

# Adaptation Measures Adopted by Pastoralist Livestock Farmers in Kenya in Response to Climate Change

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## Abstract

Pastoralist communities in Kenya, such as the Maasai, Samburu, Turkana and Borana, predominantly inhabit the arid and semi-arid regions of the country. These communities have traditionally relied on livestock for their livelihoods, with cattle, goats, and sheep forming the backbone of their economic and cultural practices. However, in recent years, this adaptive animal production system has faced growing external threats due to issues such as climate change, political instability, agricultural expansion and rural banditry that have transformed the rangelands in which they operate. In response to climate change challenges, Kenyan pastoralist livestock farmers have devised and implemented a variety of adaptation measures. Hence, identifying effective adaptation measures can facilitate the replication and scaling of successful strategies across different regions and communities. The review entailed a systematic search of relevant scholarly articles published between 2013 and 2023 using search engines Scopus, Web of Science, World Health Organization, the Centre for Agriculture and Bioscience International (CABI), the Scientific Electronic Library Online (SciELO) as well as Google Scholar and structured Google. The findings indicated that diversifying livestock breeds to more resilient species, adopting rotational grazing practices to prevent pasture depletion, destocking, forming or joining cooperative societies slathering of weak animals and developing water conservation methods such as rainwater harvesting and construction of water pans are some of the adaptation measures adopted by pastoralist communities in Kenya. The study recommends that there need for government to increase support for the implementation and scaling-up of rotational grazing and feed conservation techniques as well as promote herd diversification by supporting the breeding and acquisition of drought-resistant livestock species, thereby reducing vulnerability to climatic shocks.

**Keywords:** Livestock farming, climate change, adaptation, mitigation, pastoralist communities

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## Introduction

Kenya, situated in Eastern Africa, is predominantly characterized by arid and semi-arid lands (ASALs) that constitute over 80% of the country's land mass (Mganga, 2022; Ouma, 2015; Njoka et al., 2016; Amwata & Nyariki, 2021).

According to Schilling and Werland (2023), arid regions receive between 150 mm and 550 mm of annual rainfall, whereas semi-arid regions receive between 550 mm and 850 mm annually. ASAL areas are home to diverse ecosystems, unique wildlife, and pastoral communities whose livelihoods is livestock production (Ndiritu, 2021; Muhati, 2022). Pastoralists, defined as populations that practise animal husbandry as their primary economic activity and typically practise some degree of seasonal mobility, inhabit some of the harshest, most remote terrain on earth (Lelenguyah, 2023; Tenaw, 2021; Mohamed, 2019). These communities migrate with herds of livestock to follow seasonal grazing grounds and water sources (Hauck & Rubenstein, 2017).

Globally, pastoralist communities are found in diverse regions including Central Asia, the Middle East, and parts of South America (Manzano et al., 2021;

Ventresca Miller et al., 2020). Often not included in routine demographic surveys, their numbers are unknown, however estimates range from 50 to over 300 million individuals globally (Wild et al., 2019). They rely on the raising of livestock, such as cattle, sheep, goats and camels, for their economic and cultural sustenance (Salzman, 2018; Nyariki & Amwata 2019). Across the African continent, 268 million people practice pastoralism, both as a way of life and a livelihood strategy, contributing between 10 to 44% of the GDP of African countries (Brottem & McDonnell, 2020; Luizza, 2017; Akov, & Asua, 2021; Chelang'a & Chesire, 2020). Pastoralism in the region is a predominant mode of livelihood, especially in the arid and semi-arid regions of the continent (Omolo & Mafongoya, 2019; Blocher, 2018). Africa's pastoralists, contribute significantly to national economies through livestock production and trade. The pastoralist way of life in Africa is deeply intertwined with cultural traditions and social structures, with many communities practicing transhumance, a seasonal movement to access water and grazing lands (Schareika, Brown & Moritz, 2021; Higazi, 2020; Galaty, 2021). However, African pastoralists

face numerous challenges, including climate variability, land tenure conflicts, and marginalization in national policy frameworks (Basupi, Quinn & Dougill, 2017; Flintan, Robinson & Allen, 2021; Basupi, 2018; Alemu, 2018).

