

A case study of the Handeni District (Tanzania) examining drought coping strategies and risk management among pastoralists based on livestock

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Abstract. Mwakalonge HL, Chingonikaya EE. 2023. A case study of the Handeni District (Tanzania) examining drought coping strategies and risk management among pastoralists based on livestock. *Intl J Trop Drylands* 7: 1-11. A case study was done to learn more about how pastoralists in the Handeni District, Tanzania, cope with drought. Drought poses a serious threat to pastoralists' way of life globally. The purpose of this research was to analyze and record data on the efficacy of livestock-based risk management and coping mechanisms in mitigating the negative consequences of drought. Despite the common belief that pastoralists can't make a living without their animals, there is a lack of information on how to make pastoral communities more resistant to drought and other dangers, information that is essential for any system of sustainable management. Many efforts have been made to deal with the drought, but it continues to worsen. Therefore, a cross-sectional research strategy was adopted to learn more about cattle risk management and coping strategies. Questionnaires, focus groups, and interviews with key informants were used to gather socio-economic information from 160 herders. Frequencies and percentages were calculated using a statistical software package for social sciences. A regression model was used for inferential statistics to establish a connection between the socio-economic status of pastoral households and the independent variable of interest. A negative correlation with age was found ($\beta = -0.451$; $p = 0.808$), a positive correlation with education ($\beta = 43.821$; $p = 0.497$), a positive correlation with family size ($\beta = 3.379$; $p = 0.50$), a negative correlation with marital status ($\beta = -53.979$; $p = 0.847$), and a positive correlation with the land area ($\beta = 58.898$; $p = 0.004$). Herd mobility positively influenced the socio-economies of pastoral households ($\beta = 91.749$; $p = 0.01$), as did the availability of an early warning system ($\beta = 316.537$; $p = 0.00$) and the timely availability of a market ($\beta = 11.516$; $p = 0.021$). A total of 3,666 animals out of 57,785 were lost due to the effects of the drought. The death rate was 6.34%.

Keywords: Drought, information, pastoral, socio-economies

INTRODUCTION

Drought seriously harms pastoral communities' ability to make a living (FAO 2001). People in low-income nations are four times more likely to die as a result of natural disasters such as drought, as shown by the research of Hardley (2006), Al-Rousan et al. (2014), Arouri et al. (2015), Hashim and Hashim (2015), Mohamed (2017), Zorn (2018), Barnes et al. (2019), Fatema et al. (2019), and Onuma et al. (2021). The researches show that the impacted region will double from 25% to 50% by the end of this century (Gaiha and Thapa 2006). Changing weather patterns look likely to increase the frequency and intensity of unfavorable weather events in low-income nations, as shown by the findings of the Munich (2006) and IPCC (2007) reports. It includes increased extreme climate events like droughts and floods (Christensen et al. 2007; Sunardi and Wiegler 2016; Fang et al. 2019; Asadullah et al. 2020). Turner (2000) asserts that pastoral households' access to cattle as a source of wealth significantly impacts their ability to prepare for and respond to drought and other threats. Economically, livestock can act as a buffer against food shortages brought on by drought, as the proceeds from selling animals are often used to buy food for human use.

Livestock is socially and economically vital to rural livelihoods, according to studies by ILRI (2006) and UNDP (2006), making it imperative to prioritize the sustainable use of the natural resource base that supplies them. Therefore, pastoralism is pictured as the most economically, culturally, and socially appropriate strategy for sustainable communities in dryland landscapes. That is because it is the only strategy capable of providing stable incomes, protecting ecosystem services, fostering wildlife conservation, and respecting cultural values and traditions simultaneously.

Tanzania's economy is highly dependent on pastoralism and agro-pastoralism. Pastoralists and agro-pastoralists provide most of the country's meat and milk, as evidenced by Homewood and Rodgers (1991) and Scoones (1992). According to the 2005 National Livestock Census, Tanzania is home to about 17 million cattle, 12.5 million goats, and 3.6 million sheep, making it the third most populous country in Africa south of the Sahara. Pastoralists and agro-pastoralists own over 98% of the national herd, or 16.7 million cattle. Tanzania slaughters approximately 1,500,000 cattle, 2,500,000 goats, and 555,000 sheep annually, yielding an estimated 335,000 tons of meat for the local market. Many live animal exports to nearby countries go unrecorded.

Only 3% of Tanzania's 3.7 million households are strictly pastoralists, whereas 7% are agro-pastoralists. It equates to roughly 370,000 houses or 2.2 million individuals. The resulting personal, economic, and environmental costs are unknown if these individuals were coerced out of pastoral production.

IPCC (2001) states that a fundamental factor of poverty, food insecurity, and environmental health in pastoral areas is the lack of effective risk management. Therefore, it is recommended that risk management be considered an essential aspect of a comprehensive approach to progress. Furthermore, for a risk management strategy to be successful, it needs to be integrated or linked to other initiatives aimed at rural development, food security, environmental preservation, and the reduction of poverty. Although the information on how to better prepare pastoral communities to deal with drought and mitigate associated risks is still few, it is essential to advance long-term drought management strategies (Benson and Clay 1998). Therefore, gaining insight into local community expertise, risk management practices, and drought coping strategies is crucial. Therefore, this research aims to evaluate and record data on drought-reduction strategies involving livestock-based risk management and coping mechanisms.

Even though various methods have been devised to mitigate the consequences of drought, they have had little success in the research region. Climate change, which will impact the region and, in particular, other parts of Africa and the world, is the root cause of the problem and is predicted to exacerbate it in the years ahead. Understanding the nature and dynamics of sensitivity to drought shocks in pastoral and agro-pastoral systems, as well as identifying livestock-based interventions (technical, political, and institutional) to reduce and cope with the crisis, will be aided by this study.

