

Impact of Climate Change on Sustainable Pastoral Livelihoods in Loima Sub-County, Turkana County, Kenya

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ABSTRACT

Climate change and variability have adversely affected communities' pastoral livelihoods in Kenya. The study aimed to investigate sustaining pastoral livelihoods in a changing climate in Loima Sub-County, Turkana County, Kenya. A total of 59 pastoralists were interviewed using a questionnaire. The data was analysed using the Statistical Package for Social Sciences (SPSS) software Version 22. SPSS employed descriptive statistical techniques like frequencies, percentages, cross-tabulations and proportions, means, and standard deviation. Pie charts, graphs, figures, and tables were used to present the data analysis output. Climate has been observed to vary continuously by pastoralists. Climate hazards mostly reported were livestock diseases and the frequency of droughts. The findings also indicated that livestock keepers preferred to graze their livestock on mountains/hills. Pasture and water availability and security determine the pattern of livestock movement. Pastoralists adopted various strategies to cope with climatic changes. Some of these strategies included diverse utilisation of livestock products, controlled grazing, herd diversification, and labour distribution among household members. In conclusion, climatic change and variability effects on the livelihoods of the pastoralists are evident. However, they have diversified ways of adapting and coping with these catastrophes to sustain themselves. To avert the effects of climate change, Turkana agriculture extension officers should focus on value addition to livestock products, provision of livestock insurance schemes, veterinary services, and livestock disease surveillance. Furthermore, agriculture extension needs to develop and enforce livestock policies and develop appropriate contingency plans. Among the policies recommended are- the management of grazing areas, regulations on migratory routes, and rules governing the use of water sources.

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Keywords: Sustainability, Pastoralists, Livelihoods, Climate Change, Turkana

1. INTRODUCTION

Pastoralists are livestock keepers who live mainly in Africa's remote parts, often with variable rainfall patterns. Sub-Saharan Africa hosts approximately 50% of the pastoralists living in the world (Scoones, 2021; Food & Agriculture Organisation[FAO], 2018). Pastoralists lived in Arid and Semi-Arid Lands (ASALs) and maintained their livelihoods by keeping livestock. These livestock provide them with milk, meat, blood, transport, and trade (Watson, 2016). At least half of their income is obtained from livestock and/or their products. Djido *et al.* (2021) and Opiyo *et al.* (2016) inform that there is an increasing concern that poor communities, mostly ASALs, will suffer more from climatic changes due to heavy reliance on natural resources and vulnerability to droughts, flood occurrences and low adaptation capacities (Afful, 2016). For decades, the Turkana pastoralists' resilience has been strong, but due to the frequent climatic change effects, their perseverance seems to have waned. Watson (2016) and Cuni-Sanchez *et al.* (2018) have documented why Turkana pastoralists have remained vulnerable due to climate change: the reliance on natural resources, such as firewood and herbal medicine, occupancy of less productive lands and severe environmental degradation, including nomadic ways of life.

Even though pastoralism plays a critical role in the sustenance of the livelihoods of Turkana pastoralists, climate change has emerged as the main challenge threatening their survival. In such areas, climatic changes have led to high poverty rates, reduced access to water and grazing land leading to adverse competition over scarce resources, long-drawn-out conflicts, and in most cases, livestock raids. There is also a loss of livestock from diseases and reduced pasture lands (Schilling, 2018). Climatic changes and variability have increased water scarcity for domestic use and forage regeneration. Drought frequency and competition from agriculture and oil industrial uses threaten water availability (Schilling, 2018). In some other localities, climatic variability and changes have led to increased floods and droughts (Maka *et al.*, 2019). These unfavourable climatic changes have reduced the capacity of the pastoralists to cope or maintain their livelihoods. Climate change has been attributed indirectly or directly to human activity that modifies the composition of the global atmosphere and results in the natural variability observed over a comparable time (Adebisi-Adelani & Akeredolu, 2020).

Turkana pastoralists have few options for effective adaptation and coping measures to avert these catastrophes. The area has continuously experienced frequent droughts, flash floods, and the washing away of livestock herds (Ng'anga *et al.*, 2016). There is, therefore, an urgent need to determine the effects of climate change on Turkana pastoralists' livelihoods. Further, viable coping and adaptation mechanisms of Turkana pastoralists have to be studied and recommended to the national government, county government, and other development partners. The study will hopefully also help design agriculture extension frameworks that would enable pastoralists to adjust to a rapidly changing development context and enhance our conception of their livelihoods. Moreover, the study will enhance our understanding of the diverse ways pastoralists make their living and improve their lives in ASAL areas. Although much has been written about agriculture extension workers towards their work and agronomic skills worldwide. Studies on the coping and adaptation mechanisms needed by extension workers in Kenya, to support pastoralists have not received the attention it deserves. This study aims to contribute to closing this gap by assessing the extent to which pastoral livelihoods can be sustainable in a changing and variable climate.