In East Africa, pastoralism is a key economic activity, particularly in countries like Ethiopia, Uganda, Tanzania, and Kenya (Lind et al., 2020; Nyariki & Amwata, 2019; Githae & Mutiga, 2021). In Tanzania, according to Mutekanga, Songorwa, & Kicheleri (2013), the majority of people live in rural areas and about 10% are pastoral communities with their livelihoods depending on livestock. The pastoral communities mainly live in arid and semi-arid dry land regions of Manyara and Arusha in the north, Shinyanga and Mwanza in the Lake Victoria region, and Dodoma, Tabora and Singida in the central region. The Karamojong are perhaps the most well-known pastoralist group in Uganda (Iyodu, 2009). They are located in the Karamoja sub-region in the ASALs of northeastern part of the country (Chelang'a & Chesire, 2020). This area includes the districts of Moroto, Kotido, Kaabong, Nakapiripirit, Napak, Amudat, and Abim. They all engage in raising livestock as a significant part of their livelihoods (Ogalo, 2017).

In Kenya, pastoralism is practiced by several communities, including the Maasai, Samburu, Turkana, and Borana, primarily in the arid and semi-arid northern and eastern regions (Pas Schrijver, 2019; Pickering, 2021; Pas, 2018). Pastoralism contributes 10% of the national GDP and about 50% of the

agricultural GDP, which in turn contributes about 25% of the national GDP (Sala, 2019; Kirui, Karugia, Gathogo & Wane, 2022). Pastoralists are estimated to hold over 60% of the national livestock herd, with a monetary value of between KES 60 and 70 billion (Behnke, 2011). Pastoralists have historically adapted to the harsh climatic conditions of the region by developing complex mobility patterns and social networks that enable them to cope with environmental unpredictability (Zhang et al., 2019; Fenta, 2017). Despite these adaptive strategies, they are increasingly vulnerable to the impacts of climate change which has led to more frequent and severe droughts, reducing pasture availability and water resources as cited by Ndiritu (2021), Mekuyie and Mulu, (2021), Tiruneh and Tegene (2018), Ng'ang'a et al. (2020), Ndiritu and Muricho, (2021). According to Opiyo, Wasonga, and Nyangito (2014), these changes have led to the degradation of pasturelands and water resources, which are critical for sustaining livestock. The reduced availability of grazing land and water not only decreases livestock productivity but also exacerbates conflicts over scarce resources among pastoralist communities (Galvin, 2009). The health and productivity of livestock are directly affected by climate change. Higher temperatures and irregular rainfall increase the vulnerability of animals to diseases and heat stress, which in turn reduces milk production and overall herd health. This situation is compounded by the fact that traditional grazing patterns and migratory routes have

been disrupted by environmental changes, population growth and land fragmentation forcing pastoralists to travel longer distances in search of pasture and water, often leading to overgrazing and further environmental degradation (Kratli & Swift, 2014). The loss of cattle and the reduced viability of their traditional lifestyle have profound, intertwined economic and non-economic impacts on pastoralists. Cattle have significant economic value in normal times, and droughts affect their market value by both reducing the animals' health and by broadly influencing the market (as many herders are forced to sell their livestock as a measure of last resort, at the same time and with little bargaining ability). Cattle, however, also has a very significant spiritual and social value: herders are tied to their animals by an important emotional and cultural bond and their very status in their communities is determined by their ownership of livestock heads. Losing livestock to a drought, both due to death and to forced sale, is an experience that entails both short- and long-term impacts on the wealth, well-being and prospects of pastoralists. Moreover, as herders lose their livestock, they are often forced to become sedentary, finding places to leave in and around cities. This forced immobility entails significant cultural losses, as a traditional lifestyle becomes unviable and herders' knowledge of local ecosystems and their management goes lost. The unplanned inflow of these populations into peri-urban areas brings challenges that extend to host communities, linked with competition

for limited resources, pressure on local ecosystems and basic services, and can lead to intra-communal conflicts. Despite these challenges, Kenyan pastoralists have shown remarkable resilience and adaptability. They have devised and implemented a variety of adaptation measures. Hence, identifying effective adaptation measures can facilitate the replication and scaling of successful strategies across different regions and also for designing effective programs in the region.

