EFFECTS OF CLIMATE CHANGE AND VARIABILITY ON PASTORAL COMMUNITIES IN KENYA

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Abstract. *Climate change and variability have significant impacts on pastoral communities in Kenya. The effects include reduced livestock productivity, food insecurity, and increased conflicts over resources amongst other adverse effects. Examining such effects makes it possible to suggest adaptive and sustainable practices that can be used to improve the conditions of Arid and semi-arid areas in Kenya where majority of the pastoral communities live. The goal of this paper is to review the effects of climate change and variability on pastoral communities in Kenya. The study employs a desk review of recent journal articles that have comprehensively documented the research topic. As per the research findings, pastoral communities in Kenya face significant challenges due to climate change and variability. They have, however, used a variety of adaptation strategies, such as diversifying their sources of income, managing resources as a group, and using new technologies. The use of secondary sources of information and the potential biases in the selection of journal articles are the study's shortcomings. The study has generated relevant knowledge that policymakers and development agencies can use in designing climate change adaptation and mitigation interventions that are responsive to the specific needs and circumstances of pastoral communities in Kenya, Africa.*

Keywords*: Climate Change, Pastoral Communities, Adaptation strategies, Mitigation strategies*

INTRODUCTION

Africa is highly vulnerable to climate change and fluctuations, as it is one of the continents most affected by these phenomena. Unfortunately, the continent also has limited capacity to adapt to these changes, leaving it particularly exposed and vulnerable (MUBENGA-TSHITAKA, 2023). The region is vulnerable to the effects of climate change due to a number of factors, including high poverty rates, financial and technological restrictions, and a heavy reliance on agriculture that depends on rainfall (MUBENGA-TSHITAKA, 2023) Africa has in the recent past been witnessing significant seasonal variations in rainfall and rising temperatures. This vulnerability is particularly evident in East Africa, where countries heavily rely on rain-fed agriculture, have high poverty rates, and low levels of education (MUBENGA-TSHITAKA, 2023).

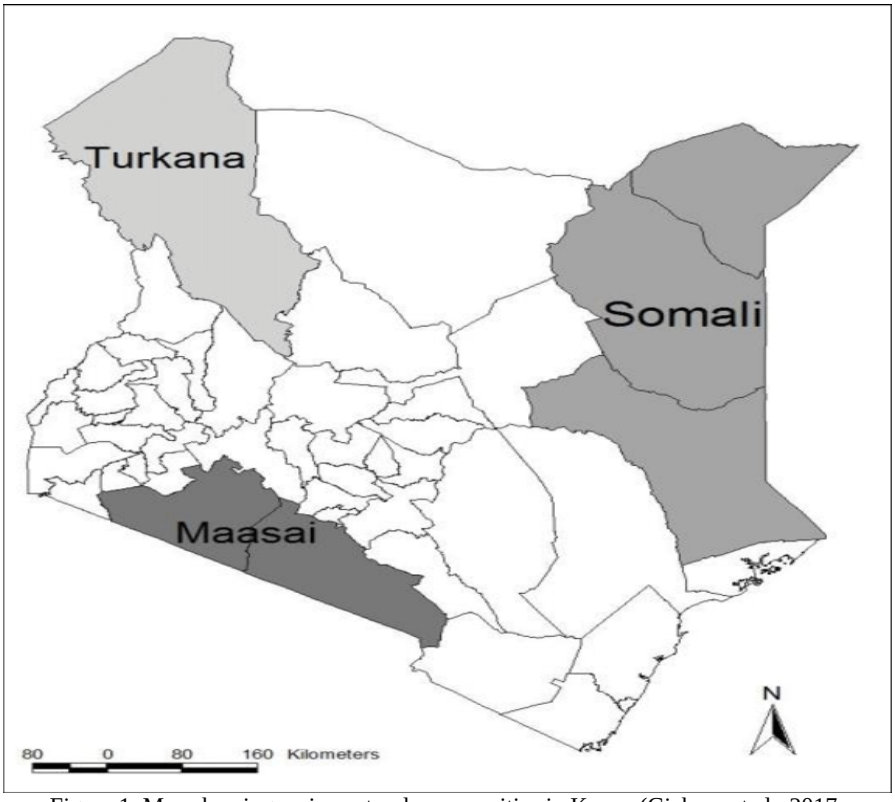

Figure 1. Map showing main pastoral communities in Kenya (Gichure et al., 2017; https://www.researchgate.net/figure/Map-of-Kenya-showing-main-counties-with-pastoral-communities_fig2_312355568, Accessed 13.05.2023)

The main pastoral communities in Kenya are the Maasai, Turkana and the Somali as shown in the map. Domestic animals such as cows, goats, sheep and camels play a significant role to these communities from economic and social perspectives (NYARIKI & AMWATA, 2019). From an economic angle, pastoralism functions as a system of livestock production that makes use of the instability of the ASALs environment while from a cultural angle, pastoralism is approached as a form of cultural identity in terms of being used as a source of wealth, social prestige and even dowry (NYARIKI & AMWATA, 2019).

