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Climate Variations and Evolving Adaptation Strategies By AGRO-Pastoral Communities in Taita Taveta County, Kenya

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Abstract
Drought and extreme temperatures are increasingly severe in Kenya's Arid and Semi-Arid Lands, causing crop failures, livestock deaths, water shortages, food insecurity, and loss of livelihoods. This study assessed climate trends, vulnerability, and adaptation strategies among agro-pastoral communities in Taita-Taveta County. Simple random and purposive sampling were used to select respondents. Primary data was collected through questionnaires administered to 298 rural household heads, field observations, focus group discussions, and key informant interviews with agriculture and livestock officers. Secondary climate data for 1988–2018 were obtained from the Kenya Meteorological Department in Voi. Quantitative and qualitative data were analyzed using MS Excel, SPSS, and content analysis. Results showed that 80% of households practiced agro-pastoralism, while 32% engaged in non-agricultural activities. Most farmers (72.7%) were male and aged 30–45 years. Mean monthly temperatures increased significantly and rainfall amounts varied considerably (R2 = 0.0006 to 0.1648). Water stress was widespread, with drought having the greatest impact (99%) on crop and livestock production. Vulnerability varied according to livelihoods, climatic and environmental conditions, education, age, household size, and structure. Households combining non-agricultural activities had higher incomes and lower vulnerability, while purely crop- or livestock-dependent households were most vulnerable. The study highlights the need for clear climate-change adaptation policies to strengthen long-term resilience.

Keywords: *Adaptation, Climate change, Variability, Arid and Semi-Arid Lands, Agro-pastoralism.*

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I. INTRODUCTION

Climate change has emerged as one of the greatest environmental and socio-economic challenges of the twenty-first century. Increasing concentrations of greenhouse gases resulting from human activities have contributed to rising global temperatures, altered precipitation patterns, and increased frequency and intensity of extreme weather events, including droughts, floods, and heat waves (IPCC, 2023; UNFCCC, 2022). These changes pose significant threats to ecosystems, biodiversity, agricultural production, and human livelihoods, particularly in vulnerable regions of the developing world (Onyeaka *et al.*, 2024).

The impacts of climate change are particularly severe in the Arid and Semi-Arid Lands (ASALs) of Sub-Saharan Africa, where livelihoods depend heavily on climate-sensitive activities such as rain-fed crop production and livestock keeping (Nontu *et al.*, 2026; Gebremeskel *et al.*, 2025). The Sahel and Greater Horn of Africa have experienced increasing drought frequency and severity, resulting in water scarcity, land degradation, reduced agricultural productivity, and food insecurity. In Kenya, ASALs cover approximately 80% of the country's land area and support millions of people whose livelihoods depend directly on agriculture and pastoralism (Oguge & Oremo, 2018).

Taita-Taveta County, located in southeastern Kenya, is largely classified as an ASAL and experiences a bimodal rainfall regime characterized by long and short rains. However, the county has increasingly experienced erratic rainfall, prolonged droughts, and rising temperatures. These climatic changes have adversely affected agricultural and livestock production, which are important livelihood activities for local communities. Approximately 95% of households in the county depend directly or indirectly on agriculture, livestock keeping, irrigation farming, tourism, trade, and mining for their livelihoods (Munyao *et al.*, 2020).

The increasing frequency and severity of droughts, rising temperatures, and unreliable rainfall present a major challenge to agro-pastoral communities in Taita-Taveta County. These climatic stresses have contributed to crop failures, livestock mortality, water shortages, pasture degradation, pest infestations, and disease outbreaks, consequently reducing household incomes and increasing vulnerability to poverty and food insecurity.

The problem is compounded by the high dependence of agro-pastoral households on climate-sensitive resources, particularly rainfall, water, land, and pasture. Households that depend exclusively on livestock or rain-fed crop production have limited livelihood alternatives and are therefore more exposed to climate-related risks (Amwata *et al*., 2016). The IPCC (2023) framework views vulnerability to climate change as a function of exposure, sensitivity, and adaptive capacity. Many scholars have attributed vulnerability within the agro-pastoral system to socio-economic factors such as household size, age, education level, livelihood dependence, and access to resources (Opiyo *et al*., 2015; Ngcamu, 2023). The County Government of Taita Taveta (2023) has reported recurrent drought-induced water scarcity in Taita Taveta that continues to affect both crop cultivation and livestock keeping, contributing to chronic food insecurity, loss of productive assets, and declining household incomes.