1.1. Objectives of the Study

The broad objective of the study was to assess the extent to which pastoral livelihoods can be sustainable in a changing and variable climate in Turkana County, North West Kenya. The specific objectives were to:

- Investigate sustainable livelihood options pursued by pastoralists within the study area.
- Identify the climatic changes experienced by local Turkana pastoralists.
- Determine the adaptation and coping strategies of Turkana pastoralists to climate change and its variability.
- Propose policy or legal frameworks necessary to sustain pastoralists' livelihoods to remain viable under variable climatic changes using the above analysis outcomes.

2. METHODOLOGY

The study was conducted in Loima Sub-County, Turkana County, which is located in North-West Kenya (Appendix 1). Loima is one of the seven sub-counties constituting Turkana County. The sub-county is considered a marginalised area and classified as ASAL, and it covers a land mass of 2,119.10-kilometre square, with a population of 107,795 people (KNBS,

2019). Loima sub-county lies in agroecological zones (AEZ) IV (semi-humid to semi-arid) and V (semi-arid) and is hot and dry throughout most of the year (Jaetzold & Schmidt, 1983). The temperatures continuously range between 24°C to 38°C. The rainfall of Loima is bimodal and highly variable, with a long-term mean of 216 mm and a maximum of 500mm per year (Rutoh, 2019). This study chose pastoralists' households as the basic unit of analysis, with members living and sharing income. A multistage sampling procedure was used to select the households to be interviewed. Multistage sampling was considered because it allows random selection after determining the sample to be considered in the study. It does not need a sampling frame or can be applied where there is no sampling frame, reducing sample preparation costs (Muzah, 2018).

In the first stage, Turkana County and Loima sub-county were purposively sampled because they are mostly affected by climatic changes and variability. All the sub-county wards were considered for the study in the second stage. The third stage involved sampling 60 households comprising 15 from each of the four wards in the sub-county. A sample of 59 households was obtained through a simple random sampling procedure in which, except in one ward where nine respondents were considered due to non-response of one household, ten respondents from five wards responded to the questionnaire. In each ward, households were stratified to livelihood zones, such as formally employed, fisheries, pastoral and agro-pastoralists.

Data were collected from 59 pastoralists using a semi-structured questionnaire. A pre-test of the data collection tool was undertaken by piloting the questionnaire with six pastoral householders (one in each ward) to ascertain the authenticity of the questionnaire and ensure it yielded the required data. The respondents were requested to provide comments on the clarity of the parameters used in the questionnaire.

The data under analysis are quantified and, therefore, numerical, leading to the use of statistical formulas. Information collected included: the household head's primary occupation, utilisation of various livestock products, income obtained from multiple occupations, and livestock keeping as a livelihood strategy. Regarding climate, information was collected on weather and climate change, climate hazards affecting livestock, the degree of exposure to risk factors, adaptation strategies, controlled grazing zones, diversification, destocking, livestock grazing patterns, the determinants of the climate movement, and the grazing pattern of livestock throughout the year.

3. RESULTS AND DISCUSSION

3.1. Demographic Information

According to the results in Table 1, there exists a gender gap between males and females. These results indicate that any strategy that may be used to develop farming systems in the area will not equally benefit men and women. The results agree with similar studies by Setshedi and Modirwa (2020) and Zenda and Malan (2021) that the gender gap exists between men and women in agriculture. Of the 59 respondents, 64% were males, and 36% were females (TABLE 1). The distribution of the ages was 33% distributed across three age categories, as depicted in Table 2.

TABLE 1: Sex of the Respondents

Age – Sex Distribution		Frequency	Females
Total		59	100%
Male		38	64%
Female		21	36%

TABLE 2: Age-Sex Distribution

Age – Sex Distribution	Total	Males	Females
Total	59	38	21
18 to 35	31%	29%	33%
35 to 40	34%	34%	33%
Above 40	36%	37%	33%

3.2. Level of Education

The results in Table 3 indicate a low attendance of pastoral children in formal schools compared to children from families with formal employment. The findings agree with the research conducted by Dyer (2021), who studied the relationship between formal education and pastoralists in Western India. As indicated, most of the respondents who participated in the survey did not have formal education. More men lacked formal education compared to women. The younger age group (18 to 35 years) had more formal education than older respondents (TABLE 3).

TABLE 3: Education Level of the Respondents

	Total	Gender		Age Category		
	Total	Male	Female	18 to 35	35 to 40	Above 40

Never been to school	66%	71%	57%	50%	65%	81%
Grade R to grade 8	29%	24%	38%	39%	35%	14%
Grade 9 to grade 12	3%	3%	5%	11%	0%	0%
Tertiary qualification	2.%	3%	0%	0%	0%	5%

3.3. Number of Years in Livestock Farming

The results in Table 4 indicate that most respondents have been practising livestock keeping for between 5-10 years, with age being a leading factor, where older people reported to have practised livestock keeping longer than their younger counterparts. The finding disagrees with the study by Opiyo (2016), who states that the Turkana pastoralists have kept livestock as their livelihood for hundreds of years. Opiyo further informed that the Turkana community raised livestock for subsistence and socio-economic reasons. On the other hand, Schilling *et al.* (2018) confirmed that reliance on livestock has been changing as pastoral households resort to a market economy, taking more livestock to sale.

