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RURAL LIVESTOCK FARMERS' ADAPTATION STRATEGIES TO CLIMATE VARIABILITY IN YAMALTU-DEBA LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA

¹Ibrahim Danjuma Yusuf, ²Idoma Kim and ³Abass Bashir

^{1,2}Department of Geography, Faculty of Science, Gombe State University, Gombe, Nigeria

³Department of Geography, Faculty of Environmental Science, Moddibo Adama University of Technology, Yola, Nigeria

ABSTRACT

The study assessed the Adaptation Strategies of Rural Livestock Farmers to Climate Variability in the Yamaltu-Deba Local Government Area, Gombe State, Nigeria. It sought to analyze the trend of climatic variations, examine predominant practices of livestock farming, investigate livestock farmers' perception of the impact of climate variability on livestock production and assess the adaptation strategies of livestock farmers to climate variability in the study area. Multi-stage sampling technique was used to sample 9 communities for the study. Data for the study were elicited via a structured questionnaire and Key Informant Interviews. The study used descriptive statistics in the analysis. Results obtained showed that 63% of livestock farmers were males, 48% had informal education and 35% were from Tera ethnic group. In addition, the trend analysis of rainfall and temperature of Yamaltu-Deba indicated low and unpredictable rainfall and high-temperature fluctuations. The impact of climate change on livestock production in the study area is generally perceived to be negative. Reduction in livestock numbers is the most widely used adaptation strategy. The study concludes that though farmers in the study area are facing stiff challenges due to climate change, various strategies have been adopted to cope with these changes, which can help to reduce the negative impacts of climate change on livestock production. The study recommends among others that policymakers should provide support to farmers in the form of training, access to credit, and provision of inputs to enable them to effectively cope with the challenges of climate variability and change.

Keywords: Climate variability, adaptation strategies, Livestock farmers, Yamaltu-Deba

1. INTRODUCTION

Climate change presents a global challenge with profound implications for agriculture and rural communities (Sanyang and Saine, 2022). Climate change is primarily caused by human activities, such as the burning of fossil fuels and deforestation, which release greenhouse gases into the atmosphere (Sanyang and Saine, 2022). These gases trap heat and lead to rising global temperatures. The consequences of climate change include altered precipitation patterns, more frequent extreme weather events, and rising sea levels (Chhogyel, Kumar, and Bajgai, 2020). In the agricultural sector, these changes can disrupt traditional farming practices and have a significant impact on livestock farming. For example, temperature fluctuations and erratic rainfall can affect forage availability, increase disease prevalence, and impact the overall well-being and productivity of livestock.



The consequences of climate variability extend worldwide, affecting the livelihoods and food security of millions of people in rural communities (Rusmayandi, Indriyani, Hertini, Harahap, and Nugroho, 2023) Nigeria, as a nation, is not exempted from the far-reaching effects of climate change. The agricultural sector, a cornerstone of the nation's economy, is particularly vulnerable to these changes. Nigerian livestock farmers, including those in the Yamaltu-Deba region, grapple with the intricate task of adapting to shifting climate patterns.

Rural livestock farming embodies a timeless connection between humans and animals, rooted in the tranquility of countryside landscapes (Schulze Walgern, Hecker, Walther, Boelhave, & Mergenthaler, 2023). Within these idyllic settings, livestock farmers diligently tend to their herds and flocks, nurturing them for various purposes ranging from sustenance to companionship. Their livelihoods are interwoven with the rhythms of nature, as they navigate the challenges and rewards of raising animals in harmony with the land.

Despite the serene backdrop, rural livestock farming is not without its hurdles. Farmers grapple with access to essential resources like land, water, and feed, while also contending with market fluctuations and environmental uncertainties. Yet, amidst these challenges, there exists a deep sense of resilience and community, as rural livestock farming not only sustains livelihoods but also fosters bonds within tight-knit rural communities. It is a timeless practice that continues to evolve, blending tradition with innovation to adapt to the ever-changing landscape of agriculture.

