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Climate change and livestock production in Africa

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Abstract

Climate change presents severe global challenges, with regions like Africa experiencing long-term shifts in temperature, precipitation, and wind patterns. Over the past two decades, rising surface temperatures and sea levels have been key indicators of this change, significantly affecting livestock production, a vital sector for rural livelihoods. Livestock farming, which relies on climate and natural resources, is particularly vulnerable, with rural farmers facing considerable risks despite its crucial role in food security and income. Studies on climate change's effects on livestock productivity emphasise the importance of temperature and precipitation, noting that higher temperatures typically reduce productivity, while droughts caused by reduced rainfall further exacerbate the challenges. On the other hand, increased rainfall benefits livestock by improving water availability and forage growth. Recent studies indicate that climate change negatively impacts livestock at the microeconomic level. However, the complexities of these effects, particularly the influence of socioeconomic factors such as market volatility, population growth, and conflicts, have not been thoroughly explored. As the climate crisis escalates, reliable data and effective adaptation strategies become increasingly important to mitigate these risks and ensure the long-term sustainability of livestock farming in Africa. Therefore, this study aims to study climate change and African livestock production. It is essential to expand research to include underrepresented livestock regions. Effective responses to climate change must be context-specific and holistic, with a more diversified focus addressing the impacts on non-ruminant livestock. It is crucial to conduct more research on the effects of climate change on livestock in some detail to develop practical solutions that support the resilience of rural livestock communities in Africa.

Key Words:

Introduction

Climate change continues to be a significant concern globally, posing risks to peace and economic stability. The Intergovernmental Panel on Climate Change (IPCC) predicts that global average surface temperatures will rise soon, while rainfall patterns have grown more unpredictable. In Africa, data from the World Meteorological Organization and the IPCC reveal that the continent has experienced the highest increase in average surface temperatures worldwide (IPCC, 2022). Climate change is emerging as a critical global developmental issue, with SSA expected to face particularly severe effects due to limited resources and adaptive capacity. These impacts are evident in extreme events like floods, storms, heat waves, and droughts (Archer et al., 2021). In South Africa, climate models suggest that temperatures could rise between 5°C and 8°C by 2050, with projections of more hot days, fewer cold spells, reduced overall rainfall, and potentially increased rain along the southern coast. Agriculture, which depends on stable climate conditions, is especially vulnerable to these changes. Given its role in contributing about 3% to South Africa's GDP, any agricultural disruption significantly impacts the economy (Nyoni et al., 2022). Furthermore, over 80% of the land in South Africa is non-arable and better suited for livestock farming, which supports the livelihoods of many rural and landless communities (Vetter et al., 2020). The country has a rich diversity of livestock, with approximately 12.8 million cattle, 19 million sheep, 1.8 million goats, and 1.5 million pigs. However, climate change's effects on livestock—such as higher death rates, slower growth, and reduced milk production—are causing serious challenges for South African livestock farmers (Maluleke et al., 2020). Due to the scarcity of land for new agricultural projects and increasing concerns over deforestation and climate change (Bagdatlı & Belliturk, 2016), temperature and precipitation are considered the most critical climatic factors and extreme events (Nasreldin and Elsheikh, 2022). Seasonal temperature fluctuations are slight; however, there is a significant decline in precipitation and the rainy season's length (Elsheikh, 2021; Elsheikh et al., 2022a). In South Africa, farmers with limited resources manage over half of the livestock population within smallholder traditional farming systems. These systems mainly support unemployed and retired individuals and children who benefit from selling livestock and animal products such as meat and milk. Although livestock farming is vital in enhancing the livelihoods of low-income populations, it operates under challenging environmental conditions that often limit productivity (Musemwa et al., 2012). Strengthening the resilience and efficiency of communal livestock systems is crucial for sustainable production and reducing food insecurity (Elsheikh et al., 2023; Bagdatlı et al., 2023). Livestock also has the potential to enhance climate resilience, often being more adaptable to changing