The goals of this study are as follows: (i) to locate areas of high risk due to drought's impact on livestock; (ii) to identify the socio-economic effects of drought; (iii) to investigate drought-response mechanisms and strategies; (iv) to evaluate the mechanisms and factors affecting the socio-economics of pastoral households; and (v) to evaluate the mechanisms' long-term viability.

MATERIALS AND METHODS

Study area

The Handeni District, Tanzania, served as the site of the study (Figure 1). The region was chosen because it had a high concentration of pastoralists and because there had been fewer studies on them than in other parts of Tanzania. The study included eight villages with four wards and two divisions.

Location

The Handeni District is located in Tanga's southwestern region. It is situated at an altitude of 600 to 1,000 meters above sea level and spans an area of 6,433 km². There were 248,633 people in the country per the national population census in 2002, with a 3.3% annual growth rate. It was predicted that 332,024 people would live there in 2011/2012. One of Tanzania's eight districts, Handeni, is surrounded by the Pwani Region to the south, the Kilindi District to the

west, the Korogwe District to the north, and the Pangani District to the east. Administratively, the Handeni District is divided into 112 villages, seven divisions, and 19 wards.

Most people live in poverty despite having enough land with the potential for high agricultural productivity, a generally favorable climate, sufficient rainfall, and a sizable labor force. It results from low levels of knowledge, technological advancements, insufficient infrastructure, unstable sources of irrigation water, a weak cash-selling network, and a dearth of dependable, cooperative organizations.

Socio-economic profile

Agriculture serves as the district's population's primary source of income. Around 93.1% of households, as per local government monitoring data from 2010, rely on agriculture for income, whether in cash or kind of it.

Agriculture

309,356 ha (48% of the district's total area) of the 643,300 ha total are potentially arable. Out of this, 92,809.5 ha are currently being used for crop production. Maize, beans, cassava, millet, cotton, sunflower, pigeon pea, oranges, coconut, bananas, and vegetables are among the crops farmed. A total of 3,124 ha of large farms having title deeds and 1,620 ha that have not been surveyed are also present. The primary crop grown on the estate is sisal. Crop markets can be found at Arusha, Tanga, and Dar es Salaam.

Livestock

There are 99,670 indigenous cattle, 735 improved cattle, 180,138 goats (of which 6,161 are improved breed), 17,728 sheep, 1,696 donkeys, 24,520 pigs, and 439,509 chickens in the district, making livestock the second most important production activity (11,099 are improved breed). The estimated 33,943 ha of potential range land can support 140,580 animal units per year based on the Handeni carrying capacity of 2 ha/AU/Year. The current population of Handeni is estimated to be 122,790 animal units, which does not include wildlife. Natural features include a mix of savannah woodlands and riverbank forests.

Environment

There are 37 forest reserves in the district, of which six are Local Authority Forests (LAFR), covering an area of 31,290.4 hectares, and 31 are Central Government Forests (CGRF), covering an area of 21,970.2 ha. Of the 37 forest reserves, 25 (43, 779.2 hectares) are active, while 13 (9,481 ha) are designated protected forests. However, the woodland region is in danger of disappearing because of unauthorized harvesting, widespread bushfires, mining, excessive grazing, and shifting farming.

Investment opportunities

Fruit farming, cattle ranching, sheep herding, beekeeping, honey processing, and mineral exploration are the primary areas of opportunity. The Zigua make up the majority (66.1%), followed by the Nguu (18.1%). The Maasai, a pastoralist people, is one of the other ethnic groups in the area, although their population estimate is not included in the documentation.

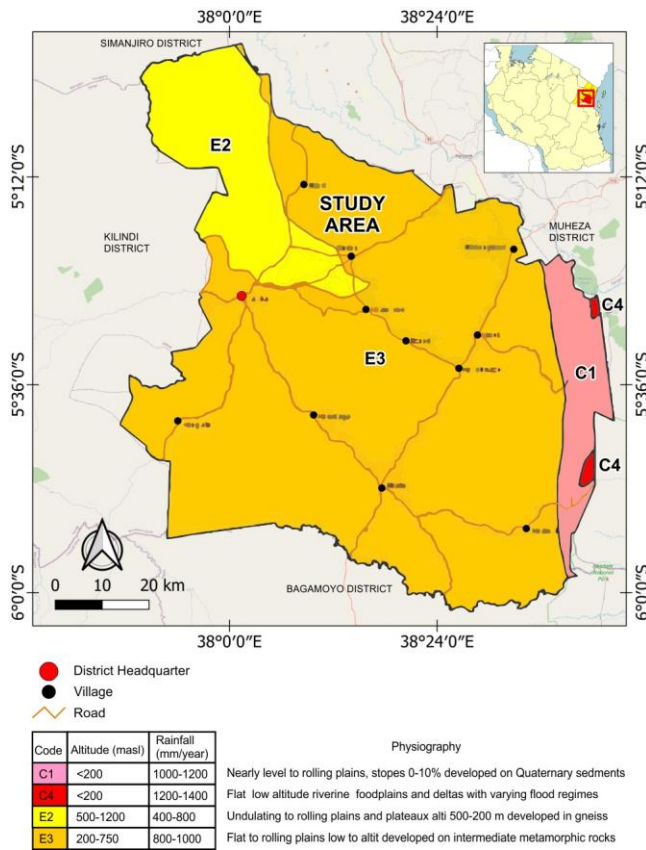


Figure 1. Map of Handeni district in Tanzania region showing the location of the study villages

Research design

All of the information for this study came from a single point in time, making it a cross-sectional study. This approach was chosen due to time, labor, and material constraints. Still more crucial because of the aims of the research.