In the Yamaltu-Deba region, livestock farmers have experienced significant changes in temperature and rainfall patterns (Jajere, Ngamdu, Ibrahim, and Ahmed, 2023). These changes have led to a reduced availability of grazing land and water sources, making it more difficult to sustain their livestock. Additionally, the increased prevalence of certain diseases, such as tick-borne illnesses, has impacted the health and productivity of livestock in the region. These challenges have forced farmers to adapt their practices and find innovative solutions to ensure the sustainability of their livestock and livelihoods (Crawshaw and Piazza, 2023)

The consequences of climate change extend beyond the agricultural sector, impacting the livelihoods and food security of millions of people in rural communities. In Nigeria, where agriculture is a keystone of the economy, the effects of climate change can be particularly devastating. Decreased productivity in livestock farming can lead to reduced income for farmers and increased food insecurity for communities. This can have long-term implications for the overall well-being and development of rural areas. Therefore, it is crucial to implement strategies and policies that enhance the resilience of farmers and promote sustainable agricultural techniques (Mrozek, 2023).

The government recognizes the importance of supporting rural farmers and has implemented various policies and programs to enhance their resilience to climate variability. These initiatives aim to improve livestock management practices, provide access to resources, and promote sustainable agricultural techniques. These initiatives include providing training and resources to improve livestock management practices, such as disease prevention and sustainable grazing techniques. Additionally, the government has established programs to enhance access to credit and financial support for farmers to invest in climate-resilient infrastructure and technologies. However, the effectiveness of these measures is still being evaluated and monitored to ensure their long-term impact on sustainable agriculture. Additionally, collaborations with local communities and organizations are being fostered to gather feedback and incorporate diverse perspectives in the decision-making process. (Yan, Zhang, Ge, and Wu, 2023)



Rural communities in Nigeria rely heavily on agriculture for income and food security, but are particularly vulnerable to climate change impacts (Sarku, 2023). Decreased productivity in livestock farming can lead to reduced income for farmers, making it difficult for them to afford basic necessities and support their families. Food insecurity can also increase as communities rely on local agricultural production. (Makate, Angelsen, Terje Holden, and Tveitereid Westengen, 2023) In the Yamaltu-Deba region, farmers have reported a 30% decrease in forage availability due to changing rainfall patterns, forcing them to purchase expensive supplementary feed. Additionally, the increased prevalence of tick-borne illnesses has led to a 20% decrease in livestock productivity, resulting in reduced income for farmers and food insecurity for communities. This study aims to explore the adaptive strategies employed by rural farmers in Yamaltu-Deba to mitigate the challenges posed by climate variability. The research specifically targets rural livestock farmers, emphasizing the unique challenges and opportunities faced by this group. Understanding these adaptation strategies is crucial for developing targeted interventions and policies that can support rural livestock farmers in building resilience to climate change and other environmental pressures. The study aims to identify best practices and provide recommendations for policymakers and stakeholders to enhance the resilience of livestock farming communities in the face of climate change and other challenges.

The following specific goals were pursued: analyze historical climate data and identify trends in temperature, rainfall, and other relevant climatic variables in Yamaltu-Deba Local Government Area over a period 30years (2006 to 2021), characterize the prevalent livestock farming practices, including the types of livestock reared, herd sizes, and management techniques employed by rural livestock farmers in the study area and identify the specific climate adaptation strategies implemented by rural livestock farmers in response to observed climate variability.

1.2 The Study Area

The study area Yamaltu Deba geographically lies between latitude $10^{\circ} 30^1$ and $11^{\circ} 10^1$ North and longitude $9^{\circ} 50^1$ and $11^{\circ} 40^1$ East (Fig.3.1), in Gombe state, Northeastern part of Nigeria. It is situated within the Upper Benue Trough; it is about 37 km East of Gombe, along Gombe – Biu to Maiduguri Road.