Pastoralism, as a livelihood system, is complex and requires a critical balance between people, livestock, and pastures which currently exist in a highly variable and uncertain weather patterns due to climate change (YALA ET AL., 2020). It has been noted that if the average global surface temperature continues to rise, it will have a more severe impact on pastoralism in the Arid and Semi-Arid Lands (YALA ET AL., 2020). The Sub-Saharan African region has an estimate of 368 million individuals, consisting of pastoral communities who highly depend on climate-sensitive resources to support their livelihood (YALA ET AL., 2020). A significant point to note is that Africa is already experiencing the impacts of climate change, with recurrent droughts, floods, and storms causing additional problems. Pastoralism faces significant threats from increasing drought frequency, dwindling water sources, and encroachment on grazing land (YALA ET AL., 2020). The climate change related challenges experienced by pastoralists in Kenya include the recurring and prolonged droughts leading to insufficient pasture and water

as well as the spread of livestock diseases due to unregulated animal movement (YALA ET AL., 2020). The dependence on rain-fed natural resources in ASALs further exacerbates the vulnerability of the livestock production system to changes in climatic conditions. According to KORIR (2019), many Kenyan communities have a limited understanding of climate change issues. The level of awareness is particularly low in Kenya's Arid and Semi-Arid Lands (ASALs). The idea is that even though many individuals in these counties are aware that there are significant changes in the weather patterns, they do not accurately associate it with the concept of climate change. Moreover, even though they can recognize the effects of climate change, they do not have access to information that could help them understand the implications of the change and their role in managing it. The majority of pastoral communities believe that climate change is a form of punishment from the gods and ancestral spirits in response to human wrongdoing (KORIR, 2019). Thus, it is crucial to educate both pastoralists and small-scale farmers about the causes and consequences of climate change before promoting adaptation measures.

Research Question

What are the effects of climate change and variability on pastoral communities in Kenya, and what adaptation strategies have these communities employed to cope with these effects?

Research Objectives

a) To identify and describe the effects of climate change and variability on pastoral communities in Kenya
b) To explore the adaptation strategies employed by pastoral communities in Kenya to cope with the effects of climate change and variability

MATERIAL AND METHODS

A desk review was conducted as a qualitative research methodology to examine the effects of climate change and variability on pastoral communities in Kenya Desk review, which is also approached as secondary data analysis, functions as a research method that involves analysing and comprehending existing data from various sources, such as academic articles, books, reports, and grey literature (Froese & Bader, 2019) It is considered a cost-effective method for gathering data and synthesizing it, especially when there are time and resources constraints (Froese & Bader, 2019). The review entailed a systematic search of relevant scholarly articles published between 2019 and 2023. The articles were accessed from various online databases, that include Google Scholar, Science Direct and EBSCOhost using keywords that include "climate change," "pastoral communities," "Kenya," and "adaptation strategies." The inclusion criteria was defined by quality, relevance, and publication date, thus, only peer-reviewed articles and reports that met the objectives of the study were included. The data extraction and analysis process involved reading and synthesizing the key findings from the selected articles and reports. The data was analysed thematically, focusing on the effects of climate change and variability on pastoral communities in Kenya and the adaptation strategies employed by these communities. The themes were identified based on the study's objectives.