Sampling procedure

The study included data from 160 randomly chosen pastoralists. The formula below, recommended by Kothari (1993), was used to estimate the appropriate size of the sample for the study.

$$n = Zpq/e^2 \text{ Where:}$$

Where:

n = Desired sample size (where the proportion is greater than 10,000)

Z is the standard normal deviate set at 1.96 (in a sample at 2.0), corresponding to a 95% confidence interval

p is the proportion in the largest population estimated to have particular characteristics

$$q = 1.0 - p$$

e^2 = degree of accuracy desired, usually set at 0.05 or occasionally at 0.01

Therefore, the total number of samples needed was $((1.96)^2 * 0.1 * (1-0.1)) / (0.05)^2 = 134$. However, to ensure the reliability of the data, 160 households were chosen

randomly. The household was chosen with the help of the local record. Households were used as the sampling unit.

Sampling technique

Two divisions, Chanika and Sindeni, were chosen at random within the district. Chanika, Kibaoni, Misima, and Sindeni are the four predetermined wards in the chosen division. Selected wards included Banju, Kilimila, Konje, Malezi, Msomera, Mbagwi Nzeri, and Sindeni, eight villages. Divisions, wards, and villages were selected based on their proximity to a large population of pastoralists. Twenty pastoralists were randomly picked from each community using a simple random selection procedure.

Data collection

Primary data

Primary and secondary data were compiled. Household surveys, focus groups, and key informant interviews were used to gather primary data. Household heads were given a questionnaire with open-ended and closed-ended items (Appendix 1). Each chosen village hosted two separate focus groups. Seven to twelve people of varying ages and sexes made up each group. A predetermined set of discussion questions served as a framework for the conversation. Key informants interviews are a phase of data collecting used to verify the accuracy of survey responses by speaking with community leaders, extension officers, and other village experts. After the questionnaire was distributed, we immediately began interviewing important informants. Preliminary testing was done to ensure that responders could comprehend the questionnaire and that it answered the research questions. After conducting preliminary tests, improvements were implemented.

Secondary data

This information was compiled from various resources, including the Handeni District Administration, published works about pastoralists, and village registries.

Data analysis

Analysis of the data was conducted using both quantitative and qualitative techniques. Descriptive and inferential statistics were employed for the numerical data. Descriptive statistics were applied to study socio-economic data. Descriptive statistics provided a snapshot of the outcomes by calculating percentages and frequency distributions. Furthermore, a regression model was used for inferential statistics to determine the connection between the socio-economic status of pastoral households and the inferred background variables' characteristics, management, and coping techniques. We postulate that some determinants positively affect the socio-economic status of pastoral households.

Following is a summary of the regression model:

$$SE(PHH) = \beta_0 + \beta_1(AGEHH) + \beta_2(EDULHH) + \beta_3(FSPHH) + \beta_4(MSPHH) + \beta_5(SPHH) + \beta_6(LOPHH) + \beta_7(MEPHH) + \beta_8(PSPHH) + \beta_9(MPPHH) + e_i$$

Where:

SE (PHH): the Socio-economies of pastoral households (Measured as the number of animals possessed)

β1 (AGEHH): Age of the head of household (in years)

β2 (EDULHH): Education level of head of household (in years spent in school)

β3 (FSPHH): Household size (measured in the number of families in the household)

β4 (MSPHH): Marital status (1 married, 2 Single, 3 Divorced)

β5 (SPHH): Sex of interviewed head of household (1 male and 2 female)

β6 (LOPHH): Land ownership (measured in the size of the land owned in acres)

β7 (MEPHH): Management practices (1 sedentary system and 2 nomadic)

β8 (HMPHH): Herd mobility (measured in the number of pastoralists migrated)

β9 (MAPHH): Market availability (Number of the available market in a specified year)

β10 (AEPHH): Availability of early warning system (1 available and 2 not available)

β(1-10): coefficient of the independent variables

e: random error

The SPSS software package was used to analyze the quantitative data statistically. After the data was analyzed, it was coded and prepared for use in achieving the desired goals. Focus groups and key informant interviews were used to gather qualitative data, which was then analyzed using structural content analysis.

RESULTS AND DISCUSSION

Household characteristics

Age, sex, education level, marriage status, and family size are just some of the household demographics covered here (Table 1).

Respondents' level of education

Findings showed that while 33.1% of respondents had completed primary school, 66.9% had only completed informal education. In this sample, no one who had completed secondary education responded (Table 1). The majority of respondents (66.9%) have only received an informal education. Yet, it does not prevent them from being aware of the issue of drought and its impact on their daily lives. Findings also showed that most people were aware of drought's root causes, warning signs, and preventative measures.

Nonetheless, many researchers have stressed the value of education as a tool for development. For instance, Bray (1996) found that people's awareness, attitude, and values improved with higher education levels, which could encourage them to manage natural resources sustainably. Education and training in natural resource management also boost productivity on the job. In addition, Adell's (2002) research found that education is crucial for alleviating poverty and ensuring full participation in

political life. Even though modern society relies on diverse skills, pastoralists are falling behind in education, and girls are particularly at risk. Adell's (2002) research suggests that pastoralists face unique obstacles to their educational participation due to mobility and isolation. Therefore, nations with considerable pastoralist populations that fail to invest adequately in their youth through education will fail to achieve the Millennium Development Goals they set for themselves and may face economic stagnation and even political unrest. Thus, it may be instructive for policymakers to devise novel approaches to elementary and secondary education and all fields of study that better prepare pastoralists for modern life and the fight against poverty. Countries with large pastoralist populations are less likely to meet their Millennium Development Goals; national economic development is slowed; rural economic diversification is impeded; and political unrest increases if pastoralist enrollment rates remain low and dropout rates remain high. The report also noted that education could help alleviate poverty by equipping pastoralists with the knowledge and skills necessary to expand their businesses and increase their income.