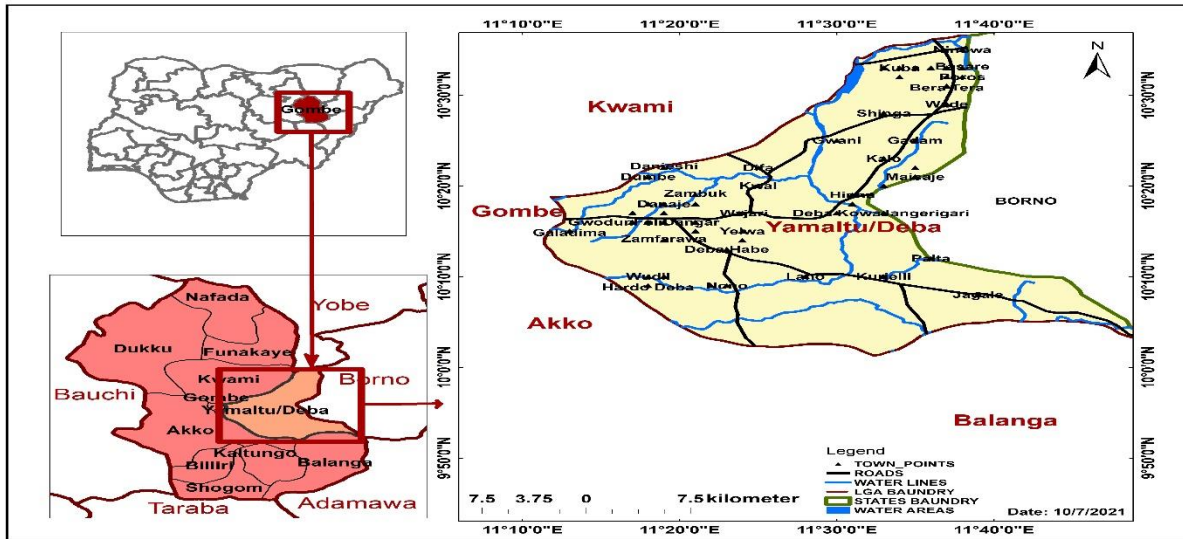


Figure 1: Map of the Study Area

Source: G.I.S Lab., Department of Geography, Gombe State University (2023)

The study area in Yamaltu Deba has a rainfall pattern of 842.63 mm, 1,119.30 mm, and 150.20 mm for the past 30 years. Rainfall typically starts in May to October, with the dry season covering November to April. Peaks occur in July, August, and September, replenishing soil water deficits. The temperature in the area is 34.33 °C and 21.52 °C over the past 30 years. The soil is lithosols and tropical ferruginous, derived from basement complexes and old sedimentary rocks. Yamaltu Deba falls within the Guinea Savannah Zone, but clearing vegetation for farming, fuel wood extraction, and sawmilling has led to the development of re-growth vegetation. Dense forests are rare, while gallery forests are common along major streams and depressions. The vegetation is mainly grasses and isolated trees, with economic-value trees scattered across the area. The people of Yamaltu-Deba are mainly farmers, producing food and cash crops, livestock production, agro-processing, and petty trading.

1.3 METHODOLOGY

The study adopted a survey research design. The survey was administered through questionnaires and targeted a sample size of 214 livestock farmers from Yamaltu-Deba Local Government Area of Gombe State. Information for the study was drawn from a range of reputable sources and data types (primary and secondary). Climate data, including monthly and annual temperature averages and rainfall totals from 2006 to 2021, were sourced from the Nigerian Meteorological Agency and Research publications.

Livestock-related information was obtained through a combination of surveys, interviews with rural livestock farmers, input from agricultural extension services, and records from local agricultural agencies. This data encompassed the types of livestock reared, herd sizes for each category of livestock, and the various management techniques employed, such as grazing practices and vaccination protocols.

The study also delved into climate adaptation strategies utilized by rural livestock farmers. These strategies were documented through surveys, interviews, and local practices. Data on the adoption

rates of these strategies within the community and the perceived effectiveness of these measures in mitigating climate variability were also gathered.

The study employed a multi-stage sampling technique for data collection. Firstly, the local government's wards were clustered into three groups based on North, East, and West geopolitical zones. Secondly, wards recognized for their livestock production were purposefully selected, resulting in three wards from each geopolitical zone, totalling nine wards. Thirdly, communities were randomly chosen from each selected ward to obtain respondents. Thus, one community was selected from each ward through a lottery, resulting in nine communities for the study.

To determine the sample size, the 1991 census data for the study area were projected to 2021 using Gombe state's population growth rate of 3.93%. This projection yielded a 2021 population estimate of 21,370 for Yamaltu-Deba. (Table 1). The sample size was determined using the Yamane Taro method, resulting in a sample size of 214 with a 10% error margin. The allocation of questionnaires to selected communities was based on their population size (Table 1)

For questionnaire administration, households were considered as units of observation. The systematic random method was employed, selecting every third livestock-rearing household until the required number of samples for each community was reached.

