

Farmers-Pastoralists Perceptions on Climate Change in Mvomero District, Tanzania

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Abstract

This study investigated the perceptions of farmers and pastoralists regarding climate change in Mvomero District, Tanzania. Data was collected using questionnaires, interview, Focus Group Discussions and documentary literature review. A total of 391 heads of households were surveyed, and 26 key informants were interviewed constituting four Village Chairpersons, four Village Executive Officers (VEOs), four Heads of Village Security Committees, four Village Agricultural and Livestock Officers (VALOs), four Ward Executive Officers (WEOs), the District Executive Director (DED), and the Officer Commanding District of Police (OCD). The study aimed to underscore local perceptions of climate change, identifying the impacts on agricultural practices, and evaluating adaptive strategies employed by the study communities. The findings revealed that both farmers and pastoralists perceive climate change as a significant threat to their livelihoods. Adaptation strategies implemented include altering planting dates, diversifying crops, improving water conservation techniques and integrating livestock with crop farming. Despite these efforts, several barriers to effective adaptation persist, including limited access to climate information, inadequate financial resources and insufficient support from local government and extension services. The study emphasizes the need for tailored interventions that enhance adaptive capacity and resilience. Policy recommendations include improving access to timely and accurate climate information, strengthening local institutions, and promoting community-based adaptation strategies.

Keywords: Adaptive strategies, climate change, farmers, pastoralists, perceptions, Mvomero District, Tanzania

1.0 INTRODUCTION

Climate change poses significant challenges to and pastoral systems with its effects in the regions heavily relying on natural resources for their livelihoods. In Mvomero District, Tanzania, both farmers and pastoralists experience increasingly unpredictable weather patterns, prolonged droughts and extreme rainfall events. These climatic changes exacerbate competition for scarce resources such as land, pasture and water, heightening tensions and conflicts over land and water use (Msangi, *et al.*, 2016). Despite the clear evidence of climate change and its impacts, there remains a critical gap in understanding how local communities perceive these changes and the strategies they adopt to

cope with. Farmers and pastoralists, whose livelihoods depend directly on natural resources, offer unique and essential perspectives on the shifts in climate patterns. These perceptions influence their adaptive strategies, which can either mitigate or exacerbate the impacts of climate change and resource-based conflicts (Jeckoniah *et al.*, 2015).

Recent studies indicated that perceptions of climate change among farmers and pastoralists vary significantly, shaped by socio-economic status, access to information, and traditional knowledge systems (Detges, 2020; Nyong & Fiki, 2021). However, there is limited empirical data on these perceptions in the specific context of Mvomero District. This lack of localized understanding impedes the development of effective, culturally appropriate adaptation and conflict resolution strategies. Globally, the impacts of climate change are well-documented through scientific data and long-term observations. Phenomena such as changes in rainfall and wind patterns, drought conditions, extreme storms, temperature fluctuations, rising sea levels, and desertification have been recorded in various parts of the world (Twinomugisha and Mushy, 2019). Understanding local perceptions of climate change, particularly among rural communities, is crucial for developing effective adaptation strategies and mitigating conflicts arising from environmental changes.

In Tanzania, studies have shown that farmers and pastoralists are increasingly aware of changes in weather patterns, although their responses and adaptations differ significantly (Mwangi & Dohrn, 2019). The study by Kashaigili *et al.* (2021) found that most farmers in Mvomero District recognize climate change as rising temperatures and irregular rainfall patterns. These changes negatively affect crop yields, water availability, and soil fertility, which are very crucial for agricultural practices. Addressing barriers such as limited access to information and resources is essential for supporting sustainable agricultural practices in the district.

Similarly, Msuya *et al.* (2020) highlighted that, pastoralists in Mvomero District exhibit high levels of awareness regarding climate change, noting increased frequency of droughts and unpredictable weather patterns. Pastoralists perceive climate change as adversely affecting livestock health, pasture availability, and water resources which is a key component of their livelihoods. The study underscores the need for flexible land use policies to accommodate pastoral mobility and for strengthened conflict resolution mechanisms to reduce tensions between pastoralists and farmers as Mhache (2019) noted in his paper. Mzuna *et al.* (2022) conducted a comparative analysis of farmers' and pastoralists' perceptions and adaptation strategies in Mvomero District. Their findings revealed that while both groups are aware of climate change and perceive it as a significant threat to their livelihoods, the specific impacts and perceived severity vary. Both groups acknowledged that climate change exacerbates land use

conflicts, especially during drought periods when competition for water and grazing land intensifies.