TABLE 4: Summary Statistics of a Survey Carried Out in Turkana (n=59)

Farming experience	Percentage
Less than 5 years	10
5 to 10 years	39
10 to 20 years	31
More than 20 years	20

3.4. Dependencies

The results in Figure 1 indicate that all respondents reported having dependents living with them. Households had an average of eight dependents and a median value of six. The sample's average household-dependant size closely mirrored the 2019 Census data report that put the average household size for Turkana County at 5.6. A comparative analysis of dependent size across various age categories revealed that the older the respondents, the higher the number of dependents, as depicted in Figure 1. Yoda (2020) supports the findings on the number of dependents. He found that increased droughts among the Turkana increased the dependency ratio.

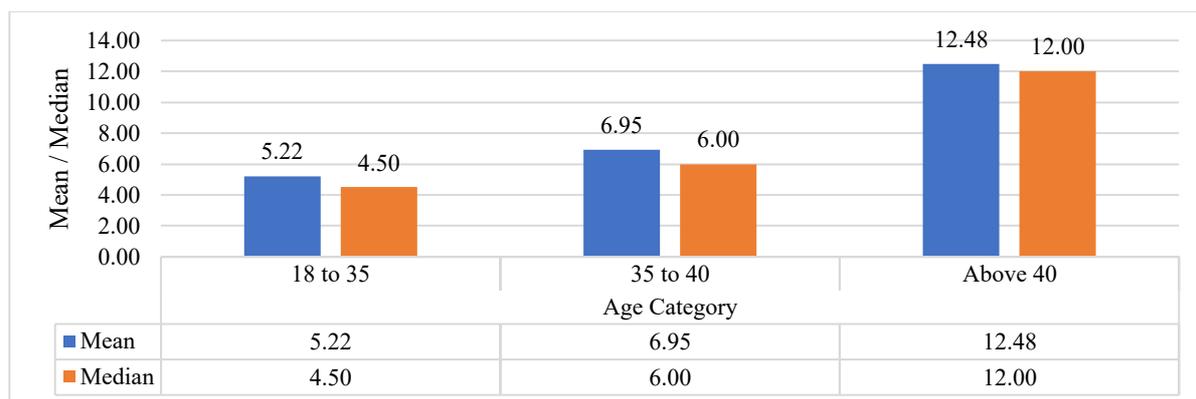


FIGURE 1: Percentage of Respondents With Dependencies in their Farming System

3.5. Pastoral Livelihood Options and Other Livelihood Strategies

3.5.1. Main occupation

The results of Figure 2 indicate that most respondents reported practising livestock farming as their primary occupation, while a few reported practising crop production. Other occupations reported included salaried employment and business ventures (Figure 2).

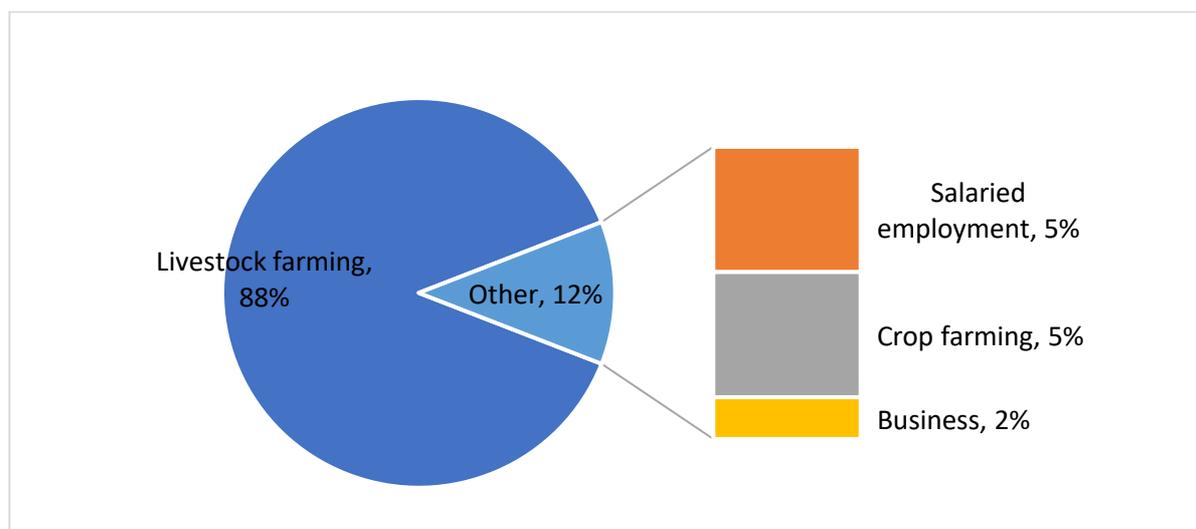


FIGURE 2: Displays the Respondents' Primary Occupation Percentages

Pastoralists mostly keep livestock, most of which do well in the dry areas of Kenya. This finding agrees with the study by The Food Economy Group (2016), which stated that 60% of Kenya's livestock are found in ASALs. It shows that 88% of the respondents practised livestock farming as their primary occupation. Only 5% of the respondents reported practising crop production; 5% said their primary occupation was salaried employment, and for 2%, the main occupation was business (Figure 2). This indicates that livestock farming plays an important role in pastoral communities.

