Current Science
CS 2 (6), 241– 256 (2022)
Received 10 Oct 2022 | **Revised** 25 Oct 2022 | **Accepted** 15 Nov 2022 | **Online Available** 01 Dec 2022

Current Science

Current Science

OPEN ACCESS
2795-8639

ISSN(O)

ORIGINAL ARTICLE

Rangeland Pasture Management Strategies during Drought among Pastoralists in Kajiado County, Kenya.

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Abstract: Pastoral communities have all along developed local mechanisms for managing forage resources to cope with recurrent severe droughts. Unfortunately, these practices have been suppressed and communities are struggling from losses due to the effects of drought on livestock feeds and water. The study adopted a cross-sectional survey design and used an interview schedule for data collection from 384 randomly selected farming households. The study targeted pastoralists in Kajiado East sub-county. Data were analyzed using descriptive and inferential statistics in Statistical Packages for Social Sciences. Descriptive statistics such as frequencies and means were used to summarize data. One-way ANOVA was then used to analyze data where Turkey's honestly significant difference test was used for means comparison. However, the study found out pastoralists have inadequate knowledge and sufficient training in pasture management contributing to low levels of pasture conservation during periods of excess pasture. The frequently practiced methods were traditional herd tethering and migration. A small fraction of pastoralists adopted and practiced modern systems such as paddocking, zero grazing, haymaking and the use of other supplementary feeds. Additionally, water harvesting technologies to reduce the possibility of rivalry and conflict between and within communities arising from limited water supply during drought should be promoted. There is an urgent call for all stakeholders in the pastoral areas of Kajiado East to establish sustainable strategies to accelerate capacity building in pasture resource management.
Keywords; Drylands, Livestock management, Focus group discussion, Pastoralism

1. Introduction

The world's dryland areas are estimated to cover 41% of the earth's surface (Huang et al., 2017; Stewart & Peterson, 2014). The regions receive an annual rainfall of between 25 mm to 600 mm, which is poorly distributed and highly variable (Recha et al., 2011; Oduor et al., 2020). Due to changing global climate and expected increase in evapotranspiration because of high temperatures, the dry lands are exposed to recurrent climatic extremes such as aridity, water stress and low yields from rain-fed agriculture coupled with severe food insecurity including malnutrition (Thornton and Lipper 2014). The harsh conditions make the region unfit for any crop production, even the drought-tolerant varieties (Oduor et al., 2020). Pastoralism is considered the most viable production system, which supports over 100 million people globally (Zeng et al., 2021). In the drylands of Kenya, the pastoral economy constitutes 95% of family income and 90% of all employment opportunities (Kenya ASAL Policy 2012). With similar patterns in sub-Saharan Africa (SSA) (Stewart & Peterson, 2014).

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In the Greater Horn of Africa (GHA), including the East African Countries, pastoralism is the most upheld economic activity in which millions of people eke out their living (Oluokye, 2003). Pastoralists in these regions build their wealth on several livestock held. Pastoralists' populations in Horn of Africa countries are estimated to be about 60% in Somalia; 33% in Eritrea; 25% in Djibouti; 20% in Sudan and 12% in Ethiopia (Coppock, 1994, quoted in Ahmed et al., 2001) and Sudan, 80% (Adegoke & Abioye, 2016). Pastoralists regard livestock keeping as a source of livelihood, food, financial capital and the basis of wealth. However, with the dry conditions, even pastoralists are exposed to a lot of risks as livestock production faces challenges such as social, economic, and environmental problems that obstruct their capacity to trap the opportunities. This system of production over the years has evolved in harsh and remote areas (Mingxia et al., 2015). The infrastructure in these areas is entirely dilapidated. Nevertheless, these pastoralists have well-developed risk management and adaptation strategies (Svejcar & Kildisheva 2017).

In response to the deteriorating ecology, Maasai pastoralists in Kajiado County have developed mechanisms for survival besides their traditional mechanisms (Jaetzold et al., 2007). These include mobility of livestock for forage and water resources, feeding their animals with twigs and branches from trees such as acacia, involving in herd splitting to areas with different ecological zones, livelihood diversification; herd diversification to gain from the diverse drought and disease tolerant varieties and promoting formal education for their children through sending them to school as a long term investment in form of income gained from employment, practice of traditional pasture conservation through rotation/deferment from grazing lands according to (Julius et al., 2011).