Agro-pastoral communities have developed various strategies to cope with climatic variability, including crop and livestock diversification, rotational grazing, water harvesting, feed conservation, mobility, adoption of drought-tolerant crops, and diversification into non-farm income-generating activities. However, many households continue to face challenges arising from inadequate financial resources, limited extension services, weak institutional support, and inadequate climate adaptation policies (Odongo et al., 2025). Despite growing research on climate change adaptation in Kenya's ASALs, empirical evidence on the combined effects of climatic variability, household vulnerability, and adaptation responses among agro-pastoral communities in Taita-Taveta County remains limited. Existing studies provide limited localized evidence on how socio-demographic factors interact with climatic stressors to influence household vulnerability and adaptation outcomes. This study addresses the identified knowledge gap by examining climatic trends and their impacts on agro-pastoral livelihoods, assessing household vulnerability, and evaluating the adaptation strategies employed by agro-pastoral communities in Taita-Taveta County. A mixed-methods approach was adopted to provide an integrated understanding of climatic changes, household vulnerability, and the effectiveness and suitability of existing adaptation strategies. The evidence generated is intended to inform context-specific climate adaptation planning, policy formulation, and resilience-building interventions for agro-pastoral communities in Taita-Taveta County and other ASALs of Kenya.

II. MATERIALS AND METHODS

Study Site

Taita Taveta County is one of six counties in Kenya’s coastal region, situated about 200 km northwest of Mombasa and 360 km southeast of Nairobi, the nation’s capital. Covering an area of 17,084.1 km², the county includes 10,649.9 km² (62.3%) within Tsavo East and Tsavo West National Parks. It shares borders with Kitui, Makueni, and Tana River counties to the north; Kilifi and Kwale to the east; Kajiado to the northwest; and the Republic of Tanzania to the south. Geographically, the county lies between longitude 37°36′ East and 30°14′ East, and latitude 2°46′ South and 4°10′ South. It is is classified among the country’s arid and semi-arid land (ASAL) counties. The county is characterized by diverse ecological zones. Topographically, it is broadly divided into three major zones. The upper zone comprises the Taita, Mwambirwa, and Sagalla Hills, with altitudes ranging from 304 to 2,208 m above sea level (ASL). The lower zone consists mainly of plains, while the third zone comprises the volcanic foothills covering the Taveta region.

The soils vary considerably across the county. Some areas have well-drained and moderately fertile soils, particularly on the steep slopes, while the lowlands are characterized by shallow, highly permeable soils with low water-holding capacity. Other areas have reddish, very deep, acidic sandy-clay soils. The variation in agro-ecological zones (AEZs) creates diverse production conditions, challenges, and opportunities that influence crop yields, livestock health, and overall livelihood outcomes. Agro-ecological conditions also influence the choice of crops and livestock breeds, farming techniques, and the type of agricultural extension services required by farming communities.

The study was conducted in Voi, Mwatate, and Taveta Sub-Counties, which are predominantly inhabited by agro-pastoral communities that were purposively selected. The communities primarily practice subsistence rain-fed agriculture, with limited irrigation farming. During the short rainy seasons, beans are commonly grown, while maize is predominantly cultivated during the longer growing seasons. Crop yields are generally low and are primarily intended for household consumption. Livestock keeping is also an important livelihood activity, with a large proportion of the population depending on livestock reared under natural grazing systems. Trade and other commercial activities are practiced in the area, particularly in and around Voi Town.