Economic development, improved child health, lower mortality rates, and democratic governance are all strongly correlated with higher levels of education. However, pastoralists cannot increase their productivity in the field or diversify their livelihoods beyond their habits, trapping them in a cycle of poverty. That is difficult to break free of without education. In addition, a lack of education exacerbates gender inequality in the wider society.

In a world where poverty and insecurity are the norms, growing marginalization of pastoralists has already translated into political unrest. Therefore, strategies are required for all levels of education, learning, and skill acquisition that help pastoralists deal better with economic diversification, rising productivity, and the state. Furthermore, a comprehensive plan like this must consider the differences between the sexes, not just in age, and address the needs of both children and adults (Krätli 2000).

Percentage of male and female respondents

As seen in Table 1, the vast majority of respondents (85.0%) were male, while only 15.0% were female. It demonstrates that most women were engaged in other pursuits at the time. Niamir-Fuller (1994) argues that women's views, experiences, and needs are often overlooked in decision-making. Despite their significant contributions to pastoralism in areas such as childrearing, household management, disease treatment, animal care, water management, and the provision of building materials, fuel wood, and other resources.

Distribution of respondents by marital status

More than ninety-nine percent (99.4%) of those who responded were married, while only 0.6% were single (Table 1). This finding suggests that most people living in the study area were of adult age.

Table 1. Socio-demographic characteristics (n=160)

Variables	Freq.	Percent
Respondents' level of education		
Informal education	107	66.9
Primary level	53	33.1
Secondary level	0	0.0
Percentage of male and female respondents		
Male	136	85.0
Female	24	15.0
Marital status of the respondent		
Marriage	159	99.4
Single	1	0.6
Divorced	0	0.0
Family size of pastoral household		
1-4	13	8.1
5-9	59	36.9
10 and above	88	55.0
Age categories		
Below 20	1	0.6
21-40	61	38.1
41-50	42	26.3
Above 50	56	35.0
Land ownership		
Yes	102	63.75
No	58	36.25
Justification of the land		
Owned with title deed	84	52.5
Owned without a title deed	76	47.5

Family size of the household

About 36.9% of all households contained 5-9 people, while 8.1% comprised only 1-4 people. The remaining 55% of households consisted of 10 or more people. The average number of people living in a home was 10.76 (Table 1). An average of 4.8 was recorded in 2007's version of the household budget survey, so this is significantly higher (URT 2007). One possible cause of diversity is human migration.

Age of respondents

It was found that 38.1% of respondents were between the ages of 21 and 40, and 26.3% were between the ages of 41 and 50. About a third, or 35.0%, were aged 50 and up. Very few (0.6%) were in the 18-20 age range (Table 1). As a result, there should not be a shortage of people to help with livestock risk management initiatives, as most household members are of working age.

Legal land ownership

According to the findings, 63.75% of those surveyed own land, while 36.25% do not. The data also shows that 52.5% of landowners have a title deed issued by their village, while 47.5% do not (Table 1). In support of this view, Nori et al. (2008) contend that local institutional structures and governance have historically prevented a "tragedy of the commons" on most pastoral lands.

Identification of livestock-based risk areas associated with drought*Livestock based- risk areas*

According to the results, 11.9% of respondents attribute livestock losses to a rise in deaths and inadequate feed

resources in the risk areas. In comparison, 6.3% attribute an increase in poverty and conflicts between humans and wildlife to these factors. The remaining 45.6% indicates an increase in sickness and resource scarcity. Table 2 shows that the remaining 36.3% of respondents consider livestock losses, inadequate feed resources, human-wildlife conflicts, and increasing poverty the most significant livestock-based risks associated with drought. According to a study conducted by the International Livestock Research Institute (ILRI) in 2006, risk management in the livestock business necessitates a mix of risk reduction and financial techniques. In light of this, it is essential to supplement Pastoral and herd management with financial mechanisms that give herder households access to quick cash in the aftermath of a disaster.

Livestock-based risk absorption mechanisms

Half of the respondents think there should be a system for setting aside grazing land to be used in times of extreme poverty and splitting up huge herds into smaller groups. While another 20% think there should be a system ready to alert pastoralists of developing drought conditions. Five percent more say insurance should be used instead. Twenty-five percent of respondents suggested using all three approaches together (Table 2).

A 2006 study by the International Livestock Research Institute (ILRI) found that it takes a combination of risk mitigation and financial approaches, such as providing credit (providing liquidity after the disaster) and insurance against livestock death due to drought, to manage risks associated with livestock effectively. As a result, it seems reasonable to propose that a combination of risk avoidance, risk management, and risk adaptation strategies is necessary for an efficient livestock-based risk absorption mechanism.

The two most important reasons to keep track of their livestock are disease prevention and the ability to save grazing land in the event of a severe drought. Both of these highlight the need to register their livestock as a form of risk management. In addition, better drought-mitigating treatments and institutionalization of local, national, and regional livestock early warning systems can be informed by identifying livestock-based solutions in risk management and dealing with climate shocks, as shown by Gaiha and Thapa (2006). It will enable pastoral and agro-pastoral households to protect their animals and climate shocks better.