Most of the pasture management strategies by the farmers have not been fully documented. Different communities use different coping strategies depending on the situation and the resources at their disposal. Hence, there is no clear clarity on the reliability as well as the effectiveness of the various p strategies. The study, therefore, sought to evaluate the extent of drought and identify the various strategies the pastoralists use to cope with the drought in Kajiado in Kenya.

2. Materials and methods

2.1 Study area

The study was conducted in Kajiado County, Kajiado East sub-County (Figure 1). The region has about 687,312 households spread across the five wards (Kitengela, Sholinke, Kaputie North, Imaroro and Kenyawa-Poka). It covers an area of 19,600 km^2 (CBS, 2009). Kajiado County lies in the Lower Midland zone 5, dry land zones. Only 8% of the County's land is the potential for rainfed cropping. The mean annual rainfall for the region ranges between 300 to 800 mm, and is poorly distributed and highly variable (Sombroek et al 1982). The rainfall pattern is bimodal, with short rains from October to December and long rains from March to May. The main economic activity in the region is pastoralism (Jaetzold et al., 2007).

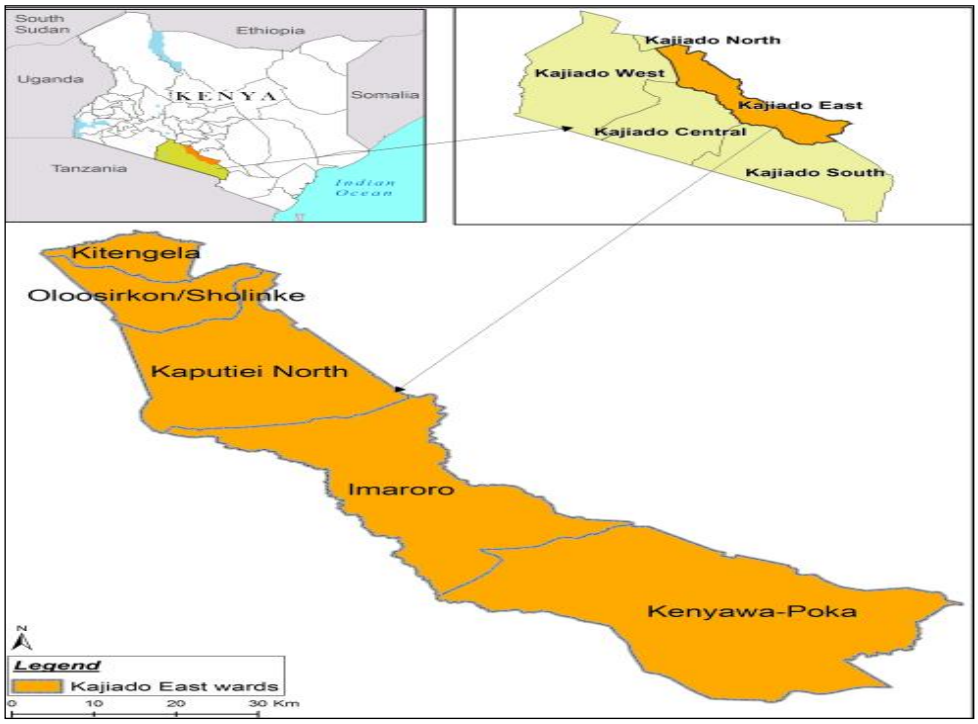

Figure 1 Map of Kajiado County Administrative Boundaries

2.2 Research Design

The study was carried out using cross-sectional survey design. The study employed a combination of multi-stage sampling method and probability proportionate to size sampling techniques in selecting the sample households. In the first stage, Kajiado East Sub County has a population of 136,482 persons (KNBS, 2012) was selected. This was because the region is among the most drought-affected region, and they have devised various coping strategies (Jaetzold et al., 2007). In the second stage, all five wards in the sub-county (Imaroro, Kitengela, Kenya-Poka, Oloosirkon and Kaputiei North) (Table 1) were selected to ensure every area within the sub-county were represented. In the third stage, a random sampling technique was used to select the households. Household records were obtained from the Sub-County agricultural offices. The records were used as a sampling frame from which sampled households were selected using computer-generated random numbers.