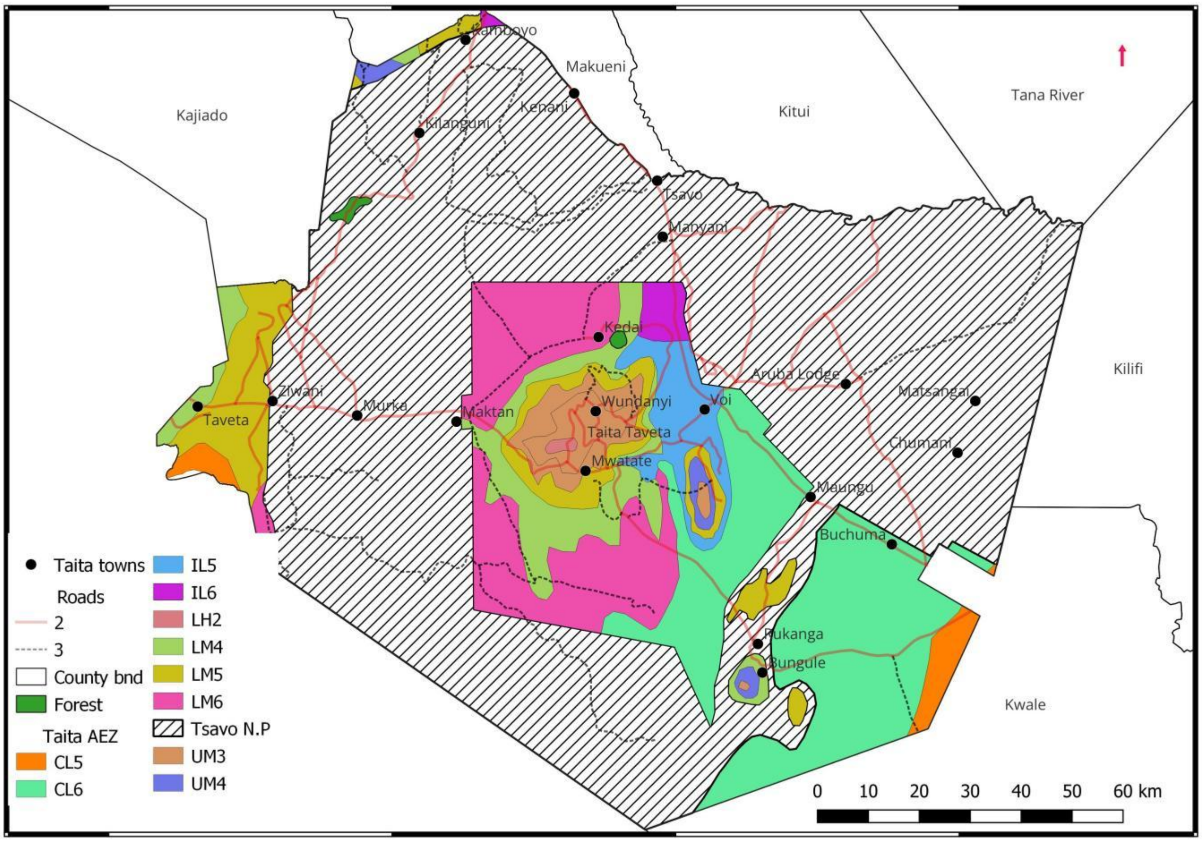

Figure 1. Study area and agro-ecological zones of Taita Taveta County, Kenya. Source: Integrated & Climate Smart Innovations for Agro-Pastoralist Livelihoods (2022)

Climatic Conditions

The climate of Taita-Taveta County is strongly influenced by the south-easterly trade winds. The county is predominantly dry, except for the Taita Hills, which receive considerably higher rainfall. The lowland areas receive approximately 440 mm of annual rainfall, while the highlands receive up to 1,900 mm. The county experiences a bimodal rainfall pattern, with the long rains occurring between March and May and the short rains between October and December. The short rains here are generally considered more reliable.

Rainfall distribution is uneven across the county, with the highlands receiving substantially more rainfall than the lowlands. The hilly areas provide favorable conditions for the condensation of atmospheric moisture, resulting in relief rainfall. The mean annual temperature is approximately 23°C, decreasing to about 18.2°C in the hilly areas of Taita, Mwambirwa, and Sagalla, and increasing to approximately 25°C in the lower zones (Rotich & Musyimi, 2023).

Research Design

The study adopted a convergent parallel mixed-methods design (Creswell & Plano Clark, 2011), in which qualitative and quantitative data were collected concurrently, analyzed separately, and subsequently integrated to corroborate and complement the findings. The study was also guided by a pragmatic paradigm, which emphasizes knowledge as emerging from actions, situations, and their consequences rather than from fixed conditions, thereby facilitating the development of practical solutions to research problems (Creswell, 2014). The pragmatic paradigm supported the use of multiple methodological approaches, enabling a comprehensive exploration of the research problem while maintaining flexibility and emphasizing problem-centred inquiry (Foster, 2023).

Multi-Stage Sampling Approach

A multi-stage sampling approach was used to select the study sample from Voi and Mwatate Sub-Counties. The two sub-counties were purposively selected because they have a large number of households engaged in agro-pastoral activities. All six wards in Voi Sub-County (Sagalla, Mbololo, Kasigau, Marungu, Kaloleni, and Ngolia) and all five wards in Mwatate Sub-County (Rong'e, Mwatate, Bura, Chawia, and Wusi) were included in the study.