## Methodology

This study conducted a systematic approach to analyzing existing literature and empirical studies. Extensive literature review on search engines Scopus, Web of Science, World Health Organization, the Centre for Agriculture and Bioscience International (CABI), the Scientific Electronic Library Online (SciELO) as well as Google Scholar and structured Google was done to gather relevant information from academic journals, government reports, non-governmental organization (NGO) publications, books and grey literature. The review entailed a systematic search of relevant scholarly articles published between 2013 and 2023. Keywords included "climate change," "pastoral communities," "Kenya," "ASAL", "Livestock farming", "Maasai", "Turkana", "Pokots", "Samburu", and "adaptation strategies." The inclusion criteria were 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 was analysed

thematically, focusing on incidences and impacts of climate change among pastoralist communities living in ASAL areas and the adaptation strategies employed by these communities.

## Findings and discussion

### Incidences and Impact of drought and floods among pastoralist communities in Kenya

Pastoralists in Kenya are bearing the brunt of climate change despite being the least contributors to the phenomenon. Climate change has disproportionately affected communities in Arid and Semi-Arid Lands (ASALs) in Kenya, displacing people multiple times. Over the past two decades the region has been hit hard by recurring and longer-lasting droughts, and by more frequent and intense flooding during the rainy seasons which have led to the loss of livestock and livelihoods.

Kenya's pastoral areas, which have faced increasing drought frequency and intensity since the 1960s, are among the most vulnerable and drought-prone regions in the country (Opiyo et al., 2015; Chufe, Oindo, & Abuom, 2019; Njoka et al, 2019). Both the minimum and maximum temperatures have increased significantly by 0.7 to 1.9 °C between 1960 and 2013 in ASAL regions of Kenya (Ogutu et al. 2016). Since independence, there have been several drought episodes, namely: 1983/84, 1991/92, 1995/96, 1999/2000, 2004, 2005/2006, 2009, 2011 and 2016/2017. The 1999-2000 drought was one of the most severe; it affected 4.4 million people, killed an estimated 60-70 per cent of livestock

in the arid and semi-arid areas of the country, and caused crop failure in most arable areas in the country (Rift Valley, Coast, Eastern and Central regions) (Laibuni, 2020). Although the pastoralists in the ASALs have always been exposed to droughts and excesses of climate, the incidence of such events has increased drastically over the last 15 years, severely affecting livestock production.

According to Ndiritu (2021), droughts occurred roughly every 7-10 years before 1990. However, since then, Kenya has faced eight severe droughts in the years 1991-1992, 1995-1996, 1999-2000, 2004-2005, 2008-2009, 2011, 2014, and 2016. McCormack (2022) also notes that over the past 20 years, the interval between droughts has shortened from 5-10 years to just 2-3 years. These droughts have caused deterioration of livestock condition, increased incidence of certain diseases and livestock deaths, altered herd composition, and a collapse of livestock markets. Because of the droughts, a high level of livestock mortality has become the norm in most pastoral areas in Kenya.

The ASAL area of Kenya has had three severe droughts in the recent decade (2010-2011, 2016-2017, and 2020-2022), according to ASAL Humanitarian Network (2022). The 2020-2022 drought was the worst and longest, causing widespread livelihood losses and massive displacement. More than 2.4 million livestock, which pastoralist families rely upon for nourishment and livelihood, died in Kenya. For example, in Marsabit County, the communities lost more than 121,000

sheep and goats, 35,000 camels and 38,000 cattle in the last few months. Kenya had its worst drought in 40 years between 2020 and 2023, with 5 consecutive failed rainy seasons. This devastating period resulted in the deaths of 2.6 million animals and left 4.4 million people, particularly those in pastoralist communities in Arid and Semi-Arid Areas (ASAL), facing food shortages (Obi, 2023). The areas most affected by climate change include Garissa, Isiolo, Kajiado, Turkana, Kitui, Mandera, Marsabit, Laikipia, Samburu, Tana River, and Wajir (Said et al., 2019; Mude et al., 2007). Climate change, through more acute and longer-lasting droughts, has however undermined the environmental conditions in which these movements have traditionally taken place, affecting the pastoralists' ability to sustain their herds (especially cattle) and modifying their mobility patterns. People are being forced to move to new destinations, farther away from their homes and in some instances across national borders, and for longer periods of time, often leaving on multi-year journeys