Table 1

A List of the Articles Used in the Review

Article	**Key Points**
Bowell et al. (2021)	- 89% of Kenya's land mass is covered by Arid and Semi-arid Lands (ASALs) inhabited by at least 70% of the national livestock population. - Kenya's livestock sector is highly vulnerable to the effects of climate change. - Livelihoods of pastoralists depend greatly on rearing livestock.
Ndiritu (2019)	- Varying weather conditions in ASAL areas have resulted in a shortage of water and feeds for animals, endangering the health of animals and the welfare of pastoralists.
Lenaiyasa (2020)	- Livestock perished due to unfavorable climate changes, leading to a lack of food for the pastoralists and their families.
Miller et al. (2020)	- Frequency of dry seasons in East Africa has increased in recent years, leading to the loss of livestock. - Livestock mortality rates in East Africa exceeded by 50% during the drought that occurred between 2008 to 2011.
Mutanda and Kimaru (2022)	- Climate variability was significantly associated with increased livestock mortality in pastoral communities in Kenya. - Livestock mortality rates increased during low rainfall and high temperature periods. - The highest mortality rates were observed among cattle and camels.
Yala et al. (2020)	- Spread of livestock diseases is enhanced by excess drought or excess rainfall in the ASALs. - High mortality rates of livestock due to exhaustion of feeding pasture and inter-community conflicts caused by competition for resources
Chepkwony et al. (2020)	- Climate variability was significantly associated with the prevalence of East Coast Fever (ECF) in cattle in pastoral communities in Kenya. - Higher temperatures and lower rainfall increased incidences of ECF.
Muturi et al. (2021)	- Climate variability was associated with increased incidence of livestock diseases such as Brucellosis, Q-fever, and Rift Valley fever. - Changes in rainfall patterns and the availability of water sources were significant drivers of disease transmission.
Filho et al. (2020)	- Severe drought compelled pastoralists to relocate their animals to distant areas, increasing their vulnerability to various health hazards during their transhumance.
Omolo & Mafongoya (2019)	- Changes in resource availability and quality as a result of climate change affect the division of labor, decision-making power, and access to services and resources for women and men in these communities. - During extended periods of migration by men to satellite camps, women are left with the responsibility of caring for their homes and livestock.
Walker et al. (2022)	- Climate change and variability was associated with changes in women's roles and responsibilities in pastoral communities in Kenya's ASALs.
Rao (2019)	- Climate change and variability had gendered impacts on access to and use of climate information among pastoral

	communities in Kenya's ASALs.
Korir (2019)	- Pastoralists have their own strategies of predicting climate changes even when they lack access to information regarding weather patterns from the relevant authorities.

RESULTS AND DISCUSSIONS

a. The effects of climate change and variability on pastoral communities in Kenya

About 89% of Kenya's land mass is covered by Arid and Semi-arid Lands (ASALs) which are inhabited by at least 70% of the national livestock population (Bowell et al., 2021). This data suggests that the nation's livestock sector is highly vulnerable to the effects of climate change. It employs half of the agricultural labor force and supports over 10 million people residing in the ASALs. It is important to note that the livelihoods of pastoralists depend greatly on the rearing of livestock, which serves as a crucial means of building social capital and as a form of insurance against climate-related risks. The ASAL areas are characterized by savanna vegetation, high seasonal and inter-annual rainfall, as well as recurring dry spell episodes in the recent years. The varying weather conditions have resulted in a shortage of water and feeds for animals, endangering the health of animals and the welfare of the pastoralists (Ndiritu, 2019).

Climate change and variability is significantly associated with increase in livestock mortality. The effects brought about climate change on livestock are experienced in diverse ways. A study by Lenaiyasa (2020) on the Samburu community in Kenya showed that the livestock kept by pastoralists in the ASAL areas perished due to unfavourable climate changes, leading to a lack of food for the pastoralists and their families. In rural regions, the effects of drought include diminished access to water and pasture, lower livestock output, and heightened susceptibility to disease. Also, the study by Miller et al. (2020) showed that the frequency of dry seasons in East Africa has increased in recent years, leading to the loss of livestock. The authors explain in their study that during the drought which occurred between the years 2008 to 201, livestock mortality rates in East Africa exceeded by 50%, with the highest mortality rates observed among young animals. Another study by Mutanda and Kimaru (2022) found that climate variability was significantly associated with increased livestock mortality in pastoral communities in Kenya. According to the findings of their study, livestock mortality rates increased during low rainfall and high temperature periods and that the highest mortality rates were observed among cattle and camels. Overall, the studies indicate that climate change and variability have significant impacts on livestock mortality rates in pastoral communities in Kenya.

Another effect that has been documented is the spread of livestock diseases due to changes in weather patterns and environmental conditions. As per the research by Yala et al. (2020), the spread of livestock diseases is enhanced by excess drought or excess rainfall in the ASALs. This has led to high mortality rates of livestock due to the exhaustion of feeding pasture as well as inter-community conflicts caused by the competition of resources. Some pastoralists are forced to take their cattle to national parks to access pasture, an action that puts their livestock and themselves at risk of being attacked by wild animals. A study by Chepkwony et al. (2020), found that climate variability was significantly associated with the prevalence of East Coast Fever (ECF) in cattle in pastoral communities in Kenya. The study found that higher temperatures and lower rainfall increased incidences of ECF due to changes in the reproduction and survival of the tick-borne parasite that causes the disease. Another study by Muturi et al. (2021), found that climate variability was associated with increased incidence of livestock diseases such as Brucellosis, Q-fever, and Rift Valley fever. The study

found that changes in rainfall patterns and the availability of water sources were significant drivers of disease transmission especially in the communities in the North-Eastern and Eastern part of Kenya. Furthermore, severe drought compelled pastoralists to relocate their animals to distant areas, increasing their vulnerability to various health hazards during their transhumance (Filho et al., 2020).