Table 1 Sample distribution in selected wards in Kajiado East Sub-county

County wards	Number of households	Percentage of total	Sample distribution
Kaputie Ward	29,989	20.3	78
Kitengela	30,663	20.8	80
Oloosirkon/Sholinke	34,175	20	77
Kenyawa Poka	24,559	19.5	75
Imaroro	17,096	19.5	75
Total	**136,482**	**100**	**385**

Source: GOK National Census 2009

2.3 Target population and sample size

The study targeted smallholder farmers in Kajiado East sub-County. The sample size was calculated using the formula by Cochran, (2007).

$$n = \frac{^2 pq}{d^2} = \frac{1.96^2 * (0.5) * (1-0.5)}{0.049^2} = 400 \quad \text{(Eq 1)}$$

Where n = sample size, Z= 1.96 the standard normal deviate at the required confidence level, p = (0.5) the proportion in the target population estimated to have the characteristic under observation, q =1-p =0.5 = the proportion of the population without the characteristics being measured d = 0.049 = the desired level of precision.

This formula was used because there was no assumed mean of the population and therefore the sample mean was only calculated using the maximum error estimates that allowed the sample size to fall within the population mean. With the formula above, a sample size of 385 was identified.

2.4 Instruments of data collection

Actual data collection was preceded by an exploratory survey. The exploratory survey gave insights into the technologies that were of interest to the farmers and the likely challenges. Data collected during the exploratory survey guided in technology selection and the development of the data collection tool. The study used both primary and secondary data.

Qualitative data on the effect of drought on pastoralists, pasture management strategies and coping strategies were collected from five focus group discussions (FGD) in each ward. This was carried out with older herders who have a wide range of knowledge on animal feed management, having experienced several droughts and great ideas on what the community has always done to manage their pasture and ensure their survival. The interview schedule collected was also used. Both open-ended and closed-ended questions were used in the interview guide. The open-ended were used predominantly as follow-ups to the close-ended questions. The interview guide addressed the specific objectives of the study. Secondary data was collected from secondary sources such as books, reports, and journal papers.

Reliability indicates the degree to which the survey instrument is consistent with what it measures (Litwin, 1995). A split-half reliability test was conducted to determine the consistency of the survey instruments. This method eliminates chance error by testing the instrument under different conditions (Mugenda & Mugenda, 2003; Amugune, 2014). The interview schedule was administered to 30 smallholder farmers who were randomly selected. According to Israel (2012), a sample size greater or equal to 20 can yield meaningful results in a survey study. The correlation coefficient (*r*) between the halves of the items was calculated using Pearson's product linear correlation coefficient formula. Spearman brown prophecy was used to determine the reliability of the full instrument.

Field (2005), states that validity is the capability of a research instrument to measure what it ought to measure so that the difference in individual scores can be taken as representing a true difference in the characteristic under study. To ensure validity, survey instruments were checked and critiqued by the supervisors and colleagues to determine whether they contain an item that can measure study objectives. The advice provided was reflected upon and taken into consideration while revising the interview schedule. After data collection, a validity test was performed using the Pearson Product Moment Correlations.

2.5 Data Collection

Focus Group discussions (FGD); Five focused group discussions were done with representatives from animal herders, women groups, community elders and representatives of community-based organizations, to acquire useful and detailed information on drought effects in the area, pasture management strategies during drought and coping strategies used by the pastoral community.

Administration of Questionnaires; Quantitative and qualitative primary data were gathered using pre-tested questionnaires administered to the pastoralists. Enumerators from the local community were identified and trained on how to administer the questionnaires on the basis that they could speak the local language and understand the geographical area. After training, the enumerators, pretested questionnaires were pretested in the neighboring Kajiado West sub-county. Thereafter,

necessary modifications were made to the questionnaires before the actual data collection began. The semi-structured questionnaires were used to collect information on household size, demographic structure, literacy level, marital status, pasture management strategies, effects of drought on livelihood and animals, drought coping strategies and pasture recovery mechanisms.