Apart from droughts climate change has also disrupted traditional weather patterns, leading to more erratic and extreme weather events, including heavy rains and flooding. According to Quandt and Kimathi (2017) floods have become more frequent and severe in ASAL regions, overwhelming the already limited infrastructure and resources. In October 2023, two months of flooding in Kenya resulted in significant devastation. The floods caused the deaths of at least 1,781 people and displaced nearly 64,000 homes. In the

Arid and Semi-Arid Lands (ASALs), where agro-pastoral communities live, the infrastructure damage severely impacted their livelihoods. The floods destroyed livestock and businesses, exacerbating the region's high poverty levels. Livestock accounts for over 95% of family income in the ASALs (ACTED, 2024). In March 2018, floods in Kenya resulted in the displacement of more than 211,000 individuals, causing the death of 72 people and injuring 33, according to the UN Office for the Coordination of Humanitarian Affairs (OCHA). According to OCHA's report in 2018, Turkana, Tana River, Garissa, Isiolo, Kisumu, Taita, Mandera, Wajir, Marsabit, West Pokot, Samburu, and Narok were the areas that saw the most effect. Floods result in the loss of livestock, the destruction of residential structures, and the impairment of transportation routes and medical facilities. As noted by Kogo et al. (2020), the loss of livestock has a cascading effect on the livelihoods of pastoralists, leading to food insecurity, reduced income, and increased poverty levels.

#### **Adaptation measure adopted by pastoralist livestock farmers**

Adaptation to climate change is a process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. Historically, pastoralists have had relatively high adaptive capacity in inhabiting arid and semi-arid areas. However, increasing frequency and intensity of extreme climatic events are heightening their vulnerability. Herd diversification involves keeping a variety of livestock species rather than

relying on a single type. This practice helps to spread risk and increase resilience against climatic shocks. For example, while cattle are highly susceptible to droughts, smaller livestock such as goats and sheep can survive on less water and poorer vegetation. According to Bobadoye et al. (2016), Maasai pastoralist communities in Kajiado County have increasingly diversified their herds to include more drought-resistant species as a response to climate variability. This strategy has helped them to cope better with the erratic weather patterns and maintain their livelihoods. In her study on climate change adaptation methods for sustainable livelihoods among the pastoral community in Narok County, Korir (2020) identifies livestock diversification as a primary solution employed by the community. This approach involves maintaining a variety of livestock species to mitigate the risks associated with climate variability. Similarly, Magal (2016) highlights that livestock diversification is a key adaptation mechanism for pastoralists in West Pokot County, Kenya, enabling them to better cope with climate change and its impacts. Ndiritu (2021) also emphasizes this strategy in his research on drought responses and adaptation strategies in Laikipia County's semi-arid areas. He reports that pastoralists are increasingly diversifying their livestock to adapt to the frequent and severe droughts they face. These findings collectively highlight the importance of livestock diversification as a resilient and adaptive measure for pastoralist communities across different regions in Kenya. Kaye-

Zwiebel and King (2014) highlight that diversification not only enhances food security but also offers economic stability by providing multiple sources of income.