3.5.2. Type of Livestock Kept

The results in Table 5 depict that goats were the most common animals. The popularity of goats can be attributed to the fact that they are browsers and can withstand adverse climatic conditions. They are also versatile because the owners can quickly sell them for immediate needs. The findings also agree with the study by Opiyo (2016), which stated that the Turkana Pastoralists preferred to keep goats in their farming system since the species is perceived to be more resistant to drought than other livestock.

TABLE 5: Summary Statistics of a Survey Carried Out in Turkana (n=59)

Types of livestock reared by farmers in the Turkana County	Percentage
Cattle	20
Sheep	63
Goats	98
Camel	41
Donkey	24
Poultry	19
The main reasons for rearing livestock in Turkana County	
To provide money to maintain their families	76
Providing money for school fees	54
Cultural reasons	51
Reasons for selling livestock	
Drought	36
To buy food	95
Education	59
Medical care	51

3.5.3. Reasons For Keeping Livestock

Table 5 also indicates that Livestock rearing is the preferred primary occupation for various reasons but mainly as a significant source of income to provide for their families. The primary reasons cited included historical/cultural reasons, ease of management, drought-resistant, and they breed quickly. The main reason for preferring to rear livestock was to provide money to maintain their families (76%), followed by providing money for school fees (54%), and, lastly,

for cultural reasons (51%). The finding also agrees with the study by Imana (2016), who stated the main reason for keeping livestock (mainly goats) was to provide household food.

3.5.4. Reasons For Selling Livestock

As indicated in Table 5, most respondents reported that their primary motivation for selling animals is to buy food, with education and health care tying in second place. Some respondents said that their primary motivation to sell animals was drought (36%) (Table 5). The ASAL region is prone to adverse climatic conditions which have threatened pastoralists' and communities' way of life in this region, concluding the findings by Opiyo (2016). This finding disagrees with the study by Opiyo (2016), who researched the Turkana pastoralists and found that they use this option to cover regular adaptation costs. Nevertheless, they sell their livestock to cope with short-term shocks. Every few years, thousands of livestock die due to drought and flooding. The government sometimes comes in to rescue these farmers by buying their animals, slaughtering them, and distributing the meat to disaster-stricken families.

3.5.5. Income Obtained From Various Occupations

The results in Figure 3 indicate that most households relied on livestock keeping as their livelihood strategy. Households that received high income (above R20000) relied on business. The finding further explains that pastoralists relied on diversified sources of revenue. This finding agrees with Opiyo (2016), who stated various reasons the pastoralists have to diversify their livelihood and income sources, one of which is to cope with climate changes and variability. The households obtained income from various occupations. Most respondents obtained it from livestock (44%), business (8%), and crop farming (7%) (Figure 3). The households which received income between R1000-R5000 received their income mainly from livestock (25%), business (7%), and crop farming (5%) (Figure 3). Further, the household which received income between R5000-10000 reported mainly relying on livestock (8%) (Figure 3). Those receiving income between R10000 to R20000 relied only on livestock (2%). Finally, households that received income above R20000 reported obtaining their income mainly from business (2%) (Figure 3).