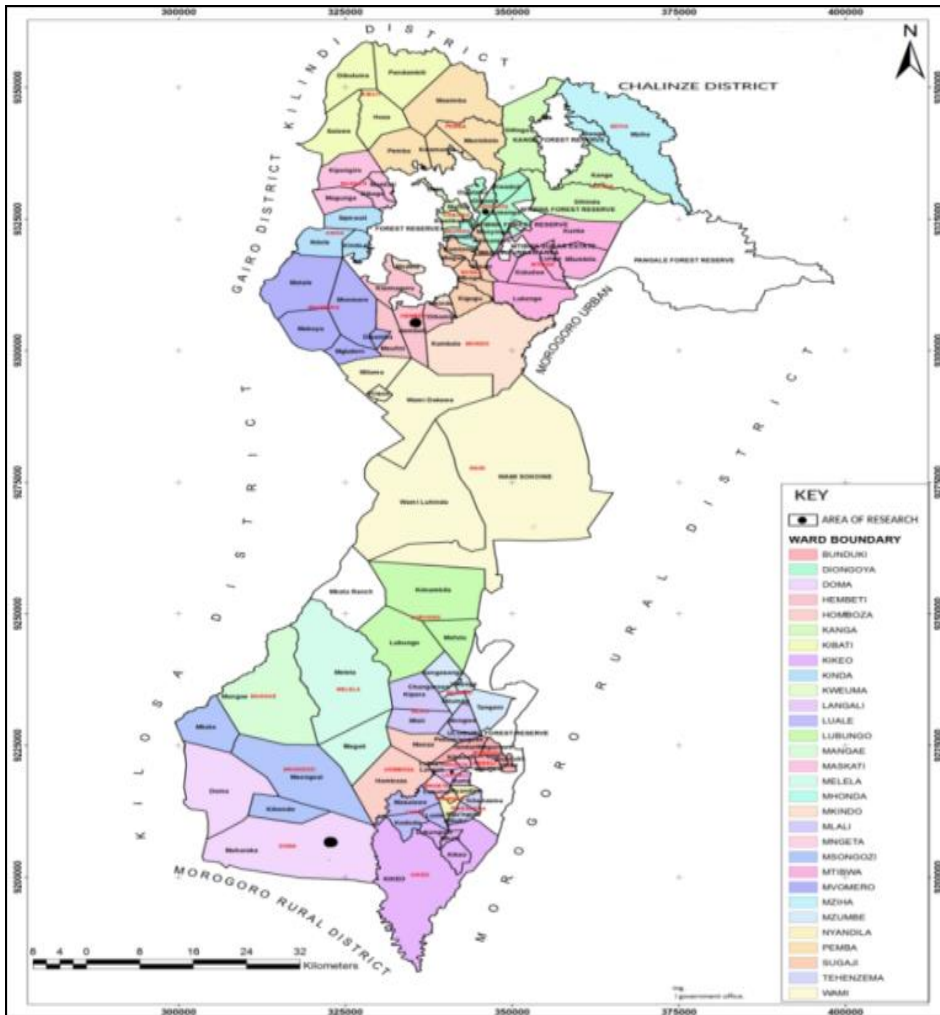
The implications of these studies for the current research highlighted the importance of understanding different perceptions and adaptation strategies of farmers and pastoralists to inform the development of integrated and context-specific policies. Collaborative efforts between these groups, supported by effective governance, are essential for enhancing resilience and reducing conflicts. Addressing challenges such as limited resources, inadequate support, and land use conflicts which requires a comprehensive approach that integrates local knowledge and fosters sustainable resource management.

This study aims to address this gap by exploring the perceptions of climate change among farmers and pastoralists in Mvomero District, Tanzania. By examining how these communities understand and respond to climate change, the research provides insights into the drivers of land use conflicts and informs policies and interventions designed to enhance resilience and promote sustainable resource management. The primary objective of the study is to assess farmers' and pastoralists' perceptions of climate change in Mvomero District. The research framework focuses on several key areas: factors influencing perceptions, impacts on livelihoods, adaptation and mitigation strategies, and the institutional and policy frameworks that shape responses to climate change.