Sampling Procedure and Sample Size

Households in the villages within the two sub-counties were sampled based on population data obtained from the Kenya National Bureau of Statistics (KNBS, 2019). A cluster sampling approach was adopted to identify the target population, particularly because a comprehensive sampling frame was not available and could not readily be constructed (Mugenda & Mugenda, 2003).

With the assistance of local chiefs, the geographical centers of the selected villages were identified to facilitate household selection. One household located at the geographical center of each village was selected as the starting point, after which systematic sampling was employed. Every fifth household encountered along established roads or footpaths was selected for participation in the study. The sample was proportionately distributed between the two sub-counties based on their respective populations.

This sampling approach was considered appropriate because it facilitated broad geographical coverage and enhanced the representativeness of the selected households. It also provided eligible households with a systematic and transparent opportunity for selection.

A sample size of 381 respondents was determined using the Krejcie and Morgan (1970) method. This sample size is consistent with established sample-size determination principles for survey research, in which the required sample is determined by factors such as population size, confidence level, and margin of error (Adam, 2020).

T**he sample size was calculated using the Krejcie and Morgan (1970) method.**

$$S= \frac{X^2 \times N \times P(1-P)}{d^2(N-1) + X^2 \times P(1-P)}$$

Where:

S = Required sample size
N = Population size
X^2 = Chi-square value for 1 degree of freedom at the desired confidence level
P = Population proportion (assumed to be 0.5 when unknown, for maximum sample size)
d = Margin of error

From the selection 191 households from Voi Sub-County and 190 households from Mwatate Sub-County were interviewed. Quantitative data was collected using structured questionnaires as per the study objectives and contained items addressing respondent's background characteristics, climate related experiences, Indigenous Knowledge practices, their perceived contribution to climate adaptation and challenges affecting their continued use. The questionnaire used both closed ended and open ended items. Likert type questions were used where perceptions and effectiveness were assessed while open ended questions provided respondents with an opportunity to explain their experiences and views.

Qualitative data was obtained through key informant interviews and focus group discussions. Questionnaires used in collecting quantitative data were pilot tested with farmers in the neighboring Kitui county. Feedback from the Pre-test was used to improve the clarity, sequencing and wording of questions to meet the study objectives. Key informants included agricultural extension personnel, local administrators and community elders with relevant knowledge of farming and local adaptation. Focus group discussions provided community level perspectives on local environmental observations, traditional adaptation practices and challenges affecting Indigenous Knowledge transmission and use. To contextualize the data and interpret it better, observations were made, and secondary information was used from relevant government reports, climate-related documents, and scholarly sources. *C*limate data sourced from Voi Meteorological Station (38.575207° E, 3.381328° S) of 1988 to 2018 were validated. This was the only data available for the area, with a few missing gaps, which were filled by simple averages between missing data.

Data Analysis

Quantitative data were coded, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS Version 29) and MS Excel 2013. Given that the study did not involve hypothesis testing, data analysis was primarily descriptive in nature. Summarizing respondents and descriptive statistics of frequencies, percentages, and measures of central tendency, Cross-tabulation techniques were further utilized to examine patterns and relationships across relevant respondent categories and study wards.

Qualitative data obtained from key informant interviews, focus group discussions, and open-ended questionnaire responses were analyzed using thematic analysis. The process involved repeated reading and familiarization with the data, systematic coding of meaningful statements, identification of recurring patterns, and development of themes aligned with the study objectives. The themes were subsequently interpreted to provide contextual insights into participants' experiences and perspectives regarding climate change adaptation.

Finally, the quantitative and qualitative findings were integrated during interpretation to enable triangulation and provide a more comprehensive understanding of agropastoral knowledge in climate change adaptation among smallholder farmers in Taita-Taveta County, Kenya. The mixed-methods approach enhanced the depth, validity, and richness of the study findings by combining statistical trends with participants' lived experiences and local knowledge systems.

Ethical Considerations

The research adhered to established ethical research principles with participation made voluntary, respondents consenting to provide information based on the study objectives, and being assured of the confidentiality and anonymity of the information they provide. Institutional research permissions were also obtained before the fieldwork.

III. RESULTS AND DISCUSSION

Out the targeted 381 respondents, 300 (79%) completed the survey. Males constituted 72.7% (n=197) of respondents, while females accounted for 27.3% (n=74). Regarding age, 25.7% were below 35 years, 16.3% were 35–39 years, 24.0% were 40–44 years, 16.8% were 45–49 years, and 17.3% were above 50 years. Farming was the main occupation for 80.7% (n=242) of respondents, with 60% practicing mixed crop–livestock farming. In addition, 20.4% (n=64) participated in off-farm income-generating activities, including formal employment, casual labour, and small-scale businesses.