conditions than crop-based systems. However, to improve livestock's resilience, a deeper understanding of how climate change affects rural farming communities is essential (Maluleke et al., 2020). Effective policies and practices require detailed, sector-specific data on the range and scale of climate impacts, as these vary among livestock systems. Understanding these variations is vital to creating policies and interventions well-suited to specific needs (Archer et al., 2021). Coordinating climate impact knowledge and adaptation efforts across different levels helps identify shared challenges and fosters collaboration among production systems (Elsheikh et al., 2024). Additionally, gaps in research on climate adaptation in rural livestock production limit the sector's ability to anticipate and respond to climate impacts and track progress in adaptation efforts over time (Maluleke et al., 2020). Assessing the effects of climate change on various components of the water cycle is crucial for managing this essential resource, as water availability is increasingly strained due to growing societal demand (Elsheikh et al., 2022b; Bagdatlı & Arslan, 2019; Bagdatlı & Can, 2019).

While the livestock sector in Africa is highly complex, research on climate change's impact on rural communities has lagged compared to studies on crop production, and available evidence remains fragmented. Consistent data on climate-related damages and losses in the livestock sector is threatened. Livestock data is inherently challenging due to diverse production systems, agro-ecological zones, and differing production goals. Moreover, practices across livestock systems vary widely, shaped by cultural, socioeconomic, and institutional factors. Given its wide-ranging socio-economic and cultural benefits, livestock's role in Africa's development agenda is crucial. Despite ongoing efforts, climate change threatens rural livestock production, demanding urgent action (Zhou et al., 2022). This study seeks to address these knowledge gaps by systematically reviewing existing literature on climate change's effects on livestock production and pinpointing gaps that hinder effective adaptation strategies in rural South Africa and Sub-Saharan Africa (SSA) communities.

Climate change and livestock production in Africa

South Africa

Concerns around global climate change are escalating worldwide, with no country spared from its impacts, though vulnerability varies across regions. South Africa faces this challenge, with climate change marked by long-term temperature, precipitation, and wind patterns shifts. Over the last two decades, rising surface temperatures and sea levels have been central indicators of this change. Among agricultural sectors, livestock is particularly vulnerable due to its dependence on climate and natural resources, making rural livestock farming highly risky despite its importance for socio-economic livelihoods in rural areas. This growing climate impact on livestock has captured the attention of researchers, policymakers, and activists in South Africa (Zhou et al., 2022).

The livestock production sector in South Africa is highly vulnerable to climate risks, with both past and ongoing case studies highlighting the severity of these impacts. In the Suid Bokkeveld, an arid region in western South Africa where livestock is a primary source of income for most farmers, a participatory research study investigated the effects of climatic risks on small livestock. The study included weekly condition assessments, behavioral observations, and weather data measurements. The findings revealed significant lamb mortality due to cold conditions and a loss of condition during the dry season, primarily in summer. However, there is some overlap with cross-over summer rainfall (Archer et al., 2021). In the Limpopo region, Stroebel et al. (2011) observed that the impacts of drought were particularly evident in cattle herds, including significant effects on herd health and size. The study specifically focused on whether to cull or sell cattle, finding that such decisions are complex and influenced by how cattle are viewed and valued. Understanding these factors is crucial for making recommendations on managing cattle herd sizes in response to climatic risks.

The available literature highlights the importance of livestock to resource-limited communities, stressing the urgency for adaptation strategies to counter climate risks. Analysis of studies on climate shocks and adaptive responses is crucial for pinpointing priority areas within livestock production that need immediate action. The impact of climate change on rural livestock has gained significant attention since the 2000s, especially after a severe El Niño event triggered one of South Africa's worst droughts in 35 years, leading to disaster declarations in eight provinces. Public debates and policy discussions at all levels intensified as rural livestock farmers faced substantial production and financial losses exacerbated by the drought (Zhou et al., 2022).