Table 2. Livestock based-risk areas (n=160)

Variable	Freq.	Percent
Livestock based-risk areas		
Livestock losses and insufficient feed resources	19	11.9
Human-wildlife conflicts and increased poverty	10	6.3
Increased diseases and competition in resource use	73	45.6
Everything mentioned above	58	36.3
Livestock-based risk absorption mechanisms		
Conservation of grassland and separation of herds	80	50
Provision of early warning, timely market	32	20
Insurance	8	5
Everything mentioned above	40	25

Socio-economic effects of drought

Out of 57,785 animals owned by respondents across villages, 3,666 reported died that year due to drought, or an average of 22.91 animals per family. The range for the number of animals reported dead was between 3 and 110. The death rate was 6.34% (Table 3).

Cattle losses per household per year

Table 4 shows that 60.6% of cattle deaths occurred when more than 15 animals were in a home, 12.5% when 11-15, and 26.9% when there were 1-10 deaths annually. Therefore, the expected loss of income due to mortality was calculated as 41,949,000 TAS. That amount is equivalent to what would have been created if animals had not perished because of drought effects.

Distance tranced in looking for water and pasture

The results suggest that 39.1% of pastoralists traveled more than 10 kilometers in search of pasture and water, while 24.2% traveled between six and ten kilometers. The remaining 36.0% traverse between 1 to 5 km (Table 4).

Availability and affordability of health services during drought

Regarding the availability and affordability of health care, around 71.4% indicated that services were available but expensive, while 26.1% indicated that treatments were neither available nor affordable. 1.9% of respondents stated health services were accessible and cheap (Table 4).

The abovementioned condition affected the number of deaths, leading to income loss and other socio-economic and cultural effects. It is corroborated by research conducted by Rothauge (1998), who found that drought significantly impacts the socio-economic conditions of pastoralists. Furthermore, according to another study conducted by IPCC (2001) and URT (2003), the mortality of vast numbers of livestock owing to a shortage of water and pasture has been a recurring event in Tanzania over the past few years, jeopardizing the livelihood of the country's pastoralists.

Pastoralist vulnerability to drought

About 74.4% of respondents think pastoralists are more vulnerable to drought than the general population. It is because drought has a profound impact on both animals and humans, leading to high rates of animal mortality, decreased milk production, and increased food insecurity. About 10% of respondents reported being vulnerable to severely affecting animals and humans, and another 15% reported being vulnerable to animal deaths, decreased milk production, and subsequent food instability (Table 4). The research of Patrick (2003) lends credence to this idea since he found that a population's sensitivity to a decrease in its standard of living when a change in the productivity of the area's natural resources was directly proportional to the degree to which the people relied on those resources.

The socio-economic value of pastoralism

Concerning the socio-economic values, the findings revealed pastoralist activities are the main source of income from livestock and meat, skin, hide, and milk sales (6.3%).

Furthermore, for social and cultural values (14.4%) and the rest of the respondents (79.4%) reported that pastoralist activities were the source of income and could be used as social and cultural values. Only 14.4% of respondents said they relied on money from pastoralist activities for social and cultural purposes, but the remaining 79.4% said the same (Table 4).

Consequences of drought effects

Respondents indicated drought had led to the deaths of 1.9% of animals, 11.9% of people going hungry, and 5.6% of humans getting sick. The remaining 80.6% stated that the consequences of drought include animal deaths, human hunger, food insecurity, and the spread of animal and human diseases (Table 4).

Reasons for keeping animals

Furthermore, 7% of respondents said they kept animals for subsistence (milk, meat, and blood), and 11% said they kept animals as a form of capital. While 23% said livestock is an important store of wealth and insurance, 56% said they kept animals for all three reasons (Table 4).

Hogg's (1997) research, which found that pastoralists preserve animals for various reasons, gives credibility to these conclusions. In addition to serving as a source of food (milk, meat, and blood), transportation (cattle, donkeys, and camels), and a valuable financial and security asset, livestock constitutes a sort of productive capital. Because they are vulnerable to drought and illness impacts, they may not be a perfect type of insurance. To many herding families, however, it is the only type of insurance available due to the lack of alternatives, particularly in financial markets and organizations. Animals may be slaughtered for food, but they are typically sold to generate income to purchase grain and other staples. Social institutions like marriage and inheritance reflect the storage of capital/wealth in animals. A man's wedding is the largest exchange of livestock they will make in his lifetime. Therefore, livestock is a status symbol and a means of participating in intricate social duty and reciprocity networks that reduce vulnerability (particularly for poorer households).

Table 3. Amount of cattle owned and amount of cattle that died due to drought (n=160)

	Amount of cattle owned	Amount of cattle that died due to drought
N = 160	160	160
Mean	361	23
Median	220.00	20.00
SD	356.024	17.071
Variance	126753.051	291.426
Minimum	30	3
Maximum	2000	110
Sum	57785	3666

Table 4. Socio-economic effects of drought (n=160)

Socio-economic variables	Freq.	Percent
Cattle lost in amount per household per year		
1-10	43	26.9
11-15	20	12.5
above 15	97	60.6
Distance traced in looking for water and pasture (km)		
1-5	58	36.0
6-10	39	24.9
>10	63	39.1
Pasture availability in terms of quality		
Available but dry	69	42.9
Not available at all	91	57.1
Availability and affordability of health services		
Not available and not affordable	42	26.1
Available but not affordable	115	71.4
Available and affordable	3	2.5
Pastoralist vulnerability to drought		
Both animals and Human beings are severely affected	16	10.0
The animal dies, and low milk production hence food insecurity	25	15.6
Everything mentioned above	119	74.4
The socio-economic value of pastoralism		
Livestock and meat sales (income)	10	6.2
Social and cultural values	23	14.4
Everything mentioned above	127	79.4
Consequences of drought effects		
Death of animals	3	1.9
Hunger and food insecurity	19	11.9
Diseases to animals and human beings	9	5.6
Everything mentioned above	129	80.6
Reason for keeping animals		
Provide for subsistence (milk, meat, and blood)	12	7.5
Form of productive capital	19	11.9
Serve as an important store of wealth and insurance	38	23.8
Everything mentioned above	91	56.9

Examining coping mechanisms and strategies against drought *Respondent's response on drought management and coping mechanism*

According to the findings, every responder had felt the drought's effects. More than 86% of responders indicate that drought conditions remained from October to January annually. Roughly 66% of pastoralists attribute the drought to negligent farming and the felling of trees for charcoal and other purposes. Respondents predicted it using indicators such as dry riverbeds, dams, and tree foliage (63.9%). The data also shows that 95% of herders considered the absence of rain, well water, dam water, and pasture signs of a drought.