Agro-Pastoralists' Views Toward Climatic Change

In Voi and Mwatate sub-counties, 286 respondents (95%) agreed that drought conditions are common, while 278 (92.67%) reported that the duration of droughts is increasing. Similarly, 297 respondents (99%) agreed that rainfall patterns are changing, while 281 (93.7%) reported that rainfall amounts are decreasing. Only 1% of the respondents indicated that rainfall amounts are increasing.

These findings are consistent with the position of the IPCC (2022), which reported that climate change has increased drought in Africa and projected increases in drought frequency and duration across large parts of Southern Africa. Historical data retrieved from various secondary sources indicated trends and frequencies, although without a clear or consistent pattern. Studies on climatic trends, based on altitude and an ensemble of the ICHEC-EC-EARTH and MPI-M-MPI-ESM-LR models under the RCP4.5 and RCP8.5 pathways, predicted a significant rise in temperatures up to 2065 (Nyambariga et al., 2023). Across three agro-ecological zones, rainfall variations were found to be insignificant; however, changes in rainfall patterns and seasons could lead to declines in food production. Such climatic shifts have negatively affected agro-pastoral systems, thereby threatening livelihoods (Wandera et al., 2024). **Figure 1 depicts spatial distribution of the different agro-ecological zones in Taita-Taveta County. The map highlights the variation in agro-ecological conditions across the study area, providing geographical context for understanding the climatic conditions experienced by agro-pastoral communities.**