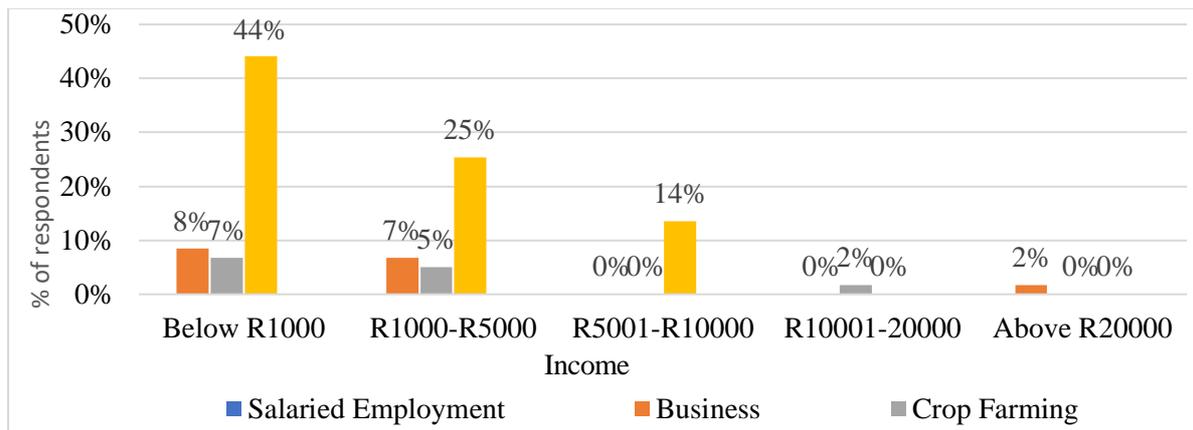


FIGURE 3: Sources of Income for Turkana County Livestock Farmers

3.5.6. *Livestock Keeping as a Livelihood Strategy*

From Figure 4 below, most pastoralists preferred to keep livestock for the future as a livelihood strategy, and 39% of all respondents reported they did not intend to continue with the venture as a livelihood strategy (Figure 4). These sentiments were mostly echoed by the males (45%) compared to the females (29%).

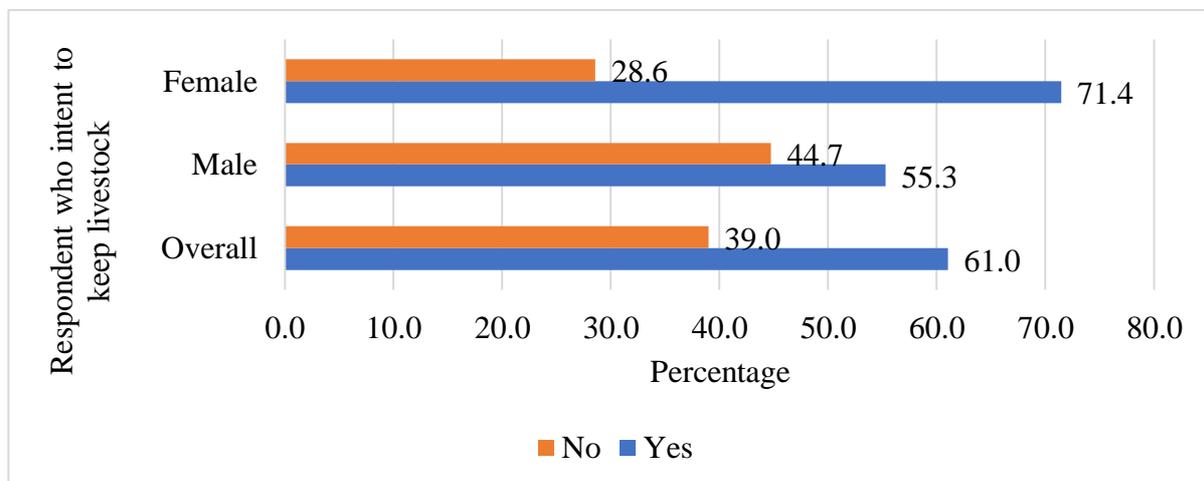


FIGURE 4: Displays the Percentage of Respondents Who Intend to Continue Keeping Livestock

The results in Figure 5 below indicate that livestock farmers would opt for a more sustainable venture like crop farming, business, and beekeeping. In contrast, most women who would abandon livestock keeping reported they would venture into business, and most men would venture into crop production. The younger farmers are more likely to start a business compared to older folk who venture into crop farming (Figure 5). Pastoralism as a livelihood strategy is

threatened by climate change and other natural disasters like the recent locust infestation in ASAL regions. The sustainability of pastoralism as a livelihood strategy is reduced further by low government policies on ASAL and a lack of alternative livelihood ventures. The communities in this region already realise that pastoralism may not be sustainable in the long run.