Table 1: Selected Settlements and Distribution of Questionnaire in Yamaltu-Deba

Yamaltu- Deba Geopolitical zone	Selected Wards	Selected communities	NPC 1991	Projected Population 2021	Copies of questionnaire
North	Shinga	Dukul	649	2045	20
North	Wade	Garinkoshi	2389	7528	75
North	Gwani	Dukul Tera	165	510	6
East	Lubo	Lafia	529	1667	17
East	Kinafa	Garin Dawaki	595	1875	19
East	Jagali	Jauro Gotel	816	2571	26
West	Kwali	Jauro Yahaya	711	2240	22
West	Liji	Jauro Sambo	514	1620	16
West	Lamban	Jauro Saidu	417	1314	13
Total	9	9	6,785	21,370	214

Source: Author's compilation

1.4 Methods of Data Analysis

The temporal changes in rainfall and temperature in the study area from 2006-2021 obtained from NIMET, Gombe were examined by employing the trend analysis. Descriptive statistics such as mean and standard deviation was used to calculate herd sizes for each type of livestock to characterize the central tendency and variability. Frequencies and Percentages were used to describe the prevalence of different livestock types and management techniques. Frequencies and Percentages were employed to identify the prevalence of specific climate adaptation strategies. While mean and standard deviation were used to assess the effectiveness or adoption level of particular strategies.

1.5 RESULTS AND DISCUSSIONS

1.5.1 Temporal changes in rainfall and temperature in Yamaltu-Deba

This section analyzes the temperature and rainfall trends in Yamltu-Deba over a 15-year period (2006-2021), a time believed to have seen significant weather and climate changes in Nigeria, particularly in Gombe State. The trend analysis is illustrated in figures 2 and 3. Figure 3 displays the average monthly temperature in Celsius.