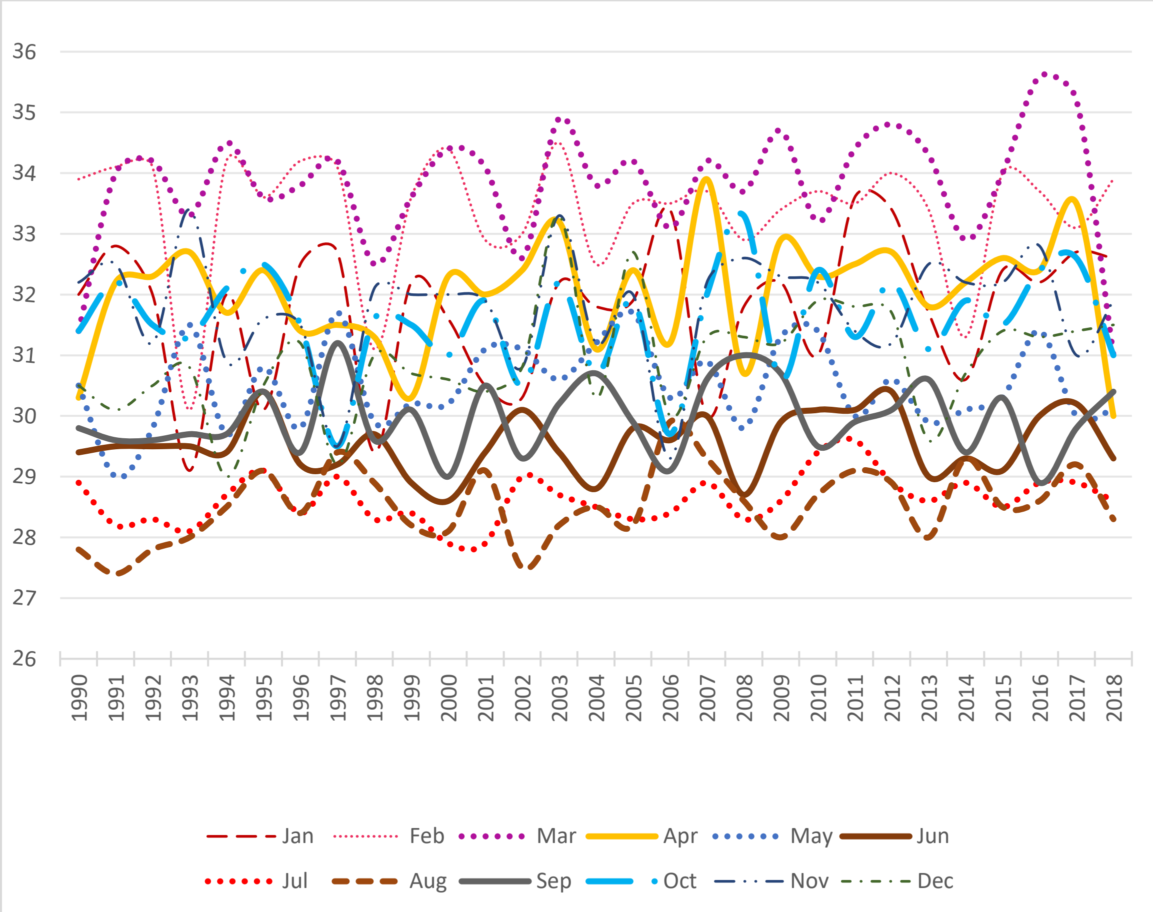

Figure 1: Average Maximum Temperature trend analysis for Voi Meteorological station (1988-2018)

Respondents' Experiences on Climate Changes and its Impact

With changes in rainfall patterns and amounts, increased seasonal and inter annual variability, and increased frequency of prolonged droughts and extreme weather events a larger population in the study area have become vulnerable while others have well-adapted to utilize their resources sustainably. The findings indicate that agro-pastoral households in Taita Taveta County have directly experienced significant changes in climatic conditions. Nearly all respondents (99%; n=297) reported that rainfall patterns have changed, while 93.7% (n=281) perceived a decline in rainfall amounts. Additionally, 95% (n=286) indicated that droughts have become more frequent, and 92.7% (n=278) believed drought duration has increased. These perceptions are consistent with meteorological analysis showing declining rainfall trends and increasing temperature variability between 1988 and 2018 shown in figures 1 and 2. It's also consistent with happenings in most Kenyan ASAL areas where vulnerability has been common in places where poverty levels are high or have been politically marginalized.

The respondents' experiences align with recent empirical studies across Kenya and East Africa. Nyambariga et al. (2023) found that climate projections for Taita Taveta County indicate increasing temperatures and more variable rainfall, exposing farming systems to greater production risks. Similarly, Kotikot et al. (2024) reported increasing rainfall variability across Kenya, characterized by more erratic seasonal rainfall patterns and heightened uncertainty for agricultural planning. These changes have significant implications for agro-pastoral livelihoods that rely heavily on predictable rainfall.

Drought and Its Influence on Farming in the Study Area

Climatic conditions, especially rainfall and temperature, were found to be critical in shaping agricultural and livestock keeping practices, their patterns and outcomes in Taita Taveta County. The choice of crops, irrigation needs, and livestock kept and overall farm management practices were determined by varying rainfall and temperature patterns. Rainfall variability, especially droughts and floods affect soil moisture which generally known to lead to crop stress and soil salinity. These variables contribute to production risks and loss.

Impact on Agricultural Production

Respondents associated climate change with declining agricultural productivity. Drought conditions have reduced crop yields, increased crop failures, and shortened growing seasons. The majority of households reported reliance on mixed farming, with 60% depending on both crop production and livestock keeping as their primary livelihood. As rainfall became more erratic, households experienced increased risks of food shortages and reduced income generation. The years 2021–2022 marked a critical period with massive crop and livestock losses and escalating hunger. Recent efforts (2023–2024) by county officials and national authorities focused on resilience through drought-tolerant agriculture and rehabilitated water infrastructure powered by renewable energy.

These experiences corroborate findings by Ortiz-Bobea *et al.* (2021), who found that anthropogenic climate change has significantly slowed global agricultural productivity growth. Likewise, Lawrence *et al.* (2023) found that climate change has altered the climatic suitability of agro-pastoral farming systems across Kenya, with implications for crop and livestock production, food security, and agricultural livelihoods.

Temperature and Its Influence on Farming in The Study Area

Our regression model detected temperature variability between 1988 and 2018. It produced measurable upward trend of temperature in all months over the 30 years' period as shown in Table 1. Results from each month, however, explains only a small percentage for overall variability. In all the months, there was significant upward trend at p-value of 0.05. However, the increments were varied from very week, modestly week to week. The model offers some insight into trend direction, but rigorous interpretation and forecasting require more refined modeling and validation.