2.0 METHODS AND MATERIALS

2.1 The study area

This study was conducted in Mvomero District in Morogoro Region. Morogoro Region is one of the regions in mainland Tanzania lying between Latitude 5° 00' 58" and 10° 00' 00" South of the Equator, and Longitude 35° 00' 25" and 35° 00' 30" East of Greenwich meridian. The region is among the major agricultural producer region in the United Republic of Tanzania bordered by Tanga and Manyara Regions to the North, Coast Region the East, Dodoma and Iringa Regions to the West and Ruvuma and Lindi Region to the South (MRIP, 2022). Other districts of Morogoro region include Morogoro municipal and Morogoro rural Districts, Kilosa, Kilombero, Ulanga, Malinyi, and Mikumi Districts. Mvomero District is geographically located between Latitude 6° 8' 49" and 6° 26' 00" South of the Equator, and Longitude 37° 32' 00" and 37° 35' 49" East of Greenwich Meridian (MDCIP, 2022). Mvomero District has diverse ecological zones that support both farming and pastoralism. This district provides a representative sample for studying the perceptions of climate change among different land use groups.



Source: Mvomero District Council Investment Profile, 2022

This study adopted a cross-sectional research design, in which data were collected from four villages which consists Doma, Langali, Diongoya and Hembeti. Both qualitative and quantitative approaches were used in data collection and analysis. The study population included 16,675 head of households in which 391 heads of households were randomly selected and 26 key informants were purposively selected for inclusion in the sample of the study. In this study, data were collected using various methods for triangulation purposes; hence key informants' interviews, focus group discussion, questionnaire, documentary review and field observation methods were employed. The interview method used to collect data from 26 key informants that involved four Village Chairpersons, four Village Executive Officers (VEO), four Heads of Village Security Committees, Four Village Agricultural and

Livestock Officers (VALO), Four Ward Executive Officers (WEO), the District Executive Director (DED), and one Officer Commanding District (OCD).

FGDs engaged community members, specifically head of households from farmers and pastoralists to sit in groups for discussions to explore shared experiences and perceptions of climate change, where four group discussions were conducted in Doma, Langali, Hembeti and Diongoya, one group for each sample village. Questionnaire items were administered to 391 heads of households to gather quantitative data on climate change awareness, perceived impacts, and adaptation strategies. The researcher prepared and placed the questionnaire to heads of households from farmers and pastoral communities from the four village of Doma, Langali, Hembeti and Diongoya. The documentary review was done by analyzing existing reports and records on climate change awareness, perceived impacts, and adaptation strategies so as to contextualize the study findings.

Observation method involves a systematic walk within a defined transect in the given area of interest and people so as to observe environmental condition, asking different questions, listening and looking to natural environmental features (De Zeeuw and Wilbers, 2004). Through observation the researcher collected information on observable impacts of climate change such as flooding, drought condition, erratic rainfall, soil acidity, and features of desertification. Also, the researcher observed some effects climate change to the environment which spark to the land use conflicts such as dried grazing, loss biodiversity and hunger, size of farms destroyed during the fights and number of crops destroyed. Data was processed and analyzed quantitatively through descriptive statistics using Statistical Package for Social Sciences (SPSS) version 20. Qualitative data was translated and categorized data in several themes and sub-themes basing on objective of the study. The data from in-depth interviews were transcribed and analyzed by thematic content analysis

3.0 RESULTS AND DISCUSSION

3.1 Perceptions of Climate Change in Mvomero District

This study sought to understand how farmers and pastoralists perceive climate change in Mvomero District. Respondents were asked about their awareness of changes in climate, such as temperature increases, prolonged droughts, and irregular rainfall. The study found that both farmers and pastoralists are not having knowledge that climate has been changing. Therefore, they could not adapt easily to climate change effects; whose adverse outcomes would catch them unprepared. They reported experiencing unpredictable weather patterns, prolonged droughts, and reduced water availability. These changes have led to a decrease in agricultural productivity and pasture quality, intensifying competition for available resources. Respondents also were asked where did first hear about climate change such as media platforms, Education Institution, Community meeting groups and multi-platform approach. The study found that

mostly of the respondents (45%) they heard through media platforms, (32%), heard through education institutions, 13% through community meetings and groups, while 10% heard via multi-platforms approach.