2.6 Data Analysis

The completed questionnaires were crosschecked for completeness and consistency before analysis. SPSS (Statistical package for social science Version21.o) Microsoft Excel was used to generate descriptive charts and graphs and other functions. Microsoft word processing tools were used to analyze Qualitative data. Descriptive statistics were used to analyze the data gathered for the development of indices from the raw data and included frequencies and percentages. The data from FGDs for proper understanding and confirmation of the quantitative data collected from the community was organized into themes and sub-themes for thematic analysis.

3. Results and discussion

3.1 Socio-economic and demographic characteristics of the respondents

The results showed that (75%) of the households were male-headed and 25% female-headed (Table 2). About 65% of the respondents in the study area were married, widowed, single, and divorced. Slightly over 60% of the households have relatively medium family sizes (6-10 members) while less than 30% have small family sizes (0-5 members), and 13% of the households had a large family size (over 11 household members). The results revealed that the literacy level in the study area was low as the majority (76%) of the respondents had informal education relative to only 24% of the respondents who had attained formal education.

There were diverse economic activities in the region (Table 2). The respondents were pastoralists; their main economic activity was pastoralism (57%). Crop production (farming), was taunted, as the upcoming economic activity was 7%, while hired herdsmen contributed 2% of the economic activities of the study area (Table 2). Both formal employment and unemployment were very low (2%). The majority of the unemployed were women 17% of them were housewives. On the other hand, it was found that almost half (48%) of the residents had lived in the study area for more than 10 years, while slightly over 40% had lived between 5-10 years while only a few people (8%) had stayed for less than 5 years. The result also indicates that adults (87%) attended to the herds during the drought period as opposed to children (13%).

Table 2 Household socio-economic and demographic characteristics of respondents

Socioeconomic factors	Characteristic	Percentage
Marital Status	Married	65
	Divorced	4
	Widowed	21
	Single	10
		100
Type of Household	Male headed	75
	Female-headed	25
		100
Number of people per household	0-5	26
	6-10	61
	11-15	10
	Over 15	3
		100
Literacy status	Did not attend school	77
	Lower primary (1-4)	8.8

	Upper primary (5-8)	8	
	Secondary school	4	
	College (diploma/Certificate)	1	
	University	1.6	
		100	
Source of Family Income	Formal employment	2	
	Pastoralist	57	
	Hired herdsman	2	
	Farming	7	
	Housewife	17	
	Unemployed	2	
	Businessman/woman	13	
		100	
Livestock herders during drought	Children/boys		13.3
	Youth/Moran		43.6
	Men aged 30 and above		43.1
			100
Number of Years lived in the area	<5yrs	8.2	
	5-10yrs	43.9	
	>10yrs	47.9	
		100	

Socio-economic attributes of a population are important in understanding the behavior of the people. The study revealed that the majority of the pastoralist are married thus implying that they are family-oriented. Nonetheless, the pastoralists are conservative and have strict gender roles hence 25% of female-headed households were attributed to the death of a husband, divorce, or single parenthood. Gender is important in access to resources and participation in community affairs in pastoralist communities. Similar studies have reported the effect of gender on resource access and access to education in Tanzania (Campbell, 2021; Lusasi & Mwaseba, 2020). Gender inequality could explain the low economic development in the study area. Altuzarra et al. (2021) found positive correlation between gender inequality and low economic growth in developing countries.

This study found a low level of literacy within the study area which could be ascribed to the economic status of the pastoralists, the value placed on livestock and gender bias in access to education (Kaul, 2015). The low literacy level could also explain the few people informed in formal employment (Table 4.1). The findings of this study resonate with the results of Lowe et al. (2021) who found that young pastoralists' girls are denied access to basic education as they are married at a very tender age. The low education level could possess a significant impact on development and technology uptake by the community (Abu-Shanab, 2011; Riddell & Song, 2017). About 75% of women in Kajiado are housewives that could be associated with the cultural conservation of the pastoralists. Other scholars have opined that this could be attributed to fear of power dynamics among the communities and hinder women's career choices and growth (Ford et al., 2021; Mtey, 2020; Olga et al., 2020).