The results show that 13.1% of pastoralists looked at a wide variety of drought-tolerant plant trees, 3.8% forecast drought by examining leaves in selected trees, and 20% predict drought when there is a severe dry spell during the short rain season (Table 5).

Coping mechanism adopted

About 66.9% of respondents engaged in Nomadic pastoralism as a means of survival, whereas 1.2% separated large herds of animals into smaller ones and dispersed them to different areas. The remaining 31.9% used migration and

subdividing their animal populations (Table 5). Research by Ndikumana et al. (2000), who stated that Pastoralists routinely migrate with their livestock in search of pasture and water, is consistent with these findings. It is also claimed that traditional pastoral mobility led to the most efficient use of available natural resources by taking advantage of seasonal and geographical differences in the rainfall pattern and forage availability and selecting areas where the forage was most nutritious. As a result, climate-dependent hazards like drought and disease or insect outbreaks can be avoided, making this a useful risk management tool. Additionally, pastoralism helped to avoid the overexploitation of natural resources by reducing the concentration of livestock in one area. That would lead to biodiversity conservation. As a result, pastoralists and their livestock require a great deal of resource utilization mobility to respond to temporal and spatial variation in the distribution and quantity of rainfall and forage (Homewood and Rodgers 1991). Finally, the ability to move around helps pastoralists control the spread of disease by allowing them to avoid areas of infestation (Shem et al. 2005).

Limitations of the adopted mechanism

It was discovered that 63.1% of respondents found the mechanism to be limited because it leads to social disputes with farmers, 16.3% found it to be limited in their ability to access social services, and 2.5% found it to be limited in their ability to own land. In addition, some 18.1% of respondents said the process has drawbacks, such as escalating tensions between farmers, making it hard for them to access social assistance, and making land ownership problematic (Table 5).

Pastoral system practiced

For the pastoral system practiced by the respondents in keeping animals, 33.8% reported practicing the Nomadic system, while 66.2% reported practicing the sedentary system. No respondent practiced the transhumance system. The finding indicates that 87% of the respondents reported that the nomadic system has the advantage that it optimizes the available resources and avoids over-exploitation of the land. However, the system adopted was reported to have the disadvantage of resulting in social conflict with farmers (63.1%), difficulty in owning land (2.5%), and limited acquisition of social services because of mobility (16.3%). The rest, 18.1%, indicates that the system had a disadvantage because it resulted in conflicts with farmers, difficulty in owning land, and limited acquisition of social services (Table 5).

This finding is supported by the study by Shem et al. (2005). They argue that increasing poverty due to reduced mobility, lack of alternative livelihoods, confused and competing rights and entitlements, poor provision of basic needs, and increasing human and livestock populations aggravate conflicts. For example, surveys (by Shem et al. 2005) in his study show that the number of cattle in Tanzania has already surpassed the normal carrying capacity in most areas. In addition, increasing land scarcity and conflicts of interest between land users in these and other areas have implied that many people have migrated in search of arable land and pastures elsewhere.

Table 5. Respondent's response on drought management and coping mechanism (n=160)

Experience of drought	Freq.	Percent
Yes	160	100
No	0	0.0
Causes of drought reported by the respondent		
Clearing of forest cover for charcoal production and other purposes	51	31.9
Ineffective methods of farming	10	6.3
Everything mentioned above	99	61.8
Drought signs, as indicated by the respondent		
Drying up of water sources such as rivers, reservoirs, and wells	54	33.8
Dry tree leaves	4	2.5
Everything mentioned above	102	63.7
Perception of drought as reported by the respondent		
One year without rainfall	1	0.6
When rainwater, wells, and dams are dry	60	37.5
When pastures are dry	7	4.4
When 2 and 3 apply	92	57.5
The most common month of drought in a year		
October to January	138	86.2
Other time	22	13.8
The reason why pastoralists are more vulnerable to drought		
Both animals and Human beings are affected	16	10.0
Death of animals, low milk production hence food insecurity	25	15.6
Everything mentioned above	119	74.4
Local knowledge used by pastoralists in predicting drought		
Scheduling of leaves in some plant trees	6	3.8
Heavy dry spell during Vuli season	32	20.0
All 1 and 2 above	101	63.1
Identification of a wide variety of tolerant plant	21	13.1
Coping mechanism adopted		
Migrating to look for pasture and water	107	66.9
Splitting of animals into smaller groups	2	1.2
Everything mentioned above	51	31.9
Limitations of the adopted systems		
It can result in social conflict with the farmer	101	63.1
Difficult in owning land, predators	4	2.5
Limited acquisition of social services because of the system	26	16.3
Everything mentioned above	29	18.1
Pastoral system practiced by the respondents		
Sedentary	106	66.2
Nomadic	54	33.8
Transhumance system	0	0.0
Advantages of the Nomadic system		
Possible to optimal utilize the available resources	61	38.1
It avoids over-exploitation of the land	2	1.3
It exploits different areas of vegetation types and productivity	10	6.3
Everything mentioned above	87	54.3
The disadvantage of the Nomadic system		
It can result in social conflict between farmer	101	63.1
Difficult in own land	4	2.5
Limited acquisition of social services	26	16.3
Everything mentioned above	29	18.1
Assistance from the government		
Receiving assistance from the government	44	27.5
Not receiving assistance from the government	116	72.5

