012). Rendering Pastoral Livelihoods: Motives and Effects of violent conflicts in North Western Kenya Pastoralism. Kenya Institute of Policy Research and Practice (KIPPRA).

Kagunyu, W.A. (2014). Effects of Climate Variability on the Livelihoods and coping strategies of the Borana Community in Isiolo County, Northern Kenya. Unpublished Master of Environmental Science Thesis, University of Nairobi.

Kenya Institute of Public Policy Research Analysis. (2007). *Statistical information on Livestock Marketing in Garissa livestock Market*. Nairobi: KIPPRA.

Kenya National Bureau of Statistics. (2009). National population survey report. Nairobi: KNBS.

Kenya National Bureau of Statistics. (2010). *Statistical information about ASALs of Kenya*. Nairobi: KNBS.

Kirimi, N.J., Mwangi, G.J., & Nkurumwa, O.A. (2013). Climate change Challenges and adaptation strategies among pastoralists of Laikipia County, Kenya. *International Journal of Agricultural Extension,* 1(1), 20-30.

Kirui, K.L., Jensen, D.N., Obare, A.G., Muriuki, M.I., Chelanga, K.P., & Munenobu, K. (2022). Pastoral livelihood pathways transition in Northern Kenya: The Process and impact of Drought. *Pastoralism*, 12(1), 1-12.

Korir, C.J. (2019). Climate change stress on Pastoral Livelihoods in Narok County, Kenya. *European Journal of Social Studies*, 9(2), 11-23.

Lokapana, L.P. (2013). Socioeconomic impacts of drought on Pastoralists. Their coping strategies and Government's intervention in Marsabit County, Kenya. Unpublished master of Environmental Science, University of Nairobi.

Majekodunmi, O.A., Fajinmi, A., Dongkum, C., Shaw, A. P. M., & Welburn, C.S. (2014). Pastoralist Livelihoods of the Fulani on the Jos Plateau of Nigeria. *Pastoralism*, 4(1), 1-16.

Moenga, B.O., Muchemi, G.M., Kang'ethe, E.K., Kimenyu, J.W., Mutiga, E.R. & Matete, G.O. (2013). The impact of climate change on the incidence of cattle diseases in a Pastoralist area in Kenya. Nairobi: Unpublished Master of Arts Thesis, University of Nairobi.

Mukuna, E.T. (2013). Assessing the impact of Climate change on coping strategies and Social safety on the Pastoralists of Narok District, Kenya. *Informal and Formal Social Protection System in Sub-Saharan Africa*, 191(3), 200-209.

Ndiritu, W.S. (2021). Drought responses and adaptation strategies to climate change by pastoralists in the Semi-Arid area of Laikipia County, Kenya. Mitigation *and adaptation strategies for Global Change*, 26(2), 1-18.

Ng'ang'a, W.T. & Crane, A.T. (2020). Social differentiation and Climate Change adaptation: One community multiple Pathways in Transitioning Kenyan Pastoralists. *Environmental Science and Policy*, 114(20), 478-485.

Ng'ang'a, W.T., Coulibaly, J., Crane, A.T., Gachene, K.C., & Kronchi, G. (2020). Propensity to adapt to climate change: Insights from pastoralists and agro pastoralists' households of Laikipia County, Kenya. *Climate Change*, 161(15), 393-413.

Ojany, F.J. & Ogendo,J.B. (1973). *Kenya:A study of Physical and Human Geography*. Nairobi: Oxford.

Okoti, M., Kung'u, J. & Obando, J. (2017). *Impact of climate variability on pastoral households and adaptation strategies in Garissa County*, *Northern Kenya*. (243-249).

Okunola, R., Okuomola, A.D. (2015). Climate Change, desert encroachment and Community Conflicts in Northern Nigeria. *African Journal of Social Sciences* 11(3), 112-121.

Ole Saitabu, H. (2017). *Impacts of Climate Change on the Livelihoods of Loita Maasai Pastoral Community and the related indigenous knowledge adaptation and mitigation.* National Museum of Kenya, Nairobi.

Omolo, N., &Mafongoya, L.P. (2019). Gender, Social Capital and adaptive capacity to Climate Variability: A Case of Pastoralists in the ASALs of Kenya. *Journal of Climate Change Strategies and Management*, 11(2), 744-758.

Opiyo, F., Wasonga, V.O., Nyangito, M.M., Mureithi, M.S., Obando, J. & Munang, R. (2016). Determinants of perceptions of climate change and adaptation among the Turkana Pastoralists in North Western Kenya. *Climate and Development*, 8(2), 179-189.

Oxfam. (2008). *Survival of the fittest: Pastoralism and climate change in East Africa*. Oxfam. Nairobi: OXFAM International Ltd.

Peter, J. Gregory, John, S.I., Ingram, M.B. (2005). Impact of climate change on food security in Kenya: the implications on human health. *Philosophical Transactions of the Royal Society B*: *Biological Sciences*, 360(1463), 2139-2148.

Quandt, A., & Kimathi, A.Y. (2017). Perceptions of the effects of floods and droughts on livelihoods: Lesson from Arid Kenya. *International of Change Strategies and Management*, 9(3), 337-351.

Schimdt, M. & Pearson, O. (2016). Pastoralists livelihood under pressure: Eological. Political and Socioeconomi Transitions in Afar, Ethiopia. *Journal of Science and Environments*, 124(13), 22-30.

Sengre, T., & Verchot, L. (2006). *Impact of adaptation to climate variability and climate change in the East African Community*:*A focus on Agricultural Sector*: ICRAF.

Sinatayehu, W.D., Dalle, G. & Bobasa, F.A. (2020). Impacts of climate change on current and future invasion of Prosipus Juliflora in Ethiopia: Environmental and Socioeconomic implications. *Heliyon*, 6(8), 9-17.

Tawane, A.A. & Wakhungu, J.W. (2018). Risks of Climate Change to Agro Pastoralists development in Mandera County, Kenya. *Journal of Environmental Engineering and Sciences*, 5(4), 77-103.

Terdoo, F. & Adekola, O. (2014). Perceptions, Knowledge, adaptation and Socioeconomic cost of Climate Change in Northern Nigeria. *Journal of Agricultural Science*, 6(8), 60-71.

Teresiah, W.N. & Todd, A.C. (2020). Social differentiation in climate change adaptation: one community multiple pathways in transitioning Kenyan Pastoralism. *Environmental Science & Policy*, 114, 478-485.

Theodory, F.T., & Milapula, M. (2014). Climate Change and Socio-economic Vulnerability among Maasai Pastoralist Community in Northern Tanzania. *Journal of Policy and Leadership*, 2(10), 20-22.

Volpato, G. & King, G.E. (2019). From cattle to Camels: Trajectories of livelihood adaptation and socioecological resilience in a Kenyan pastoralist community. *The Regional Environmental Change*, 19(2), 849-865.

Xi, S., Ding, W., Ye, W. & Deng, Z. (2022). Agro-Pastoralists' Perceptions of Climate Change and adaptation in Qilan Mountains of North Western China. *Scientific Reports*, 12(1), 126-138.

Zampligre, N., Dossa, H.L. & Schlecth, E. (2014). Climate changes and Variability: Perceptions and adaptation strategies of Pastoralists and Agro-Pastoralists across different Zones in Burkina Faso. *Regional Environmental Change*, 14(2), 769-783.