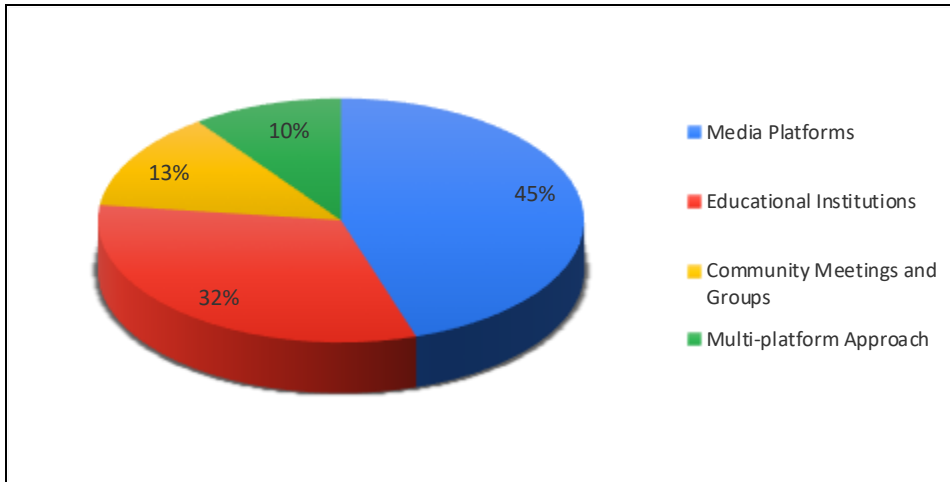


Figure 2: Perceptions of climate change in Mvomero District

Source: Field survey data, 2024

3.1.1 Perception of rainfall and temperature between pastoralists and farmers

Both farmers and pastoralists reported noticeable changes in climate patterns. They observed a decrease in rainfall and an increase in temperatures over recent years. The majority of farmers and pastoralists recognized the adverse effects of climate change such as increased temperature and prolonged droughts. These changes directly affected their livelihoods by reducing the availability of water and grazing land. Result on maximum and minimum temperature and rainfall amount were computed. Linear line was used to indicate the rainfall and temperature data.

There is a consensus among both farmers and pastoralists that temperatures are increasing, leading to more intense and prolonged dry conditions. These harsher conditions have resulted in diminished pasture quality and water shortages, adversely affecting both farming and pastoral activities. Results of temperature for 10 years from 2013-2023 indicates positive trends which implies that there was fluctuation in temperature. The increase in the temperature; indicated an increase in temperature especially in January and February, the months where by the recorded temperature was always high. The increase of temperature has a great impact on pasture resource whereby during periods of high temperature, pastoralist community does not get water, they move from one place to another in search of water as they move, they graze in the agricultural land and conflict erupts (Mhache, 2017). If we can solve the water problem, pastoralists will have enough water and limit their movement to search water. This is in line with other

studies which show that, during the dry season the conflict between farmers and pastoralist is likely to occur due to shortage of water and pasture as shown by low rainfall and the decline in quantity and quality of available feeds (Mhache, 2017; 2019).