Rainfall and Its Influence on Farming In the Study Area

Regression results (Table 1) show that each month had a mean temperature change that is significantly different from the other between 1998 to 2018, confirming that monthly climatic variations exist. It also confirms that local community's perception on the changes in variability and decreased rainfall amounts over the years were correct. The model produced measurable downward trend in all months, except in the months of September and October over the 30 years' period as shown in Table 1. Results from each month, however, explains only a small percentage (2%) for overall rainfall variability, most of them experiencing a downward trend. In most of the months, the R^2 values were very low (many below 0.05), suggesting weak explanatory power. However, the increments were varied from very week, modestly week to week. The model offers some insight into trend direction, but rigorous interpretation and forecasting require more refined modeling and validation.

Table 1: Regression Coefficients of rainfall trends in the study area between 1988 and 2018 (Source: Voi Meteorological station).

Month	Equation	R^2	Interpretation
January	y = 0.0367x + 31.198	R2 = 0.0712	Weak upward trend
February	y = -0.0002x + 33.38	R2 = 4E-06	No meaningful trend
March	y = 0.0205x + 33.492	R2 = 0.0293	very weak upward trend
April	y = 0.0221x + 31.675	R2 = 0.04	Weak upward trend
May	y = 0.0077x + 30.399	R2 = 0.0087	a minimal upward trend
June	y = 0.0101x + 29.382	R2 = 0.03	very weak upward trend
July	y = 0.0162x + 28.385	R2 = 0.1143	Modest upward trend
August	y = 0.025x + 28.16	R2 = 0.1219	Modest upward trend
September	y = 0.0071x + 29.858	R2 = 0.0103	Very weak upward trend
October	y = 0.0119x + 31.384	R2 = 0.0143	Weak upward trend
November	y = 0.0076x + 31.676	R2 = 0.0049	Very weak upward trend
December	y = 0.044x + 30.26	R2 = 0.1648	Modest upward trend

Vulnerability and Its Causes

Vulnerability in this work referred to the propensity of households to experience adverse impacts from climatic hazards owing to their level of exposure, sensitivity, and adaptive capacity (IPCC, 2023). Income levels was also key in determining such vulnerability but most importantly it came from triangulated analysis of the response from the respondent. Majority of the respondents were found to be highly vulnerable to climate change (53%) while 31.3% were vulnerable and 8.7% less vulnerable (Figure 2). The remaining 7% were not classified, as they had demonstrated greater flexibility in responding to climatic and environmental fluctuations. Adaptation strategies remains crucial for enhancing the resilience of local communities to resilience against climatic and environmental threats. The study identified a range of traditional practices, as well as innovative technical, environmental, social and economic approaches that local communities employ to mitigate the impacts of climate change for both agricultural and livestock production. These strategies contribute to enhancing food security and sustainable livelihoods.

Escape from climate vulnerability in the ASALs, as discussed in many studies, can come from investment in infrastructure as an important enabler of development. However, this has historically been inadequate in the study area's road conditions and transport networks are generally poor. Accessibility to water and markets is also important, yet in the study area, less than 5% of the respondents reported having access to reliable water supplies and modern markets. Poverty is widespread in the area, limiting the capacity of local communities to mobilize the financial and material resources required to adapt to or mitigate the impacts of climate change. Furthermore, the erosion of traditional coping strategies, coupled with increasing population pressure, has been identified as a major contributor to vulnerability. These socioeconomic and infrastructural constraints further undermine the capacity of local communities to build resilience to climate and environmental changes and their improvements would be a game changer.