Is a financial institution has anything to play?		
Yes	160	100
No	0	0.0
The role needed to play		
Provision of credit to pastoralists	115	71.9
Insuring pastoralists when a situation of drought occurs	45	28.1
Pastoralists' opinion on local institutions		
Community-based pastoral associations are established	159	99.4
Others	1	0.6

Additionally, the growth of the livestock population has led to increased movement of large herds of livestock to areas that traditionally had a few livestock, such as Mbeya, Iringa, Morogoro, Rukwa, and Coast Regions, creating serious land use conflicts. Worse, as they lose their land, some pastoralists become sedentarized. In contrast, others migrate to new areas often occupied by crop farmers, resulting in conflict and sometimes violence, particularly over the allocation of land and water resources.

In addition, Shem et al. (2005) argue that sedentarisation, for whatever reason, without good planning and transfer of appropriate livestock management techniques, extension services, and good livestock marketing systems, tends to affect pastoralists and the environment negatively.

Government interventions

On government interventions in assisting pastoralists during drought seasons, the results indicated that 72.5% of the respondents didn't receive any assistance from the government, while only 27.5% reported getting assistance in the construction of check-dams and wells (Table 5).

These results show that the government takes little effort to assist pastoralists with drought. A study by Thompson (1992) stated that it is the role of government to support in movement of livestock, provision information where forage is available, and management of conflicts concerning access to key resources (water points, forage), support the marketing of livestock to ensure purchasing power and avoid waste of assets; provision of food aid to relieve pressure on food prices and supply grain directly to pastoral populations; subsidies and price control, and to ensure pastoralist a minimum of purchasing power in the context of selling animals, buying food, health, and nutrition support, and to control disease outbreaks and to protect the nutrient status of vulnerable groups. Furthermore, the study pointed out that the government should put more emphasis on conducting veterinary campaigns to avoid large-scale livestock deaths due to outbreaks of contagious animal diseases during drought. The study concluded by saying there is a need to build a successful program to reduce pastoral risk and vulnerability by creating new strategies to enhance the ability of herders and herder communities to manage risk.

Financial Institutions interventions

On financial institutions aspects, all (100%) of the respondents reported that financial institutions had a great role to play in improving the livelihood of pastoral households. About 71.9% of the respondents said the role financial institutions need to play is to provide them with credit. In comparison, 28.1% of the respondents said financial institutions need to assist in ensuring pastoralists when drought occurs (Table 5).

Toulmin's (1995) research corroborates this idea by showing that governments should investigate the most effective means of establishing and administering emergency funds for natural disaster relief, such as readily available stand-by funds. To further expand agricultural banks, microfinance programs, private financial institutions, and financial incentives for risk management, he explains that the government should establish an economic and legal climate and institutional support that is friendly to their development. The need for central government and donors to assist is reduced, self-reliance is encouraged, and dependence is reduced if pastoral groups can create formal or informal savings and/or insurance.

Katani (1999) noted the importance of understanding national policies and legal frameworks for credit union development and micro-finance in the African pastoral context, as well as whether or not NGOs and CBOs pastoral associations are interested in or involved with developing credit, finance, and savings institutions and providing management and training. In India and Bangladesh, for instance, microfinance is successful for livestock production, and extremely low-income households (typically headed by women) prefer to invest their loans in livestock rather than crops. Investment in livestock has been shown to result in the growth of other assets in the long run. Therefore, to lessen the effects of drought and finance post-drought recovery, more research on the prevalence of informal banking and credit arrangements is necessary, as is an increase in the potential for the formation of savings clubs and micro-credit. Investigate herd dynamics to learn if there is a surplus of unproductive animals in the years between droughts, and check if conventional savings accounts can grow fast enough to compete with livestock output (over the drought cycle). Before banking and credit can be safely brought to these societies, a more nuanced understanding of ownership, wealth, and private, communal, and commercial assets among pastoral households is required.

Local institutions

About 99.4% of respondents agreed they would feel more represented and empowered if local institutions were created (Table 5). Davies (1993) found that establishing local institutions that use a bottom-up risk management planning mechanism was an essential first step in meeting the needs of herders and communities. This method would supplement the predominant top-down planning approach. As a result, the planning process for risk management should include input from herder's representatives, community leaders, and representatives of herder cooperatives.

Impacts of the mechanisms and factors influencing socio-economics of pastoral household

The analysis found that age had a negative effect on the socio-economics of pastoral houses ($\beta = -0.451$; $p = 0.808$), while education level had a positive but insignificant effect ($\beta = 43.821$; $p = 0.497$), family size had a positive but insignificant effect ($\beta = 3.379$; $p = 0.50$), marital status had a negative effect ($\beta = -53.979$; $p = 0.847$), and the land area had a positive. Additionally, the results show that early warning systems ($\beta = 316.537$; $p = 0.00$), the availability of timely markets ($\beta = 11.516$; $p = 0.021$), and herd mobility all have a positive and significant effect on the socio-economics of pastoral households. Positive and statistically significant is the pastoralist system ($\beta = 316.537$; $p = 0.00$). The findings imply that demographic factors such as age, education, marital status, and family size do not influence drought risk management strategies or coping mechanisms. Drought risk management and adaptation mechanisms depend on land area, herd mobility, pastoral system, timely market access, early warning system, and insurance (Table 6).