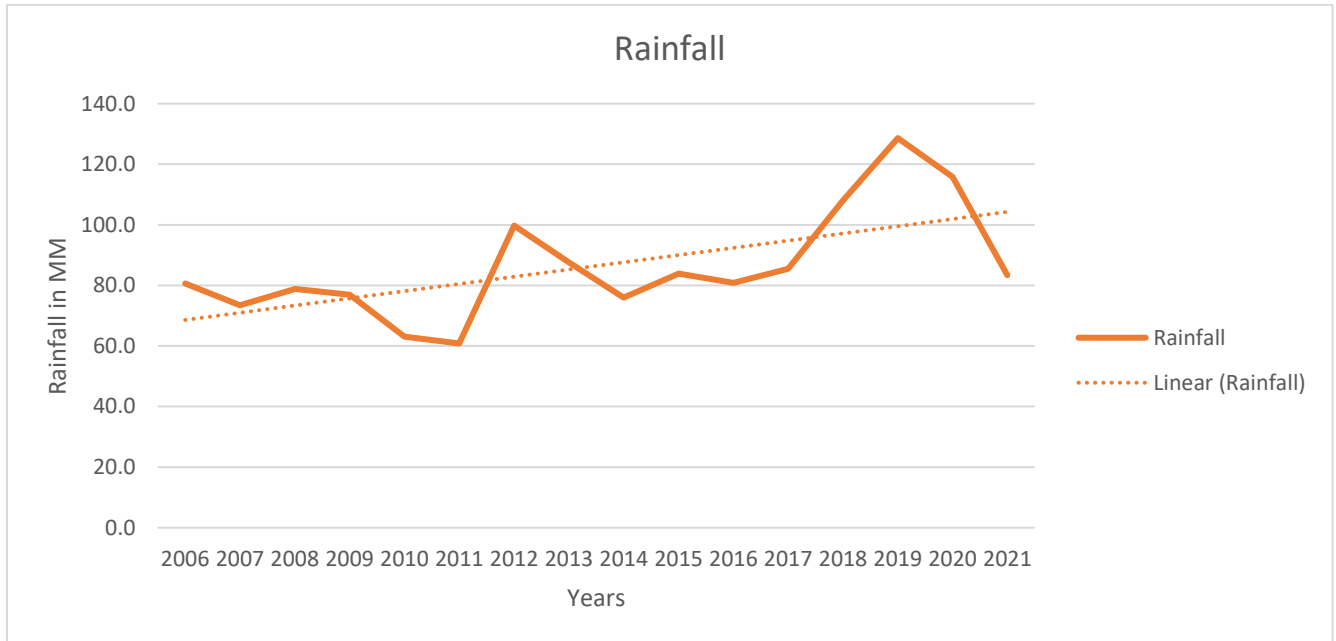


Figure 2: Annual Mean Rainfall for Yamaltu-Deba (2006-2021)

Source: NMetS Abuja

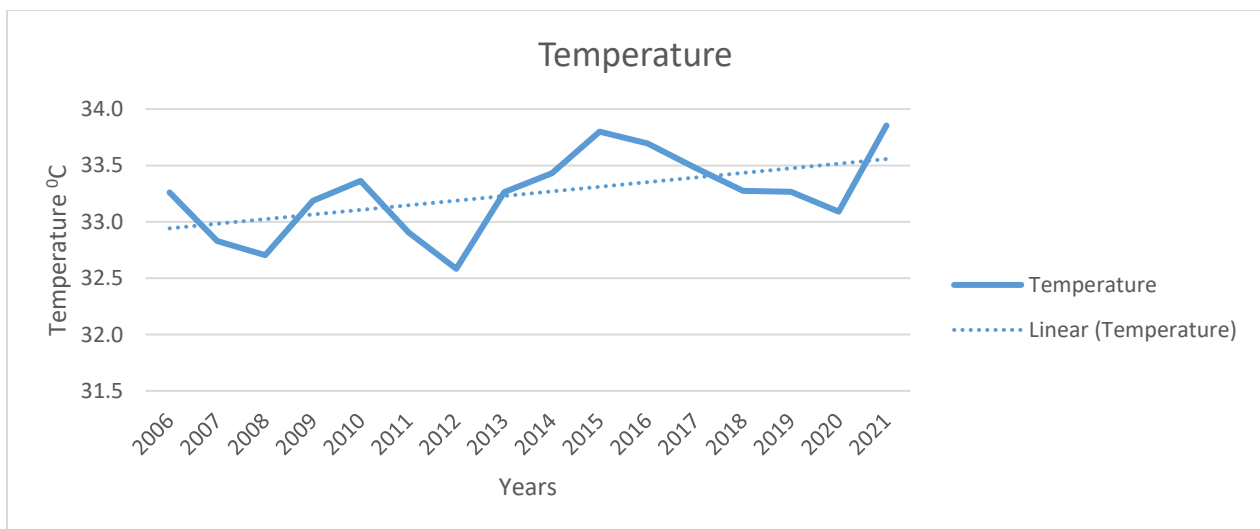


Figure 3: Annual Maximum Temperature for Yamaltu-Deba

Source: Source: NMetS Abuja



The data reveals that the highest temperature, averaging 33.9°C, was recorded in 2021, while the lowest, averaging 32.6°C, was noted in 2012. Overall, temperatures have consistently remained high with minor fluctuations. Due to the wide range, many livestock may be affected, resulting in low yield and poor quality calves.

Figure 2 showcases the monthly rainfall amounts in millimetres. The data indicates that the highest rainfall, at 128.6 mm, was observed in 2019, whereas the lowest, at 63 mm, occurred in 2010.

Rainfall patterns have been irregular over the years, with some years experiencing above-average rainfall and others below. Consequently, the analysis suggests that Yamaltu-Deba's climate is characterized by low and erratic rainfall, along with significant temperature variations. These conditions notably have impacted on livestock production in the region. Temperature fluctuations adversely affect livestock in various ways, such as causing heat stress, leading to reduced feed intake, growth rates, and reproductive performance. Heat stress also elevates disease and parasite prevalence among livestock. Conversely, low temperatures decrease feed intake and weight gain in livestock, while increasing the likelihood of respiratory ailments.