3.2 Effects of drought on pasture production and management

Drought influenced pasture production in Kajiado County (Table 3). The majority of the respondents (60%) opined that droughts lead to loss of pasture while slightly over (23%) of the respondents said that the climatic event causes the death of their livestock. About 8% of the respondents felt that an occurrence of drought lowers their selling price,

with 5% attributing droughts to loss of family income. However, only 4% of the respondents associated tribal conflicts with drought. A range of pasture management strategies was proposed. Above 40% of the respondents, suggested training on pasture management, and 30% suggested rainwater harvesting and the use of irrigation were proposed by 25% of the respondents.

Table 3 Effects of drought on pasture production and management

Characteristic	Parameter	Percentage (%)
Effects of drought experienced	Loss of pasture	60.2
	Death of livestock	23.5
	Low selling price	7.6
	Loss of family income	4.5
Total	Tribal conflict	4.2
		100
Measures to manage pasture during drought	Water harvesting	30.0
	Practice of irrigation	24.6
	Training on pasture management	41.4
Total		100

The study highlighted the various effects of drought on pastoralists in Kajiado County. The effect ranged from economic, environmental to social. This could be attributed to the fact that livestock is the mainstay of the community as per section 3.2. Additionally, Kajiado is situated in the ASAL part of Kenya and is most vulnerable to the effect of prolonged droughts as a result of climate change (Mogotsi et al., 2013). This finding is in agreement with the observations by Frank et al. (2014), who found that drought increased the need for more income and reduced the mobility of the pastoralists. The pastoralist community depends on natural resources and therefore inadequate water and pasture due to drought translate into a huge effect on pastoralists' livestock production, which could often lead to conflicts. A positive correlation between drought severity and livestock losses in the pastoral region has been established (Hugo and Mugalavi, 2010; Nkedienye et al., 2010). Similar results have been reported among pastoral communities in Somalia, Ethiopia, and Kenya (Africa, 2021; Fava et al., 2021; Jibat & Abashula, 2020).

3.3 Household pasture management strategies

The pastoralist community in Kajiado County (Table 4) adopted several pasture management strategies. Paddock grazing accounted for (42.2%), herding of animals (29.7%) while buying hay was (28.0%) (Table 4). The majority (80.5%) of the community emphasized that they move (mobility) with their livestock during droughts. Although most pastoralists own land, haymaking has not been taken up seriously with the majority of the pastoralists' relying on natural resources (Table 4). Herding was also practiced as a pasture management strategy by 29.7% of the respondents.

Table 4 Household pasture management strategies

Characteristic	Parameter	Percentage
Have animal feed reserves during the drought	Yes	24.9
	No	75.1
		100
Strategies used to manage pasture by the pastoralist	Herding	29.7

	Paddock grazing	42.2
	Buy hay	28.
		100
Most considered method of pasture management during drought	Paddocking	68.3
	Herd splitting	21.8
	Rotational grazing	8.5
	Migration	1.4
		100
Sources of feed during drought	Natural forage	81.3
	Use of concentrates	5.1
	Buy Hay	13.6
		100

The results of this study found that paddocking is the most preferred method of pasture management by the Kajiado pastoralists. This could be attributed to the flexibility of the method to accommodate the herds throughout the year. This assertion is supported by other researchers who reported the same results in various regions (Tawe, 2018; Korir, 2020). The adoption of rotational grazing by the pastoralists probably was because of its ability to allow vegetation and soil a resting time to recover, and to improve vegetation conditions hence enhancing conservation and production goals (Roche et al., 2015). Vecchio et al. (2019) also found that rotational grazing improved conditions of grassland containing halophytic steppe as opposed to continuous grazing. On the contrary, Augustine et al. (2020) found that the rotational grazing method is an adaptive strategy and improves the performance of both pasture and livestock.