Furthermore, climate change and variability have impacted the gender roles among the pastoral communities in Kenya. The roles of men and women in pastoral societies have been altered as climate risks have prompted changes in the socio-cultural and socio-economic structure of these communities (Omolo & Mafongoya, 2019). The basic notion is that changes in resource availability and quality as a result of climate change affects the division of labor, decision-making power, and access to services and resources for women and men in these communities. As per the study by (Omolo & Mafongoya, 2019), during extended periods of migration by men to satellite camps to search for pasture or livestock markets, women are left with the responsibility of caring for their homes, as well as their camels, sheep, goats, and cattle. The idea is that due to having limited access to education and information required for managing climate-related risks to agriculture and pastoralism, women are more susceptible to the effects of climate variability and change. Also, a study by Walker et al. (2022) found that climate change and variability was associated with changes in women's roles and responsibilities in pastoral communities in Kenya's ASALs. In addition, a study by Rao (2019) found that climate change and variability had gendered impacts on access to and use of climate information among pastoral communities in Kenya's ASALs.

Table 2

Thematic Analysis of the effects of climate change and variability on Pastoralists

Aspect	**Impact of climate change and variability**
Livestock Mortality	- Climate change is significantly associated with increased livestock mortality in pastoral communities in Kenya - Effects vary depending on specific climatic conditions and livestock management practices
Livestock Diseases	- Climate change and variability can significantly impact the spread of livestock diseases in pastoral communities in Kenya - Changes in temperature and rainfall patterns affect availability and quality of pasture and water sources, leading to changes in livestock behavior, nutrition, and immunity that can increase their susceptibility to diseases - Higher temperatures and lower rainfall were associated with increased incidence of East Coast fever, brucellosis, Q fever, and Rift Valley fever
Gender Roles	- Climate risks have prompted changes in socio-cultural and socio-economic structures of pastoral communities in Kenya - Changes in resource availability and quality have affected division of labor, decision-making power, and access to services and resources for women and men in these communities - Women have limited access to education and information required for managing climate-related risks to agriculture, including pastoralism - Climate change and variability have gendered impacts on access to and use of climate information among pastoral communities in Kenya's ASALs - Women's workload had increased due to changes in water availability and quality, leading to changes in their decision-making power and participation in community and household decision-making processes

b. The adaptation strategies employed by pastoral communities in Kenya.

Pastoral communities in Kenya, it has been observed, have their own strategies of predicting climate changes. The idea is that pastoralists are capable of describing the specific changes in climate conditions even when they lack access to information regarding weather patterns from the relevant authorities (Korir, 2019). Despite having limited access to information on climate change, pastoral communities in Kenya have still managed to create their own methods for observing and describing climate changes. This entails using indigenous methods, such as noticing changes in star patterns, disappearance of termites and birds like hornbills and ravens, and changes in animal behavior that they have used to indicate the prospects of upcoming rains (Korir, 2019). The perspective is that locals do not express knowledge about climate change in terms of statistical figures for mean temperatures or precipitation but rather on what they observe first-hand (Korir, 2019).

Migration also functions as another adaptive strategy that has been employed by the pastoral communities. According to a study by Nnko et al. (2021), the Maasai community has a historical adaptation strategy to cope with harsh weather conditions, known as "ronjo" movement, which involves the movement of both herdsmen and livestock to nearby dry season grazing areas. During this movement, temporary homesteads are set up for the herdsmen while women, children, and elders remain in the permanent homestead. According to Maasai culture, the responsibility of security during this movement falls on a specific age group known as "the warrior" (typically aged 30-40 years old), who traditionally walk the livestock to “ronjo”. The elders play an advisory role, while women and children are responsible for household chores. However, changes in land tenure have limited the ability to use this movement strategy (Nnko et al., 2021). Also, migration can occur within a county, to other pastures in other counties and even across the borders in terms of pastoralists moving to Ethiopia in the north and Tanzania in the south (Lenaiyasa, 2020). It can also help to alleviate pressure on natural resources and make communities less vulnerable to extreme weather events and other shocks. Despite its potential benefits, migration has been receiving limited attention in adaptation policy and planning.