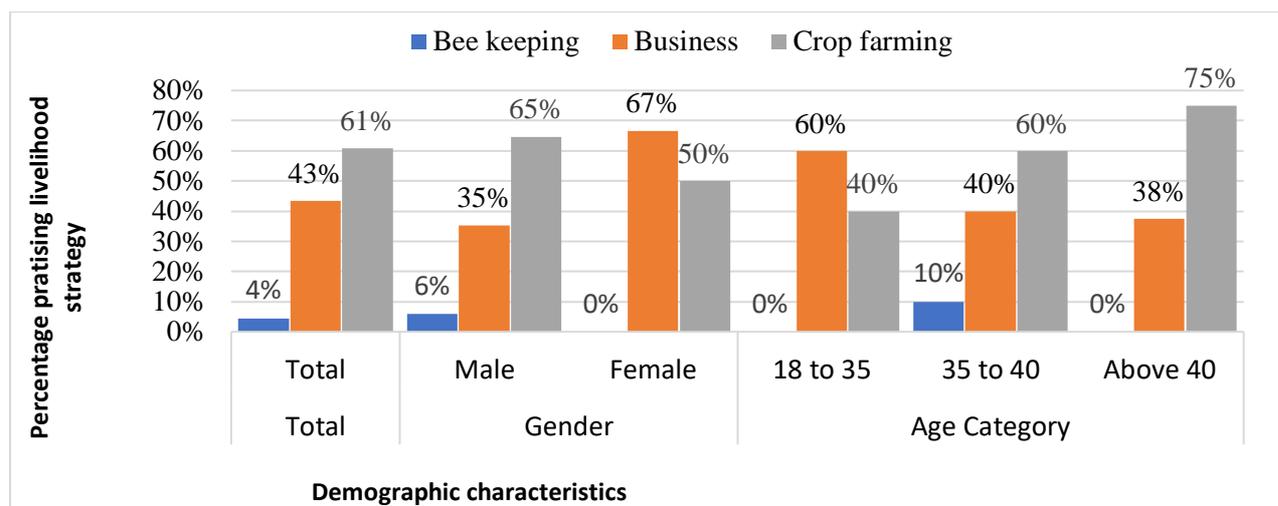


FIGURE 5: Livelihood Strategy of the Respondents

3.6. Effects of Climate Change and its Variability on Pastoral Livelihoods

3.6.1. Weather and Climatic Changes

Table 6 shows that all respondents who participated in this study agreed that the area had temperature, weather, and climatic changes. The majority opined that the changes or patterns have been varying continuously (Table 6). This finding is factual since pastoralists live in ASAL areas prone to changing and variable climates.

These findings agree with Djido (2021) studies, which postulated that pastoral livelihoods are threatened by the adverse impacts of a variable and changing climate. They were further concerned that the climatic changes adversely reduced the capacity of the pastoralists to promote their livelihoods. The study also concurs with Nga'nga *et al.* (2016), who alluded that continued extreme weather changes were likely to continue with severe impacts on livestock, human and natural resources.

TABLE 6: Summary Statistics of a Survey Carried out in Turkana (n=59)

Perception of the respondents regarding temperature, weather, and climatic changes in an area.	Percentage
Varies continuously	86
Increasing	8
Don't know	2
No change	2
Decreasing	2
Main causes of livestock deaths	
Diseases	95
Drought	53
Predation	8
Slaughter	3
Floods	3
Other	0
The respondent's level of satisfaction with the condition of their livestock	
Yes	8
No	92
Reasons for dissatisfaction with livestock conditions	
Diseases	66
Drought	90
The grazing field is poor	12
Other	2

The fears of pastoralists identified in this study were also confirmed by Ramanan (2020), who stated that climate change could mean changing situations, such as weather or temperature patterns, for an extended period. All the respondents reported that they had noticed changes in the rainfall amount, drought, floods, and wind. Climate change was a significant threat to pastoralism, and diseases were singled out as the primary cause of animal deaths, followed by drought. Other factors reported causing death included: predation at 8%, slaughter at 3%, and floods (3%). Climatic changes and variability lead to drought, water shortages, and pasture

depletion, explaining why it has become a significant threat to pastoralism. This finding agrees with Lenaiyasa (2020) study, which researched a similar environment (Samburu-Kenya). Lenaiyasa's study associated climate change and livestock mortality. The study reported that adverse climatic changes resulted in animals' deaths, ultimately bringing hunger to pastoralists and their dependents. Climatic changes are further related to wasting livestock conditions, leading to rampant disease outbreaks and market reduction.

Livestock condition is a critical variable for pastoralists because it indicates the average market price of the livestock. The pastoralists observe the body condition and the behaviour of the animals. Up to 92% of the respondents reported that they were not satisfied with the condition of their livestock (Table 6). The majority singled out drought (90%), livestock diseases (66%), and poor pasture (12%) as the leading causes of poor animal conditions due to climate change (Table 6). This finding agrees with Mushy's (2018) and Ng'anga *et al.* (2016) studies. The two studies pointed out adverse climatic changes as the culprit threatening water resources and poor pastures. These result from frequent drought, which is a consequence of climate change. The two studies added flash floods, which washed away herds of livestock.

Disease outbreaks, which can also be attributed to climate change, were reported as the most recurring phenomenon. About 80% of the respondents rated it the highest, while 20% rated drought as high in occurrence (Figure 6). About one in nine of the respondents reported the occurrence of drought as either the highest (49%) or high (39%) (Figure 6). Flood occurrence was ranked as average or low by the majority of the respondents, with hailstorms seldom happening in the region. The occurrence of hailstorms was not rated, as this only happens in areas with high precipitation. This finding can be explained by the fact that pastoralists have always been risk-averse. The pastoralists have devised ways of spreading the risk. For example, Alex (2018) states that pastoralists have had to divide their livestock relatives and may resort to raiding to increase or maintain stock after drought or disease outbreaks.