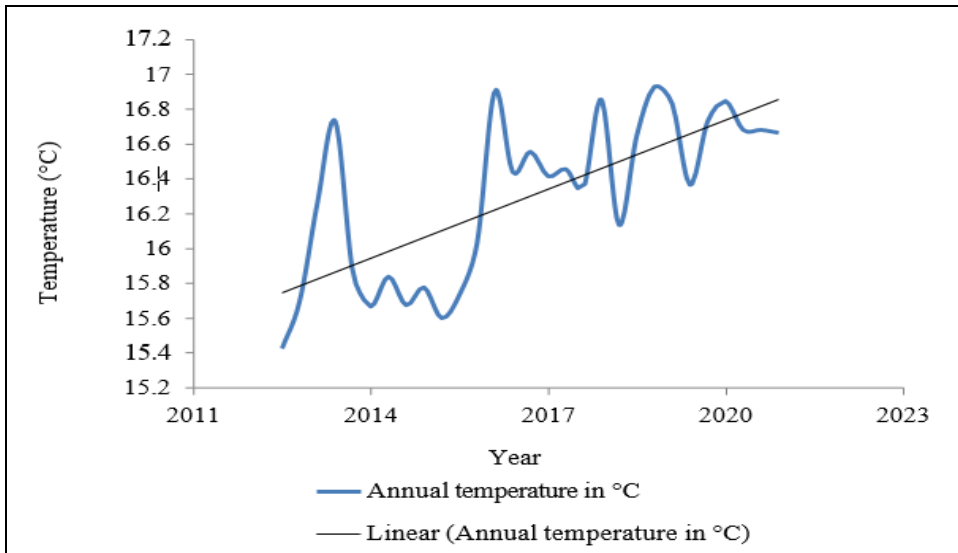


Figure 3: Showing temperature fluctuation

Source: Field survey, 2024

The majority of respondents perceived a decrease in rainfall in Mvomero District. This perceived decline has been linked to reduced water availability for crops and livestock, exacerbating competition for these scarce resources. It was shown that there has been a decrease in rainfall by about 4% especially in the present years. Water is very crucial for vegetation growth as it increases the amount of moisture in the soil. Insufficient rainfall results to the death of plants as well as negatively affecting pasture growth. In Tanzania, the fluctuation in rainfall can be dated back to 1960 where there was observed a decline in rainfall at an average rate of 2.8 mm per month and 3.3% per decade (TCAR, 2020). Regarding the rainfall pattern, majority of the respondents 77% declare that rainfall have decreased in terms of amount and timing. During focus group discussion, it was noted that currently Mvomero District rarely receives short rains commonly known as Vuli. This was confirmed by a Maasai elder saying that:

“We have not received the Vuli rains since 2021....we are depending on single rain per year like our neighbors in Gairo District” (Key Informant/ Hembeti Village, November, 2024).

Also added by saying:

“Rainfall is very crucial for pasture growth as it increases the amount of moisture in the soil. Insufficient rainfall results to the drying up and

retardation of vegetation". (Key Informant/ Hembeti Village, November, 2024).

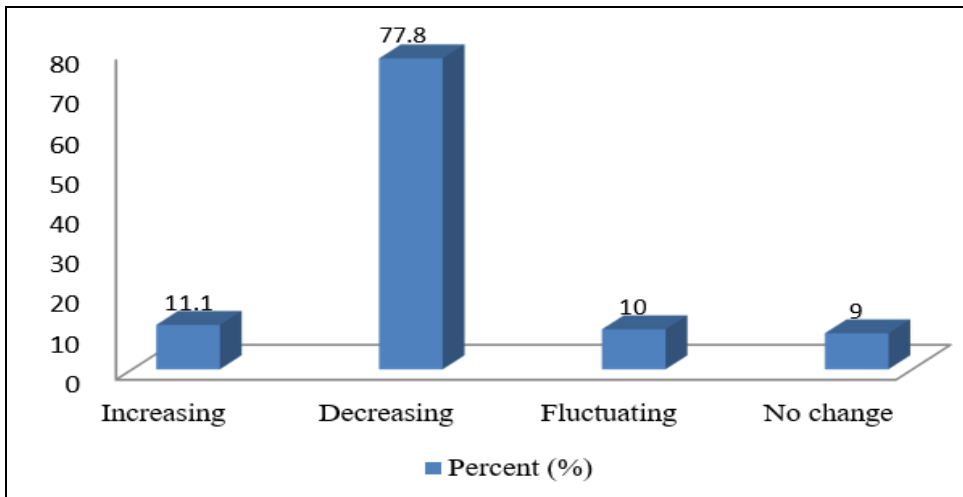


Figure 4: Showing decreasing rainfall in Mvomero District

Source: Field survey data, 2024

Osofsky (2021) found that, the number of animals died due to long drought that led to inadequate pastures. Figure 6 shows some of pastoralist's cows feeding on crops plants during drought in Mvomero district which lead to the conflict between farmers and pastoralist. The study revealed that majority of the respondents 77.8% commented that, rainfall has decreased over time, indicating that the amount of rainfall was insufficient for their uses; which makes pastoralist to be more vulnerable due to their dependence on rainfall. Ceven *et al.* (2020) agreed that in 2019, the Vuli, short rains were very poor in many regions including areas where the rains are usually plenty, like Kilimanjaro region. Also Thornton *et al.* (2019) supported that African countries are vulnerable to the impact of climate change due to overdependence on rainfall for crop and livestock production.



Figure 5: Pastoralist feeding cows on crop during critical pasture loss in dry season at Hembeti Village, Mvomero District

Source: Researcher, 2024.