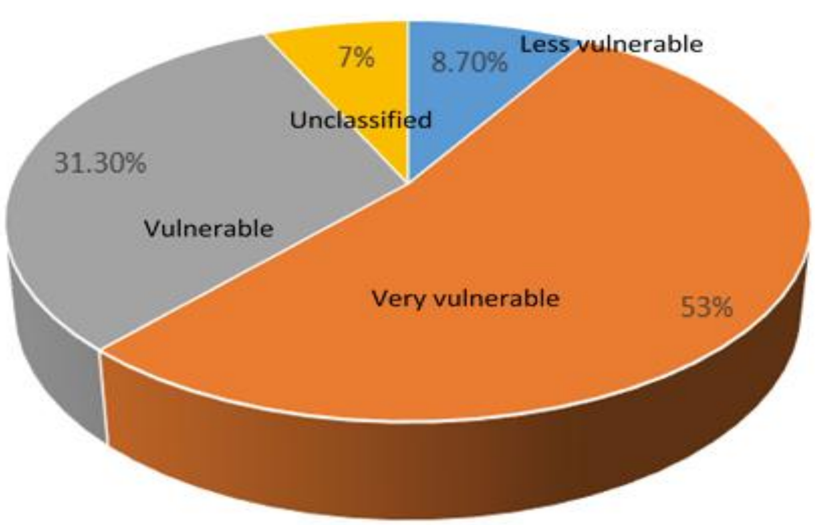

Figure 2: Vulnerability levels of households in the study area

Key Adaptation Strategies

The study revealed that households in the community employ a range of adaptation strategies in response to climate variability. In agriculture, the most common strategy was the adoption of suitable crop varieties, reported by 67.14% of respondents, highlighting a strong shift towards climate-resilient crops that can withstand changing rainfall and temperature patterns. Other strategies included farmer education and training (13.07%), which enhances knowledge on climate-smart practices, and the use of irrigation (8.13%) to counter erratic rainfall. Smaller proportions of farmers adapted by reducing the size of their farming area (6.71%) or by diversifying into non-farm businesses (4.95%) as alternative income sources.

For livestock keepers, the dominant approach was livestock education and training (53%), showing the importance of capacity building in managing animal health and productivity under changing conditions. About 32% of respondents reduced their livestock population, an important measure to ease pressure on scarce water and pasture resources, while 19% adopted improved breeds that are more resilient to heat and disease.

Livelihoods and Farming Systems

As shown in Table 2, the majority of respondents (60%) reported mixed crop and livestock farming as their main farming activity, indicating a strong reliance on diversification to spread risks and secure livelihoods. Crop production alone was reported as the main farming activity by 25% of respondents, while 15% primarily engaged in livestock production. Horticulture accounted for less than 1% of respondents. These findings indicate that mixed farming is the predominant farming system among the households surveyed, reflecting the importance of combining crop and livestock production as a livelihood strategy.

Overall, the findings indicate that households employ a combination of strategies to cope with climatic and environmental challenges and enhance livelihood resilience. These include planting suitable crops (67.14%), farmer education (13.07%), irrigation (8.13%), reducing the farming area (6.71%), and shifting to other businesses (4.95%). Among livestock keepers, the strategies include livestock education, reducing livestock populations, and adopting improved breeds. The use of these complementary strategies demonstrates the efforts of households to adapt their agricultural and livestock production systems to changing climatic conditions while safeguarding food security and livelihood.

Table 2: Livelihoods and Farming systems

Livelihood	Strategy	**Frequency (F)**	**Percentage (%)**
Agriculture	Plant suitable crops	190	67.14
	Farmer education	37	13.07
	Irrigation	23	8.13
	Shift to other business	14	4.95
	Reduce farming area	19	6.71
Livestock keepers	Improved breeds	17	19
	Livestock education	29	53
	Reduced Livestock population	43	32
Main farming activity	Crops	55	25
	Mixed Livestock/Crops	133	60
	Horticulture	1	0
	Livestock	34	15

IV. CONCLUSION

In Taita-Taveta County, the major factors affecting household food security include inadequate and unreliable rainfall, recurrent droughts, limited access to capital, low levels of education, and farming practices. Integrated agriculture, which combines multiple farming enterprises and production strategies, enhances both productivity and sustainability. It is therefore an important strategy for strengthening food production systems and improving their capacity to withstand the challenges posed by climate variability.

Climate change and variability in the study area were characterized by rising temperatures, prolonged droughts, and increasingly erratic rainfall patterns. These climatic changes adversely affected both crop and livestock productivity, thereby undermining household food security and livelihoods.

The study further identified multiple social, economic, and biophysical factors at the household level as key determinants of vulnerability to climate-induced stresses. Strengthening policies and interventions that promote education, agricultural extension services, diversified income-generating activities, access to credit, livestock mobility and diversification, employment opportunities, market access, and effective early-warning systems would significantly enhance the resilience of agro-pastoral households.

Moreover, the diverse and dynamic nature of household composition, including household size and structure, plays an important role in shaping adaptation strategies and livelihood practices among resettled agro-pastoral communities. Larger and smaller households face different challenges and opportunities, which influence resource allocation, decision-making, labour availability, and socioeconomic dynamics. Understanding these differences provides valuable insights into the factors that shape household sensitivity, adaptive capacity, and resilience.

Overall, understanding the interplay between household characteristics, climatic stresses, policy frameworks, and diverse adaptation strategies is essential for developing effective and context-specific interventions. Such an integrated approach would contribute to strengthening long-term resilience, improving food security, and promoting sustainable livelihoods among agro-pastoral communities in Taita-Taveta County.

CONFLICT OF INTEREST

The authors have not declared any conflict of interests

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