Another adaptation strategy entails the diversification of livelihoods. According to a study by Korir (2020), pastoralists in Kenya have diversified their livelihoods by engaging in non-livestock activities such as farming, trade, and wage labor. The study found that pastoralists who engaged in multiple income-generating activities were more resilient to the effects of climate change than those who relied solely on livestock husbandry. Another study by Boas (2022) found that diversification of livelihoods also enabled pastoralists to access alternative sources of food and income during droughts and other climate-related shocks.

Another strategy involves the collective management of resources. The collective management of resources by pastoral communities has been found to be an effective adaptation strategy to climate change and variability. A study by Marty et al. (2023) found that pastoral communities in Kenya have established community-based organizations to manage water resources, grazing lands, and wildlife conservation. The study showed that the collective management of resources promoted sustainable use of natural resources and reduced conflicts among pastoralists.

Finally, the adoption of new technologies has also been cited as an adaptive strategy to climate change and variability by pastoral communities in Kenya. This entails the integration of strategies such as improved livestock breeds, drought-resistant crops, and rainwater harvesting.. As per the study by Lutta et al. (2020), pastoralists who adopted improved livestock breeds were able to increase their livestock productivity and reduce their vulnerability to the shocks brought about by climate change. Similarly, a study by Mganga et al. (2022)

showed that the adoption of rainwater harvesting technologies enabled pastoralists in Kenya to improve their access to water during dry seasons. The basic idea is that by adopting these strategies, pastoralists are enhancing their resilience to shocks caused by climate change while also promoting sustainable use of natural resources.

Table 3

Thematic Analysis of the Adaptation Strategies

Strategy	**Description**
Traditional methods of observing climate changes	Pastoralists use traditional methods, such as observing changes in star patterns, disappearance of termites and birds, and changes in animal behavior, to predict climate changes. They do not rely on statistical figures nor modern meteorological information but on what they observe firsthand.
Migration	Pastoralists move with their livestock to nearby dry season grazing areas in a movement known as "ronjo." Migration can also occur within a county, to pastures in other counties, and even across country borders. It helps to diversify income sources and improve access to financial and social capital while reducing pressure on natural resources
Diversification of livelihoods	Pastoralists engage in non-livestock activities such as farming, trade, and wage labor. Diversification enables access to alternative sources of food and income during droughts and other climate-related shocks.
Collective management of resources	Pastoral communities establish community-based organizations to manage water resources, grazing lands, and wildlife conservation. Collective management promotes sustainable use of natural resources and reduces conflicts among pastoralists.
Adoption of new technologies	Pastoralists adopt improved livestock breeds, drought-resistant crops, and rainwater harvesting to increase their livestock productivity, improve access to water during drought, and reduce their vulnerability to climate-related shocks.

Limitations of the Study

As earlier mentioned, a desk review was used as the research design to examine the effects of climate change and variability on pastoral communities in Kenya. The research design had some limitations to the study. One such limitation is that desk reviews rely on existing literature may limit the scope of the study, as some important information may be lacking. Moreover, the findings of the desk review may not be applicable to all pastoral communities in Kenya as the communities are diverse and differ in terms of their cultural practices, livelihoods, and geographical locations. This means that the strategies employed by one community may not be relevant to another and that the findings may not be applicable to pastoral communities in other parts of Africa. Moreover, the desk review did not involve the primary collection of data. Thus, there is a need for further research that involves primary data collection to validate and extend the findings from the desk review as was the case in this study.

CONCLUSIONS

The review highlights several key findings on climate change and its impacts on pastoral communities in Kenya. It reveals that pastoralists possess traditional methods of predicting climate changes. Secondly, migration, diversification of livelihood, collective management of resources, and adoption of new technologies are among the adaptation strategies employed by pastoralists to cope with the effects of climate change and variability. In terms of recommendations for future research, there is a need for more comprehensive analysis to understand the effectiveness and sustainability of the adaptation strategies

employed by pastoral communities in Kenya. Another recommendation is that further research on the impacts of climate change on pastoral communities and how these impacts are likely to change in the future is necessary. In relation to policy implications, policy makers need to recognize and include the traditional knowledge and practices of pastoralists in climate change mitigation efforts. Finally, policy makers should also support the adoption of new technologies that are appropriate and acceptable to pastoral communities. This could include the promotion of drought-resistant crops, improved livestock breeds, and rainwater harvesting technologies. Overall, this study underscores the need for policy interventions that take into account the unique circumstances and knowledge of pastoral communities in Kenya and the overall horn of Africa.

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