Herd migration is another pastoralist adaptation strategy, especially during droughts. Opportunistic resource usage and drought mitigation are possible with herd movement. The Maasai pastoralists of Kajiado have long travelled to find pasture, water, and markets for their animals. Pastoralists graze their livestock in confined national parks and occasionally cross the border into Tanzania during acute droughts (Bobadoye et al., 2016). Achola (2021) conducted a study on the sustainability of pastoralism under a changing climate in Kajiado County, Kenya, and reported that pastoralists migrate their livestock in search of pasture and water during dry spells. Similarly, Ng'ang'a et al. (2020) observed that pastoralists from Laikipia County also migrate with their livestock during drought periods to find better grazing areas. Syomiti et al. (2015) further confirmed that livestock migration is a key adaptive and coping strategy for pastoralists facing climate change in Baringo, Laikipia, and Nyeri Counties. These studies collectively highlight livestock migration as a critical response to the challenges posed by climate change, enabling pastoralist communities across various regions in Kenya to sustain their livelihoods in the face of environmental stressors.

Water management practices have also evolved significantly among pastoralist communities. With water scarcity becoming a more frequent

issue, pastoralists are investing in the construction of water storage facilities such as water pans and dams. These facilities capture and store rainwater, providing a reliable source of water during dry spells (Ng'ang'a et al., 2016). Additionally, some farmers have adopted rainwater harvesting techniques and the use of boreholes to ensure a steady water supply for their herds. 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. According to Bobadoye et al. (2016), Maasai pastoralist communities in Kajiado County have adopted rainwater harvesting during the rainy seasons to ensure water availability during dry periods. This adaptation strategy is crucial in mitigating the impacts of climate variability. Mngoli (2014) also highlights rainwater harvesting as a key coping strategy for communities in Kajiado North, who are increasingly facing changing land use patterns and water scarcity due to climate change. Similarly, Ouma (2021) reports that sedentarized pastoralists in Isiolo County have embraced rainwater harvesting as a key adaptation measure. Additionally, a study by Wanjara and Ogembo (2023) on the impact of climate

change on the health and livelihoods of pastoral communities in the North Eastern Region of Kenya indicates that rainwater harvesting and storage for livestock is an essential practice. These studies collectively emphasize the importance of rainwater harvesting as a sustainable adaptation strategy for pastoralist communities across various regions in Kenya, helping them to secure water resources amidst climate challenges.

Pastoralists are also embracing improved grazing management practices. Rotational grazing, which involves moving livestock between different grazing areas to prevent overgrazing and land degradation, has gained popularity (Wangui, 2008). This method not only helps in maintaining the quality of pasturelands but also allows for the natural regeneration of vegetation, which is crucial for sustaining livestock during dry periods. The adoption of feed conservation techniques has become another key adaptation measure. Farmers are increasingly practicing haymaking and silage preparation to ensure that there is adequate feed during times of feed shortage (Nyariki & Wiggins, 1997). This practice helps in maintaining livestock health and productivity even when pasture availability is low. Pastoralists are increasingly embracing improved grazing management practices as a critical adaptive strategy in response to climate change. One such practice, rotational grazing, involves moving livestock between different grazing areas to prevent overgrazing and land degradation. Wangui (2008) highlights that rotational grazing has gained



popularity among pastoralists as it helps maintain the quality of pasturelands and allows for the natural regeneration of vegetation. This regeneration is crucial for sustaining livestock during dry periods, ensuring that animals have access to sufficient forage even when environmental conditions are harsh. In addition to improved grazing management, the adoption of feed conservation techniques has become a key adaptation measure. Farmers are increasingly practicing haymaking and silage preparation to ensure adequate feed supply during times of scarcity (Nyariki & Wiggins, 1997). By conserving feed, pastoralists can maintain livestock health and productivity even when pasture availability is low. This practice is particularly important in mitigating the adverse effects of prolonged droughts and erratic rainfall patterns. Bobadoye et al. (2016) provide compelling evidence of the widespread adoption of hay purchasing among Maasai pastoralist communities in Kajiado County. According to their study, 60% of these communities are buying hay as a coping mechanism to adapt to climate change and its extreme impacts. Similarly, Kimaru, Mutembei, and Muthee (2021) assessed the viability of hay production as a climate adaptation strategy and reported that pastoralists in Kajiado County are increasingly relying on hay purchases to reduce animal losses during drought periods. These adaptive strategies highlight the resilience and ingenuity of pastoralist communities in the ASAL regions of Kenya.