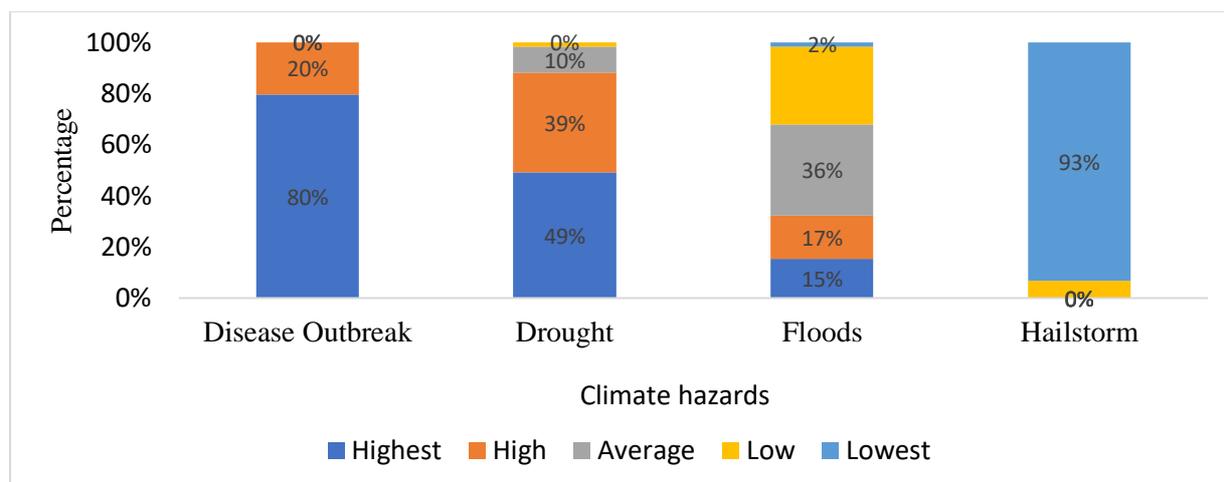


FIGURE 6: The Occurrence of Climate Hazards According to the Respondents

3.6.2. Other Climatic Hazards Reported

The results in Table 7 indicate that the climatic hazards reported include locust infestation by 45% of the respondents, worms attacking plants by 69%, and animal parasites infestation at 79% (Table 7). The respondents were also asked if they were conversant with other climatic hazards which affected their livestock. Most respondents pointed out parasite infestation, while locust infestation and work attacks were least mentioned. Due to locust invasions in the East Africa region during the year of the study, the respondents were worried these could have some adverse effect on their livestock. The literature reviewed did not provide enough information regarding the effects of these hazards on the livelihoods of pastoralists.

TABLE 7: Percentage of the Respondents Facing Other Climate Hazards

	Frequency	Percent
Total	29	100%
Locusts infestation	13	45%
Worms attacking plants	20	69%
Animal parasites infestation (ticks etc)	23	79%

3.7. How Pastoralists Adapt and Cope With Adverse Effects of Climate Change and its Vulnerability

3.7.1. Diversification

The results in Figure 2 showed that the main occupation of the pastoralists was livestock. However, pastoralists still pursued alternative livelihoods (employment, crop farming, and business) to cushion against livestock failure deaths or raids. The research supports the finding by Ng’asike (2020), who asserts that pastoralists may also seek to diversify herds to survive ravages of droughts, diseases, or disasters.

3.7.2. Destocking

As shown in Table 8 below, most pastoralists sold their livestock. Further, most sold the products simply to earn money that can efficiently be utilised for other uses. This is a form of destocking. This research supports the finding performed by Nkuba (2019), who states that pastoralists resorted to destocking to acquire income for alternative livelihoods. Similar studies by Popoola *et al.* (2019) in the Eastern Cape, South Africa, reported that 55% of respondents use destocking as an adaptation measure. Popoola *et al.* (2019) further noted that some pastoral communities cushion against drought through destocking. Pastoralists who face huge losses due to drought opt for other livelihoods.

TABLE 8: Utilisation of Livestock and Their Products by the Respondents

	Animal (whole)	Milk	Meat	Skin	Blood
Sold	73%	32%	41%	29%	2%
Family use	80%	97%	98%	88%	98%
Dowry	56%	2%	5%	0%	0%
Kinship	4%	0%	0%	0%	0%
Other	5%	0%	0%	7%	5%

3.7.3. Determinants of Livestock Movement

The results of Figure 7 reveal that pasture and water availability were the main determinants of their movement. This finding is supported by Cocimano (2021), who proposes the creation of grazing zones to enable pastoralists to control their livestock mobility through fencing. The writer stated that creating grazing zones further minimises potential conflict between the warring groups. The writer further confirms that conflicts have also restricted pastoralists from grazing their livestock, reducing pastures' availability. From the findings, most farmers

reported that they move their animals more than twice throughout the year, and these movements are informed by seeking new pastures. Others moved livestock in search of water, while others moved for insecurity. The movement can be explained by the fact that pastoralists are mobile and graze on communal rangelands in search of pasture and water.