Herding was also practiced as a pasture management strategy probably because herd mobility is restricted during droughts hence abled men move with the livestock in search of water and pasture. The preference for herding by the community could be attributed to the advantages of the herding such as low expenses for fencing or water supply, reduced manpower, hence lower cost of labor, uncontrolled livestock movement provides plenty of exercises and browses a variety of forages to maintain high nutrition and production level of animals, and provision of the livestock a stress-free environment. Moreover, the method could have also favored people with limited land size. The findings of this study are in agreement with the results of other researchers who found increased advantages of herding like improved management of pasture species (Molnár et al., 2020), better management of biodiversity (UNESCO, 2016), and improves sustainability and resilience of the pasture ecosystems (Riseth et al., 2016). Similarly, herders in northern Norway adopted herding as pasture management and adaptive strategy (Risvoll & Hovelsrud, 2016).

It was noted that buying hay was unpopular among the pastoralists because they do not conserve pasture before droughts and during rainy seasons. Moreover, this could be a result of the community over-relying on natural resources (Yala et al., 2020). This finding resonates with that of the study conducted in the Great Plains where buying hay was found to depict the preparedness of the pastoral communities but which was adopted to a lesser extent (Haigh et al., 2019). Buying hay offers the perfect opportunity for pastoral communities to cope and adapt to droughty situations (Salmoral et al., 2020). The pastoralist community in Kajiado could greatly benefit from storing hay and forage as a coping strategy during droughts as was noted in Mongolia (Hansson, 2020).

3.4 Relationship between pasture management and establishing feed reserves

The relationship between pasture management and establishing feed reserves (Table 5). There was no significant association (p=0.166) between understanding pasture management and the

establishment of feed reserves. This finding could be explained by the fact that the majority of the pastoralists did not reserve feeds as they depend heavily on natural grassland (Yala et al., 2020).

Table 5 Relationship between pasture management and establishing feed reserves

Understanding pasture management	Have established feed reserve		$\chi 2$	P
	Yes	No		
Yes	33 (9%)	117	1.196[a]	.166
No	55 (21%)	148		

There was no significant association between understanding pasture management and the establishment of feed reserves. This finding could be explained by the fact that the majority of the pastoralists did not reserve feeds as they depend heavily on natural grassland (Yala et al., 2020).

3.5 Pastoralists' sources of information on pasture management

The respondents obtain information on pasture management from different sources (Figure 2). Television (TV) was the most preferred (37%) source of pasture management information. The respondents also obtained information from mobile phones, radios, extension officers and NGO training (30, 16, 14 and 3%, respectively).