When pasture and water are limited, weaker animals are less likely to survive prolonged periods of drought or extreme conditions. By slaughtering these animals, pastoralists can reduce the overall demand on dwindling resources, thus increasing the survival chances of the stronger, more resilient livestock. This strategy is essential for maintaining the long-term sustainability of their herds (Njiru, 2012). Furthermore, selling livestock, especially during the early stages of drought, is another key adaptive strategy. Selling livestock provides immediate financial resources that can be used to purchase food, water, and other necessities for the remaining animals and the pastoralist families themselves. This preemptive selling can help mitigate the economic losses associated with livestock mortality during severe climate events. According to McPeak and Little (2018), early off-take of livestock not only secures better prices before the market is flooded with distressed sales but also reduces the burden on the limited natural resources available. Bobadoye et al. (2016) stated that 68% of Maasai pastoralist communities in Kajiado County are destocking livestock as a coping and adapting to climate change and its extreme.

Moreover, the integration of agroforestry and the planting of drought-resistant fodder crops have been identified as effective strategies to combat climate variability. Trees and shrubs planted within and around pasturelands provide shade and reduce heat stress on animals, while also serving as a supplementary feed

source (Mugambi et al., 2015). These practices contribute to a more sustainable and resilient pastoral system by enhancing the availability of diverse feed resources.

One of the primary benefits of forming cooperative societies is the ability to pool resources and share knowledge. Cooperative societies facilitate the collective management of scarce resources such as water and pasture, which are critical in ASAL regions where these resources are often limited and unevenly distributed. According to Ng'ang'a et al. (2016), pastoralist cooperatives in Laikipia County have successfully implemented shared grazing schemes and water resource management initiatives. These collective efforts help to mitigate the impacts of drought by ensuring that resources are used sustainably and equitably, thus reducing conflicts over resource access. Moreover, cooperative societies enable pastoralists to access markets more effectively. By banding together, pastoralists can achieve better bargaining power and secure fair prices for their livestock and livestock products. This collective market access reduces the vulnerability of individual pastoralists to exploitative market conditions, especially during periods of climatic stress when livestock health and productivity may be compromised. As noted by Mwangi and Dohrn (2008), pastoralist cooperatives in northern Kenya have facilitated the establishment of livestock markets and improved market linkages, thereby enhancing economic stability and resilience. According to a study by Kariuki et al. (2018), pastoralist

cooperatives in Isiolo County have successfully mobilized savings and provided microloans to their members, enabling them to implement effective adaptation strategies and improve their overall economic resilience.

## Conclusion

Pastoralist communities in Kenya's arid and semi-arid lands (ASAL) are employing a variety of adaptive strategies in face of the impacts of climate change. These strategies include improved grazing management practices, feed conservation techniques, herd diversification, livestock migration, and enhanced water management practices. Through adopting rotational grazing and feed conservation methods such as haymaking and silage preparation, pastoralists can maintain livestock health and productivity even during periods of feed shortage. Herd diversification spreads risk and enhances resilience against climatic shocks, while livestock migration ensures access to vital resources during droughts. Additionally, water management practices like rainwater harvesting and the construction of water storage facilities are critical in securing water supply. Collectively, these adaptive measures highlight the resilience and ingenuity of pastoralist communities, enabling them to sustain their livelihoods amidst increasingly unpredictable and severe climatic conditions.

## Recommendation

To further enhance the adaptive capacity of pastoralist communities in

Kenya's ASAL regions, several recommendations are proposed. First, there should be increased support for the implementation and scaling-up of rotational grazing and feed conservation techniques. This can be achieved through government and non-governmental organizations providing training and resources to pastoralists. Second, policies should promote herd diversification by supporting the breeding and acquisition of drought-resistant livestock species, thereby reducing vulnerability to climatic shocks. Third, investment in water infrastructure, including the construction of more water pans, dams, and boreholes, is essential to ensure reliable water supply. Finally, integrating agroforestry and the planting of drought-resistant fodder crops into pastoral systems can provide supplementary feed sources and enhance the overall resilience of pastoralist livelihoods.

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