Furthermore, rainfall variability significantly influences livestock production. Insufficient rainfall can diminish pasture availability and quality, resulting in inadequate nutrition for livestock, thereby reducing weight gain, milk production, and reproductive performance. Moreover, low rainfall can escalate water scarcity issues, exacerbating the impacts of heat stress on livestock.

The aforementioned investigation is reinforced by Mohammed et al. (2019) who analysed the long-term trends in temperature and rainfall in Gombe State, Nigeria, and found that there has been a significant increase in temperature and a decline in rainfall over the past few decades. Another study by Abaje et al. (2018) examined farmers' perceptions in Gombe State on climate change and variability. It revealed that farmers noted shifts in temperature and rainfall patterns, leading them to adjust their farming techniques to manage these changes.

1.5.2 Prevalent Livestock Farming Practices and Management Techniques

This section delves into the primary practices of livestock farming, including the types of livestock reared, herd sizes, and the management methods employed by rural livestock farmers in the study area for cattle, sheep, goats, and indigenous chickens. These insights shed light on their significance for sustainable agriculture, with a summary provided in Table 2.



Table 2: Livestock Farming Practices and Management Techniques

Livestock Type	Typical Herd Size	Common Practices	Management Techniques
Cattle	50-100	Free-range grazing Intensive feeding in feedlots Breeding for beef or dairy production Health monitoring and vaccination schedules	Pasture rotation to prevent overgrazing Regular health checks and vaccinations Monitoring feed consumption and weight gain Regular health checks and treatment for illnesses
Sheep	100-300	Rotational grazing systems Shearing for wool production Lambing management and ewe nutrition	Flock supervision for predator control Wool quality assessment and marketing strategies Monitoring for signs of disease and parasite infestation
Goats	50-200	Extensive grazing systems Meat production Brush clearing in land management Hoof care and parasite control	Hoof trimming and care Fencing and pasture management Nutritional supplementation for browsing animals Regular health checks and deworming
Indigenous chickens	50-1000	Free-range feeding Simple shelters or coops Water Provision Disease prevention	Foraging for insects, seeds, and greens in addition to supplemental feed. Protection from predators, adverse weather, and providing roosting space. Use of shallow bowls, troughs, or nipple drinkers Measures, such as maintaining clean housing, practising proper sanitation, and



Natural mating	limiting exposure to wild birds or other potential disease vectors, traditional herbal remedies or natural supplements Roosters and Hens allowed to mate freely within the flock.
Egg Collection and Meat Production	Eggs are collected regularly to prevent breakage, contamination, or predation. Slaughtering and processing conducted on-farm or in local communities.
Basic Record-Keeping	Simple records of flock size, egg production, mortality rates, and other relevant information

Source: Author's field work, 2023

The study's examination of cattle management practices reveals a distinct approach, encompassing both free-range grazing and intensive feeding in feedlots. These methods are complemented by management techniques such as pasture rotation and regular health checks, all of which are essential for optimizing both productivity and animal welfare. For instance, the implementation of rotational grazing not only ensures sufficient grazing areas for cattle but also aids in biodiversity conservation by preventing overgrazing and promoting the regeneration of vegetation, as highlighted in Table 2.

Similarly, in sheep farming, the utilization of rotational grazing systems and sharing for wool production represents common practices. These are accompanied by effective management techniques, including flock supervision for predator control and vigilant monitoring for signs of disease and parasite infestation, as indicated in the table. Such practices not only ensure the well-being of the sheep but also contribute to the preservation of ecosystem health, as they prevent habitat degradation and promote diverse vegetation growth.

In goat farming, prevalent practices include the utilization of extensive grazing systems and brush clearing, which are essential for maintaining optimal herd health and pasture management. These methods, as outlined in the Table 2, are complemented by focused attention on hoof trimming, nutritional supplementation, and regular health checks to effectively control parasite infestation and ensure the well-being of the goat herd.

Indigenous chicken farming is known for its free-range feeding and the provision of simple shelters, which are in line with the practices mentioned in Table 2. These techniques are focused on disease prevention and natural mating to maintain the health and genetic diversity of the chicken



flock. Additionally, the implementation of basic record-keeping aids in the systematic monitoring of flock performance and productivity, as indicated in Table. 2

The study by Tongol, Pillones, and Pardillo (2011) who examined the management practices of backyard goat production in Claveria, Misamis Oriental, Philippines is in harmony with the findings of the preceding study. The study interviewed 43 goat raisers, finding that 58% owned a breeder buck, with 30% having unknown breeds. Most raisers (62%) built goat sheds, while 28% tethered goats. Only 51% kept farm records. Many preferred improved goat breeds for performance, emphasizing traits such as growth rate and body size.