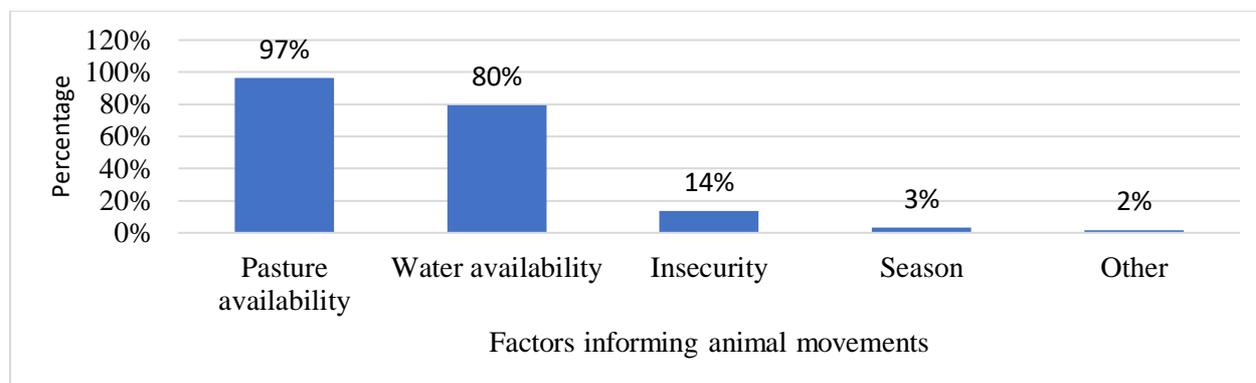


FIGURE 7: The Determinants of Livestock Movement

3.7.4. The Grazing Pattern of Livestock Throughout the Year

Figure 8 shows that increased movement for grazing can be associated with the fact that land in Loima is communal and pastoralists are nomadic and can move anywhere. The finding contradicts the idea of controlled grazing, where Olimba (2018) describes a system where producers control the grazing arrangements of livestock, which is not practised in pastoral lands. This method would have worked in privately owned lands, allowing other areas to be set aside as reserves for dry-season grazing (Olufemi, 2019).

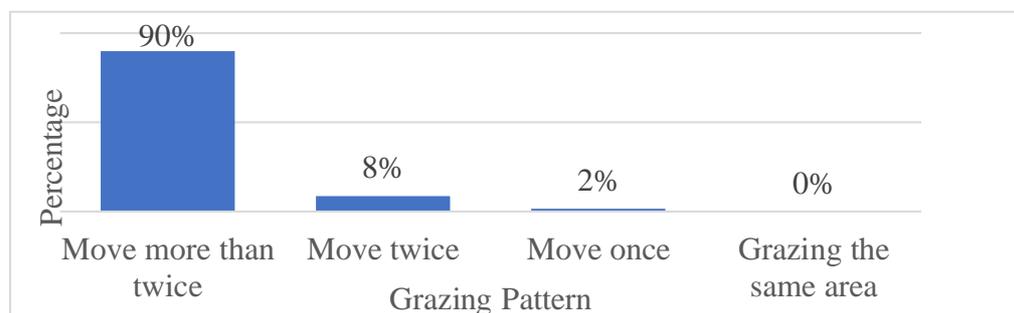


FIGURE 8: The Percentage of Respondents and Associated Livestock Grazing Pattern

Mgugi (2020) suggests adopting plans to guarantee drought-time access to specific grazing reserves, which must be developed in the context of general policy on pastoral land tenure. The practice involves dividing the livestock into small herds grazed separately and prioritising milk

animals or other categories. Regarding livestock grazing, most respondents reported moving more than twice throughout the year. Two categories were reported to have moved twice and once. None of the respondents grazed the same area throughout the year.

4. CONCLUSION AND RECOMMENDATIONS

The study has contributed to the existing literature by informing that all pastoralists have witnessed the effects of climate change in the form of weather changes. The pastoralists experienced the effects of climatic changes and variability through drought, water scarcity, pasture depletion, and increased livestock diseases. Further, as much as pastoralists have practised various livelihood options, livestock keeping remains the primary livelihood option, and they wish to pursue them even when climate effects worsen. Pastoralists have devised other adaptation and coping mechanisms, such as diversifying into other livelihoods such as crop farming, herd splitting, controlled grazing, and destocking. Pastoralists have also devised other strategies, rules, and regulations for grazing management, migration or use of resources, and conflict resolution when it arises. The research has also come up with some recommendations:

- The department of agriculture extension and development partners should support pastoralists through programs that assist with water for both human and livestock fodder production. These will ultimately strengthen pastoralists' capacity to cope and recover from climatic change effects.
- The department of agriculture extension and development partners should invest in veterinary services and disease surveillance programs in livestock grazing areas. These will readily contribute to disease control/treatment and cushion against disease outbreaks.
- There is a need for comprehensive and proactive communication and coordination of government weather predictions through extension agents to act as an early warning system for livestock keepers.
- The government can develop policies and strategies for managing pasture land, water resources, and migratory routes with the pastoral communities.
- It is also crucial to investigate further ventures into commonly owned grazing areas and practice zoning and controlled grazing management.

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