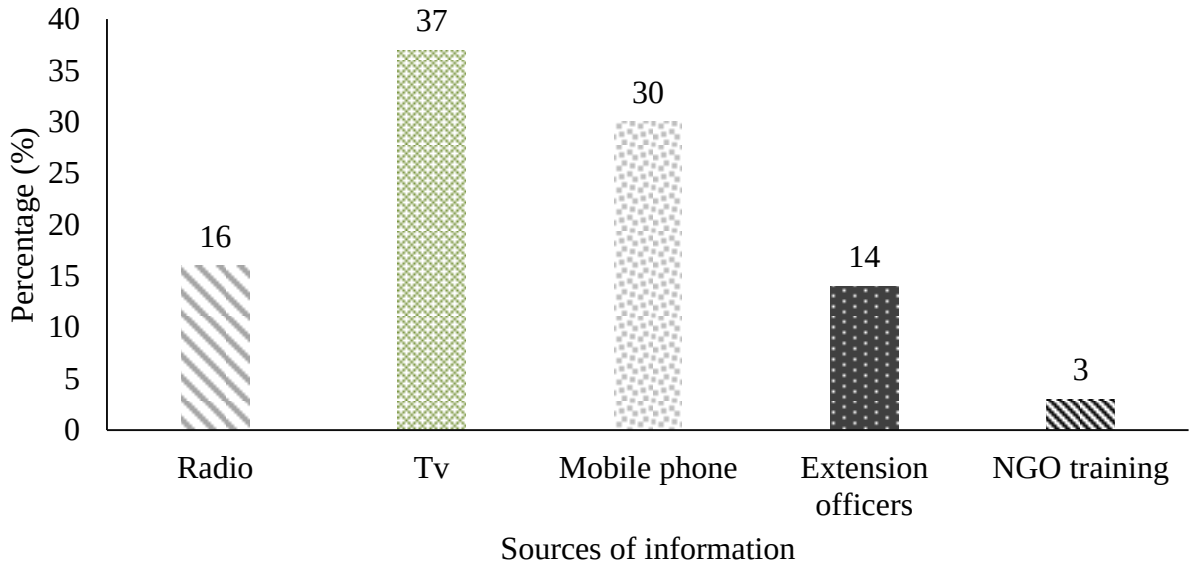

Figure 2 Household sources of information on pasture management

Pastoralists in Kajiado obtain pasture management information from both electronic sources and training from extension officers and NGOs. This could be attributed to improved infrastructure like network and electric connectivity in the County (Annemiek, 2018; Schrijver, 2019). Also, this could be associated with the improved accessibility of the County agricultural extension officers (Edwin et al., 2018). Given that Kajiado is among the vulnerable communities, the involvement of NGOs in training farmers could have been supported by an improved partnership between the Kajiado County Government and development partners (Haan et al., 2016). The NGOs play critical role in institutional development and shaping policy frameworks in pastoral regions (Ofoegbu et al., 2018).

3.6 Pastoralists' drought coping strategies

Pastoralists in Kajiado County have various coping

strategies towards the effect of drought (Table 6). The most popular coping strategy was varying livestock numbers to correspond with the diminishing forage (81%). The respondents suggested that this strategy is used to cope with the effects of drought. Only 19% did not regard this as a coping strategy, which they attributed to the changing reproduction rate (8%). The other popular strategy was breeding replacement stock (79%) as only 21% of the respondents viewed buying herds after the occurrence of drought as a coping strategy. The pastoralists use different sources of water that include boreholes, tap water and dam (73%, 26% and 1%, respectively). The study found the preference for forage types during droughty periods. The community has most preferred pasture was *Brachiaria humidicola* (97%) during the drought with *Pennisetum purpureum* Schumach only preferred by a few respondents (3%).

Table 6 Household drought coping strategies

Characteristics	Parameter	Percentage
Varied herd numbers to correspond with diminishing forage	Yes	81.3
	No	18.7
		100
Replenished/Restocked herd after drought	Bought	21.2
	Bred the replacement stock	78.8
		100
Sources of water for domestic use	Boreholes	73.4
	Tap water	25.5
	Dam	1.1
		100
Most preferred pasture species	*Brachiaria humidicola*	96.6
	Pennisetum purpureum Schumach	3.4
		100
Migration	Yes	29.7
	No	70.3
		100
Sustenance of female-dominated herds	Yes	68
	No	32
		100
Keeping different types of animals	Yes	56
	No	44
		100
Rotational grazing	Yes	71
	No	29
		100
Diversification of crops:	Maize	34.9
	Pearl millet	12.2
	Finger millet	11.4
	Sorghum	15.1
	Cowpeas	9.2
	Beans	17.2
		100

Pastoralists in Kajiado practice several coping strategies ranging from change in herd structure and management to diversification of livelihood, which entails crop farming. These diverse coping strategies could be associated with deliberate efforts

by the pastoral communities to build resilience and reduce vulnerability to the effects of climate change (Fava et al., 2021; Guye et al., 2019; Ndiritu, 2020; Ndungu et al., 2021). The migration with the herds could be associated with the desire by the pastoralists to sustain carrying capacity along the way. According to Guye et al. (2019), herd mobility enables the strategic use of resources and helps to reduce the effect of drought and dry spells. Mcguirk & Nunn (2021) suggested that migration probably ensures that the households retain the productivity of their livestock and the security of the family. The pastoralists probably prefer keeping female herds during droughts because of the production of milk for domestic consumption and an indicator of wealth. Similar results were reported by pastoralists in Kenya, not only in keeping female herds during drought, but also as an approach to meeting market demands (Mcguirk & Nunn, 2021). The results also showed that the community diversified into crop production with the drought tolerant crop varieties being the focus. These crops require minimal water resources and in agreement with studies done by Wilk et al. (2013) and Ncube and Lagardien (2015).