From 2013 to early 2016, seven of South Africa's nine provinces reported a 14.4% decline in cattle herds due to climate stress (Maluleke & Mokwena, 2017). Farmers' debts rose by 9%, and feed costs skyrocketed by 177% as farmers struggled to sustain their core herds, many relying on costly feed purchases. Drought forecasting challenges and the reluctance to sell livestock assets further complicated the situation, with poor body conditions and market saturation resulting in low prices, unsold animals, and increased deaths. Predicting climate change risks remains complex, with climatic, ecological, and socio-economic factors influencing livestock losses. The scarcity and reliability of current data on climate effects in communal livestock farming are under scrutiny as climate scientists and policymakers seek more comprehensive and dependable information (Taruvinga et al., 2013).

Sub-Saharan Africa

Livestock production is essential for sustaining populations and diversifying rural communities, helping them cope with declining crop yields. However, recent crises—such as the COVID-19 pandemic and the Russo-Ukrainian war—pose additional threats to livestock production across Sub-Saharan Africa, compounding the adverse effects of climate change. COVID-19 restrictions, including social distancing and lockdowns, limited access to livestock markets, driving up production and feed costs for farmers unable to sell their livestock. The pandemic also restricted access to essential animal feed, veterinary care, and reproductive supplies, all critical for livestock production (FAO, 2020). Furthermore, the Russo-Ukrainian conflict has driven up wheat prices, affecting livestock feed costs and, subsequently, the quality and cost of beef production, as wheat is a primary feed ingredient (Ateba Boyomo et al., 2024).

Animal welfare and production ecology are valuable for analyzing climate change's effects on livestock production. Empirically, studies have shown climate change's negative impacts on livestock at the microeconomic level. However, these studies have limitations. For instance, while Emediegwu and Ubabukoh (2023) identify climate change transmission channels—such as maize prices, water scarcity, agricultural output, and conflict—they do not empirically test these factors. Additionally, the empirical literature on climate change has established that two-way fixed-effects panel data models are preferable to fixed-effects models, as they address omitted variable issues and reduce unobserved heterogeneity among individuals within a dataset (Ateba Boyomo et al., 2024).

Godde et al. (2021) highlight the significant influence of climate change on livestock production. Studies like Habte et al. (2022) and Emediegwu and Ubabukoh (2023) show that rising temperatures negatively impact livestock production in Sub-Saharan Africa, while research by Feng et al. (2021) reveals a positive correlation between rainfall and livestock productivity. Increased rainfall supports livestock production by ensuring animal water availability and forage growth, boosting productivity. Conversely, in Africa, reduced precipitation—and consequently, lower water availability—leads to declining livestock production, a pattern mirrored by the effects of rising temperatures, as drought often results from reduced rainfall. The World Meteorological Organization (WMO, 2022) confirms drought's severe impact on livestock in the Horn of Africa, including countries like Ethiopia, Kenya, and Somalia.

According to Mbow et al. (2019), increased volatility in cereal prices leads to reduced livestock production. The FAO's May 2022 quarterly bulletin supports this, reporting a 12.6% rise in food prices in West and Central Africa from February to March 2022. This increase is attributed to reduced wheat production in the drought-prone Sahel and the effects of the Ukraine conflict. Additionally, studies like Aragón et al. (2021) show that agricultural productivity positively affects livestock production. However, as Rehman et al. (2017) point out, population growth can reduce livestock production due to rapid urbanisation and demographic pressures across Africa, where climate shocks, conflicts, and tropical diseases worsen livestock scarcity.

Conclusion

With the right adaptation strategies, livestock can play a significant role in food security and sustainable development. Climate change is now a pressing challenge, particularly for underprivileged rural populations who rely directly on livestock for survival. The study suggests expanding research to cover more geographic areas and including non-ruminant species affected by different climate stresses. To respond effectively to climate impacts, mitigation strategies should be context-specific and holistic, aiming to enhance livestock production within rural farming communities.

Drought, a primary climate stressor, has prompted adaptive strategies like destocking, supplementary feeding, breed improvements, and diversification efforts. Expanding research to cover underrepresented livestock regions is essential. Effective climate change responses must be tailored and comprehensive, with more diversified research to include the effects on non-ruminant livestock. This paper emphasizes that response capacities will likely be underestimated without clarity on the extent of climate impacts. Additional focused research on adaptation and mitigation is crucial to creating practical solutions for rural livestock communities.

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