Key informants further argued that:

“Rainfall was not only scarce but rather erratic. They reported that, for some decades, rainfall has been starting from November to March, but since 2015, the rainfall season has changed. It comes very late and one cannot tell exactly when it may commence. This variability affected several planning schedules and consequently growth of natural pastures. Reduced amount and scarcity of rainfall in Mvomero District have been said to cause shortage of feed for livestock which lead to frequently conflict between farmers and pastoralist” (Key Informant/ Hembeti Village, November, 2024).

Minority of the respondents 11%, claimed that there was an increase in rainfall, whereby 10% responded that rainfall has been fluctuating. This is in line with a study by Cabeza et al. (2020) who explained that semi-arid areas are also characterized by unpredictable differences in total rainfall between and within years. Pasture is very crucial to pastoralists' areas, as the only resource used to feed their livestock. The decreased amount of rainfall most likely may leads to reduction of pasture resource, which influence the pastoralists to graze their cows on agricultural land. Respondents noted that rainfall patterns have become more unpredictable, with delays in the onset of the rainy season and a reduction in the total amount of rainfall. This unpredictability complicates planning for planting and grazing, leading to decreased grazing and farming land hence lowering agricultural productivity.

3.2 Perceptions of Rainfall and Temperature according to Meteorological Data for the Past 30

According to Tanzania Meteorological Agency (2024), Mvomero District has experienced notable climatic changes over the past three decades. Analysis of climate data over a 30-year period revealed a linear increase in temperature by 0.02% and a decline in precipitation by 3%. The mean annual rainfall in Mvomero District varies geographically, ranging from 500 to 600 mm in the western parts to 800 to 1,000 mm in the eastern regions.

Temperature data indicates that the district experiences a hot season lasting approximately 1.9 months, from January 15 to March 13, with average daily high temperatures above 92°F (33.3°C). The hottest month is February, with an average high of 93°F (33.9°C) and a low of 75°F (23.9°C). The cool season spans about 3.5 months, from May 2 to August 18, with average daily high temperatures below 87°F (30.6°C). July is the coolest month, averaging a low of 67°F (19.4°C) and a high of 86°F (30°C). These climatic shifts align with local perceptions of climate change, as both farmers and pastoralists in Mvomero District have reported increased temperatures and decreased rainfall, adversely affecting their agricultural practices and livelihoods (TMA, 2024). Table 1 summarizes historical meteorological data from the Tanzania Meteorological Agency (TMA).

Table 1: Historical meteorological data from the Tanzania Meteorological Agency

Element of weather	Period	Trend/ Change	Perceived changes
Rainfall	Past 30 years	Decrease of ~3%	Average annual rainfall declined over the study period; spatial variability exists with lower totals in western areas (500–600 mm) and higher in eastern parts (800–1,000 mm).
Temperature	Past 30 years	Increase of ~0.02%	A gradual rise in mean annual temperatures has been recorded, with more frequent high-temperature events reported during the hot season.

Source: Tanzania Meteorological Agency, 2024

The Table 1 highlights that over the last 30 years, Mvomero District has experienced a slight increase in temperatures along with a modest decline in rainfall. These trends mirror local perceptions, where farmers and pastoralists note hot conditions and less predictable rainfall patterns. The reduction in rainfall and rise in temperature pose challenges for agriculture particularly for communities reliant on rain-fed farming prompting shifts in practices such as altering planting dates and diversifying crops. However, limited access to detailed climate information and financial resources remains a barrier to effective adaptation.

3.3 Perceived Causes of Climate Change

In Mvomero District farmers and pastoralists have identified several perceived causes of climate change, primarily focusing on observable environmental changes. The findings from this study revealed that, community attributes climate change to the increased frequency of unfavorable climatic events, such as reduced rainfall, elevated temperatures, and unpredictable onset of rainfall seasons. These perceptions are based on first hand experiences with shifting weather patterns that directly impact agricultural productivity and livelihoods. The community's observations align with broader regional studies, which have reported similar indicators of climate change, including rising temperatures and altered precipitation patterns.

3.4 Perceived Impacts of Climate Change between and among the Pastoralists and Farmers

Both groups have experienced significant adverse effects due to climate change. Farmers report reduced crop yields and increased crop failures, while pastoralists face declining livestock productivity due to poor pasture and water scarcity. These challenges have intensified competition over land and water resources, leading to frequent conflicts between the two groups. Many community members perceive climate change as a major factor contributing to these land use conflicts, as shrinking resources force farmers and pastoralists into closer competition.