3.7 Variation in pastoralists' uptake of drought coping strategies

The study sought to determine how much variation in pastoralists' uptake of drought coping strategies could be explained by some socio-economic factors through linear regression analysis. The used were the number of animals owned; land ownership and understanding pasture management. The coefficients of parameters used to determine variation in pastoralists' uptake of drought coping strategies. Table 7 shows that the three variables are important factors in enhancing pastoralists' uptake of drought coping strategies. The regression equation revealed that the number of animals owned, land ownership and understanding of pasture management to a constant zero, pastoralists' uptake of drought coping strategies would be 0.475. However, understanding pasture management (0.184) has greater effect on pastoralists' uptake of drought coping strategies followed by number of animals owned (0.130) and lastly land ownership (0.108). This implies that embarking on either of the variations would improve pastoralists' uptake of drought coping strategies and hence minimize drought-associated losses among pastoralists.

Table 7 Coefficients of parameters used to determine variation in pastoralists' uptake of drought coping strategies

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.475	0.177		2.688	0.008
	Number of animals owned	0.130	0.070	0.166	1.861	0.015
	Land ownership	0.108	0.097	0.096	1.112	0.026
	Understanding pasture management	0.184	0.070	0.236	2.615	0.010

a. Dependent Variable: Uptake of drought coping strategies

The coefficients of the established regression equation are:

$$Y = 0.475 + 0.130a + 0.108b + 0.184c + €$$

Where: a - Number of animals owned

b - Land ownership in acres

c - Understanding pasture management

€ - Error term

Table 8 indicates that (61%) of the variation in pastoralists' uptake of drought coping strategies could be attributed to number of animals owned, land ownership and understanding pasture management strategies implying that the model is a good fit for the data.

Table 8 **Model Summary**

Model	R	R Square	Adjusted R Square	Std. The error in the Estimate
1	0.653[a]	0.611	0.608	10.63

a. Predictors: (Constant), Number of animals owned, Land ownership and Understanding pasture management

The general study objective was to evaluate rangeland pasture management strategies during drought among pastoralists in Kajiado County with focus on Kajiado East Sub County. The following were the results (i) The study findings showed the semi-arid region was inhabited by pastoralism and a mixed economy. Whereas mixed economy included rain-fed and irrigated agriculture, agro-pastoralism, tourism-related activities, and small businesses based on dryland products like beading. (ii) Marriage was highly regarded and most households were male-headed, education uptake was low with the majority of the studied population recording no formal education. In addition, studied nuclear families consisted average of six family members. The findings showed family size determined responsibilities and exposure significantly. It was further analyzed that the community under study kept livestock such as Goats, Sheep, Cattle and donkeys the least reared was poultry.

4. Conclusions

The study also found the areas were frequently hit by drought and water scarcity subjecting pastoralist communities to livestock deaths, decreased livestock production, low selling price, loss of family income and tribal conflict during migration and scramble for pasture. From the study, it was evident existing water resources were dams, boreholes few rivers and tapped water implying that the community lacked adequate water sources to cushion them during droughts. It was evident most pastoralists within the study area did not have enough knowledge of pasture management and this contributed to the low level of pasture conservation during periods of excess pasture. The frequently practiced pasture management strategies were traditional methods of herd tethering and migration. Few pastoralists practiced other pasture management systems such as paddocking, zero grazing and use of other supplementary feeds including hay. The study also showed pastoralists lacked adequate skills in pasture management strategies sighting lack of local training on best practices to enable the establishment of strong buffers for their livestock during drought.

In line with the study findings, the pastoralists needed to be equipped with training on modern range pasture management to enable them effectively preserve the excess forage as haymaking and silage-making strategies were not actively taken up during the rainy season to reduce the effect of drought because of limited pasture. The community should adopt modern water harvesting technologies to reduce the possibility of rivalry and conflict between and within communities arising from the limited water supply, especially during drought. In addition, the community should collaborate with local government and NGOs to provide financial support to the herders during drought in terms of mass purchase of their livestock to reduce losses experienced when animals die due to insufficient water and forage. There is a need to strengthen community traditional pasture management strategies by sensitization of pastoralists to modern practices.

Acknowledgments

Thanks go to the Calrose Investment Limited for providing financial support to the research.

Author Contributions

All authors contributed to the study's conception and design. Mikula R. performed material preparation, data collection and analysis. Mikula R. wrote the first draft of the manuscript and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript

Data Availability

Data and materials used in this work can be found in the journal databases

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