1.5.3 Perceived Climate Variability Impact on Livestock Production and Adaptation Strategies

This section delves into the perceived impact of climate variability on livestock production, as well as the distinct climate adaptation strategies adopted by rural livestock farmers in response to observed climate variability. The findings are detailed in Table 3.

Table 3: Perceived Climate Variability Impact on Livestock Production and Adaptation Strategies

Type of Livestock	Impact of climate variability	Adaptation Strategy
Cattle	Cattle experience heat stress during heatwaves, leading to reduced milk production and weight loss	Farmers respond by providing shade structures, and cooling systems, and ensuring ample water and ventilation.
Sheep	Sheep are affected by changes in precipitation patterns, impacting forage quality and availability, resulting in malnutrition and reduced wool and meat production	Farmers adapt by diversifying forage crops and implementing rotational grazing.
Goat	Goats suffer from water and forage scarcity during prolonged droughts, resulting in decreased milk and meat production	Farmers promote drought-resistant vegetation and provide supplemental feeding.
Poultry	Poultry face increased mortality and stress during extreme weather events	Farmers strengthen coop structures and introduce heat-tolerant breeds.

Cattle are susceptible to heat stress during heatwaves, which results in decreased milk production and weight loss, adversely affecting their welfare and productivity (Table 3). To mitigate these impacts, farmers implement various measures. They provide shade structures, cooling systems such as fans or misters, and ensure ample water and ventilation. These strategies help alleviate heat stress, maintaining milk production and minimizing weight loss in cattle.

Sheep are impacted by changes in precipitation patterns, affecting forage quality and availability. This leads to malnutrition and reduced wool and meat production, impacting overall productivity. To address these challenges, farmers diversify forage crops and implement rotational grazing practices. Diversification ensures a stable food supply for sheep, while rotational grazing optimizes



forage utilization and minimizes overgrazing (Table 3) These strategies uphold sheep health and productivity despite fluctuations in precipitation.

Goats suffer from water and forage scarcity during prolonged droughts, resulting in decreased milk and meat production. Drought conditions severely limit essential resources for goat farming. To counter these effects, farmers promote the cultivation of drought-resistant vegetation and provide supplemental feeding. By ensuring access to sufficient food and water resources, farmers mitigate the negative impacts of drought on goat productivity, sustaining milk and meat production levels (Table 3)

Poultry faces increased mortality and stress during extreme weather events such as heatwaves or storms, disrupting farming operations and posing risks to bird health and welfare. In response, farmers strengthen coop structures to withstand extreme weather conditions and introduce heat-tolerant poultry breeds. Enhancing infrastructure and selecting resilient breeds help reduce mortality rates and minimize stress among poultry flocks, ensuring the continuity of egg and meat production (Table 3)

The study conducted by Ayal, Radeny, Desta, and Gebru (2018) on the impact of climate variability on the livestock system and livestock disease among pastoralists in Borana, Southern Ethiopia is in harmony with the aforementioned analysis. Climate variability and extremes were identified as significant factors adversely affecting the livestock sector, both directly and indirectly, by exacerbating the prevalence of livestock diseases, distorting production systems, and reducing sector profitability.

Similarly, an interviewee aptly stated "As a long-time livestock farmer in our community, I've witnessed firsthand the detrimental impact of climate variability on our animals and livelihoods. Over the years, unpredictable weather patterns, including erratic rainfall and prolonged droughts, have wreaked havoc on our pastures and water sources, leading to reduced forage availability and water scarcity for our livestock. This has resulted in decreased milk and meat production, as well as increased susceptibility to diseases due to weakened immune systems. In order to adapt to these challenges, we've had to implement various strategies such as investing in additional water sources, adjusting our breeding practices, and diversifying our herd composition. However, despite our best efforts, the ever-changing climate continues to pose significant threats to our livestock production, making it increasingly difficult to sustain our livelihoods."



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