The study found that majority of the farmer's respondents (41%) declare that change is caused by environmental and human impact, (38%) of the farmers' respondent change noticed is prolonged drought, (13%) extreme weather events and lastly (8%) change noticed is irregular rainfall. Also, majority of the pastoralist (48%) claimed that change noticed is prolonged drought, (22%) of the pastoralist respondents change noticed is extreme weather events and minority of the pastoralist respondents (10%) reported that change noticed is irregular rainfall

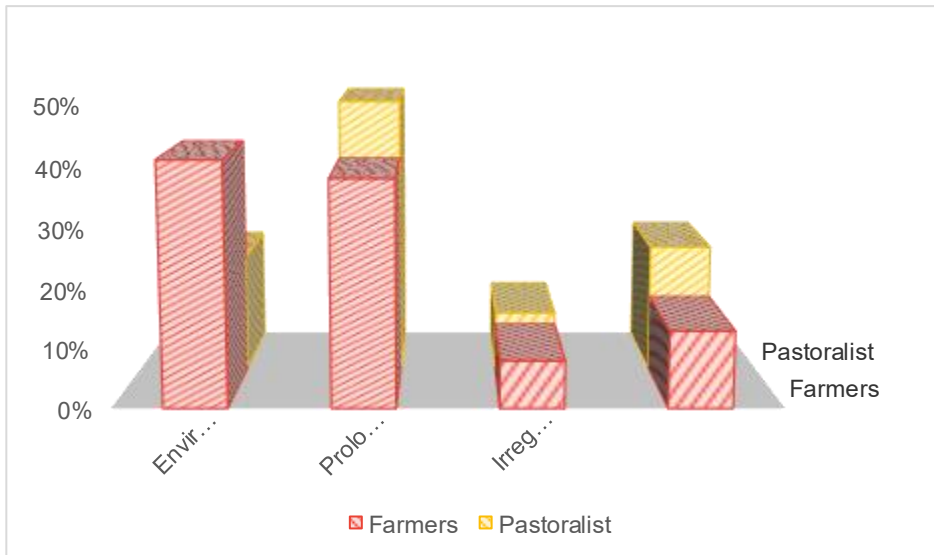


Figure 6: The perceived climate change

Source: Field survey, 2024.

4.0 CONCLUSION AND RECOMMENDATION

The perceptions of climate change among farmers and pastoralists in Mvomero District reflect a growing awareness and concern over its impacts. While farmers and pastoralists have developed various adaptation strategies, significant barriers remain. Effective adaptation requires a collaborative approach involving government, NGOs, and the communities themselves. Future efforts should focus on enhancing access to climate information, financial resources, and capacity-building initiatives to support sustainable adaptation practices. Both groups perceive climate change as a major factor influencing resource availability, particularly grazing land and water. The movement of pastoralists in search of these resources often results in conflicts with farmers, who see their crops damaged and land encroached upon. Additionally, the absence of formal land-use plans and land titles exacerbates these conflicts. The impacts of these conflicts are far-reaching, ranging from the destruction of property and infrastructure to the loss of life.

Both farmers and pastoralists have employed coping strategies to mitigate these challenges, including livelihood migration, diversification and participation in

trade. However, without long-term solutions to address the root causes of these conflicts, such as climate change and resource scarcity, the situation is likely to worsen. As mitigation measure to solve the land use conflict escalated by climate change, the government of Tanzania and other stakeholders should opt the following; promoting climate-resilient agriculture whereby farmers should be encouraged to adopt climate-resilient farming practices, such as irrigation and agroforestry. Government and non-governmental organizations should provide training and resources to support these initiatives. Another measure is to enhance conflict resolution mechanisms by creating local committees that involve both farmers and pastoralists in conflict resolution; this will help de-escalation of tensions. Also, strengthening land-use planning and policy involving implementing clear land-use policies that delineate farming and grazing zones will help to mitigate land use conflicts. This should include issuing formal land titles to both farmers and pastoralists to reduce disputes over land ownership. However, investment in sustainable water management systems is crucial. The formation of water user groups and the construction of water reservoirs can help mitigate the effects of drought and reduce competition over water resources. This study contributes to the growing body of knowledge on climate change perceptions and adaptive responses in rural Tanzania. It underscores the importance of understanding local contexts and involving community members in the development of sustainable adaptation strategies.

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