According to the data, herd mobility improved the total number of animals, which helps more animals make it through drought by better using the available resources. It also helps lessen the likelihood of disease outbreaks and prevents the wasteful concentration of livestock in any given area. When pastoralists are aware of the drought situation, they can unload the unproductive stock by selling them at good prices, ensuring that they are financially stable in terms of income, food security, and the affordability of social services. So it is because the results for the availability of the market and early warning information show a strong relationship between the two ($p = 0.021$). Access to pasture, water, animal health, market, credit, and education are crucial to pastoral communities' overall socio-economic well-being.

According to the results, pastoral risk management is a coping strategy that can improve environmental health, increase food security (meat, milk, and cash), and decrease poverty due to income from livestock sales and other byproducts (reduce land degradation). In addition, maximizing livelihood from pastoral livestock production through risk management can do so without jeopardizing the long-term viability of the resource base. Therefore, reducing poverty, ensuring adequate nutrition, and protecting the environment are all directly linked to effective risk management for pastoralists. Furthermore, the analysis shows the following strengths of the adopted mechanism: it is possible to manage disease risks by avoiding infested areas, and it effectively utilizes marginalized land (arid and semi-arid land); the mechanism reduces the loss of animals because of the effective utilization of resources, taking temporal and spatial variation in the distribution and quality of rainfall and forage into account, as well as the nutritional status of forage; however, the analysis also indicated that there is a trade-off between these strengths. However, with the ability to sell animals, people now have access to much-needed funds to meet basic social needs such as paying for tuition or medical bills.

The research also found that better product pricing and distribution are linked to higher incomes. The study also discovered that improving the quality of extension services could lead to higher pastoral income thanks to better animal health. The research also indicated that women might spend less time looking for water if they conserved it, freeing them up to participate in other income-generating activities and improve their living standards.

Assessment of the sustainability of mechanism on the socio-economies of pastoral households

Land ownership, market access, financial institution availability, information availability, and technological adoption were the metrics used to determine the long-term viability of the mechanisms. Approximately 70% of respondents evaluated the chosen mechanism as not sustainable due to issues with land rights, market access, information accessibility, trustworthiness with financial institutions, and technological accessibility. In comparison, 30% rated it sustainable due to its positive effects on the environment and animal survival (Table 7).

These findings are consistent with those of Ganya et al. (2004), who argued that sustainable development goals could only be attained if pastoralism is founded on a set of good pastoral management practices that combine policy consideration, management tools, and economic and financial instruments. Furthermore, for example, integrating indigenous knowledge, innovation, and practices; securing land right; forecasting technology to improve market access for sustainable development; and so on.

Results from the focus group discussion and key informants

The qualitative data was gathered from people who shared similar thoughts and attitudes. Women and children were identified as the most vulnerable category in the focus

group because they are forced to travel large distances in search of water for domestic use and because youngsters cannot consistently attend school due to mobility.

Loss of animals, inaccessible grazing areas, and a lack of watering holes were other negative outcomes of the drought. The created groups agreed that preventing poverty, which can result in food insecurity and environmental degradation, is best achieved by carefully managing pastoral risk. Almost all those who participated in the survey said that government assistance in the form of check-dams and other water sources would help reduce water scarcity in the area under investigation. Most respondents also agreed that if pastoralism is well managed, it may help enhance pastoralists' livelihoods and cut poverty.

Moreover, to add insult to injury, the majority demanded that the government find legitimate places for herders to graze and farmers to plant crops. They believe this will lessen the tensions between pastoralists and farmers over scarce land. According to the data gathered from our key informants, drought is getting worse in comparison to previous years. Therefore, all agree that the following actions should be implemented. First, however, the majority recommend spreading information about drought's origins and the steps that can be taken on a personal and societal level to mitigate its consequences. In addition, the vast majority agreed that legitimate grazing and farming property should be strategically located using sustainable land management practices.

Governments, with the assistance of extension officials, should establish a system for calculating the carrying capacity of land concerning the stocking rate, which would prevent overgrazing and the subsequent depletion of natural resources. They also advocated for the education of pastoralists on the significance of limiting the number of animals following the available terrain to maximize output.

Table 6. Impacts of the mechanisms and factors influencing socio-economies of pastoral households (n= 160)

Variables	Unstandardized coefficients	BETA error	t	P value
(Constant)	-377.035	325.884	-1.157	0.249
Herd mobility	91.749	26.821	3.421	0.001
Pastoral systems	316.537	60.252	5.254	0.000
Age of respondent	-.451	1.854	-0.243	0.808
Marital status of the respondent	-53.979	279.482	-0.193	0.847
Education level of the respondents	34.821	51.113	0.681	0.497
Ownership of land	58.898	69.971	0.842	0.401
Size of the land	2.854	0.970	2.942	0.004
Number of the family of the respondent	3.379	5.002	0.676	0.500
Timely market, early warning system, and insurance	11.516	23.266	0.495	0.021

Note: SS = 202228571.445; MS = 995904.383, df = 9; F = 13.261 P<0.05), R² = 44.3

Table 7. Assessment of mechanism in terms of sustainability (n= 160)

Assessment of mechanism in terms of sustainability	Frequency	Percentage	Ranking
Land right, market, financial institutions, information, and technology	112	70.0	Not effective
Land right, market, financial institutions, information, and technology	48	30.0	Effective

Several measures were taken at the District level to mitigate the consequences of the drought, including more Chaco dams being built (Lambo). A total of 30 dams have been built, using materials sourced from various settlements and livestock dips around the district. Another tactic was to educate pastoralists on land use management and land tenure systems and resolve conflicts with farmers. That was reportedly supported by Care International's Pastoral Management Project and Enviro-care. The community agreed that a policy of herd reduction based on carrying capacity should be implemented.

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