

# Impacts of Climate Change on Livestock Productivity and Adaptation Strategies among Smallholder Farmers in Ethiopia: A Review on Climate Smart Livestock Production

Sura Degefu<sup>1\*</sup>, Dawit Milkias<sup>1</sup>

<sup>1</sup>Research Quality Assurance and Evaluation Directorate, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia

<p><b>Abstract:</b> Ethiopia has the largest livestock number in Africa. Nevertheless, the productivity of this sector faces susceptibility to the effects of climate change and associated risks. Therefore, it is imperative to conduct further research and gather data to gain a deeper understanding of these impacts. This understanding will facilitate the design of effective adaptation and mitigation measures, allowing Ethiopia to effectively respond to the challenges posed by climate change and variability. The primary aim of this article is to provide a review of the impacts of climate change on livestock productivity and summarize adaptation strategies employed by small-scale farmers in Ethiopia. The study highlights an increasing trend in the intensity and frequency of drought occurrences in the country, particularly in pastoralist and agro-pastoralist regions. These trends exacerbate climate-related issues such as limited access to rainfall and water, reduced availability and quality of animal feed, heightened risks of animal diseases, and increased heat stress, resulting in diminished livestock performance. Consequently, collaboration on adaptation programs among stakeholders is crucial to bolster the traditional coping mechanisms of pastoralists and agro-pastoralists in response to the adverse effects of climate change. Additionally, comprehensive research is needed to identify and select camel and goat breeds specifically suited for drought-prone areas, serving particular purposes.</p> <p><b>Keywords:</b> Adaptation; Climate change; Impact; Livestock productivity and Adaptation Strategies.</p>	<p style="text-align: center;"><b>Review Paper</b></p> <p><b>*Corresponding Author:</b>  <i>Sura Degefu</i>                      Research Quality Assurance and Evaluation Directorate, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia</p> <p><b>How to cite this paper:</b>                      Sura Degefu &amp; Dawit Milkias (2024). Impacts of Climate Change on Livestock Productivity and Adaptation Strategies among Smallholder Farmers in Ethiopia: A Review on Climate Smart Livestock Production. <i>Middle East Res J Econ Management</i>, 4(3): 84-87.</p> <p><b>Article History:</b>                        Submitted: 24.03.2024                          Accepted: 26.04.2024                          Published: 16.05.2024  </p>
<p><b>Copyright © 2024 The Author(s):</b> This is an open-access article distributed under the terms of the Creative Commons Attribution <b>4.0 International License (CC BY-NC 4.0)</b> which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.</p>	

## 1. INTRODUCTION

Ethiopia has the largest livestock number in Africa, comprising 65 million cattle, 40 million sheep, 51 million goats, 8 million camels, and 49 million chickens in 2020 (Central Statistics Agency, CSA, 2020). Livestock farming serves as a significant source of income, sustenance, and livelihood for rural communities in Ethiopia. This sector contributed substantially to the country's economy, accounting for up to 40% of agricultural Gross Domestic Product (GDP), nearly 20% of total GDP, and 20% of national foreign exchange earnings in 2017 (World Bank, 2017).

Nevertheless, the productivity of this vital sector is vulnerable to the adverse effects of climate change. Ethiopia experiences climate variability and change, manifesting in frequent droughts, floods, heatwaves, heavy rains, and strong winds (FDRE, 2007; Bagath *et al.*, 2019; Hidoso & Guyo, 2017). These climate impacts are anticipated to worsen the

susceptibility of livestock systems, exacerbating existing challenges such as rapid population and economic growth, heightened food demand (including livestock and its products), and increased competition over limited resources.

Climate change affects livestock productivity by disrupting ecosystem services like water availability, forage quality and quantity (Gashaw *et al.*, 2014; Hidoso & Guyo, 2017; Kefyalew & Tegegn, 2012), triggering disease outbreaks, inducing heat stress in animals (Bagath *et al.*, 2019), and reducing livestock species diversity (Yilma *et al.*, 2009). These changes diminish available feed resources, create conditions conducive to disease transmission, and increase the vulnerability of livestock species to vectors and pathogens (Desalegn, 2016; Yilma *et al.*, 2009).

Hence, it becomes imperative for Ethiopia to transition towards a new sustainable development

approach to confront and adjust to the evolving climatic conditions (Anita *et al.*, 2010; Belay *et al.*, 2017 FDRE, 2011). Over recent decades, Ethiopia has increasingly emphasized the development and implementation of both mitigation and adaptation strategies. Key initiatives include promoting climate-resilient livestock and crops, developing drought-resistant crops, enhancing soil conservation methods, and refining water management practices (Tewodros, 2018; Muchuru and Nhamo, 2019). Despite these strides, Ethiopia still grapples with significant challenges that need to be addressed to effectively adapt to and mitigate the impacts of climate change and unpredictable weather events on livestock production.

Hence, it is imperative to conduct research, comprehend, and devise effective adaptation and mitigation measures tailored to Ethiopia's response to climate change and its variability. While there is a growing body of literature on climate variability and change in Ethiopia, studies must specifically identify and evaluate viable adaptation and mitigation strategies focusing on the livestock sector. While existing studies have primarily examined how climate change affects livestock production (Fereja, 2016; Desalegn, 2016; Gashaw *et al.*, 2014; Hidosa & Guyo, 2017; Kefyalew & Tegegn, 2012; Yilma *et al.*, 2009), there is a scarcity of research on adaptation strategies. Although some researchers have highlighted various community and government-led adaptation strategies, their applicability at the national level is limited due to the diversity of findings (Hirpha *et al.*, 2020).

Therefore, this study aims to synthesize and summarize research findings in Ethiopia pertaining to this topic to establish a shared understanding for further development and implementation of appropriate adaptation strategies to mitigate climate change impacts on livestock productivity. Consequently, this review aims to address the following research questions within the Ethiopian context: i) What are the potential impacts of climate change on livestock productivity in Ethiopia? ii) How can local communities adapt to these impacts? Additionally, this review could serve as a valuable resource for global organizations and donors supporting Ethiopia's climate change adaptation and mitigation endeavors. By identifying successful solutions, it ensures that limited resources are directed towards the most effective and sustainable initiatives.

## 2. LITERATURE REVIEW

### 2.1. Concepts and Definitions of Key Terms

**Adaptation:** Adaptation to climate change involves making adjustments within ecological, social, or economic systems in reaction to current or anticipated climatic influences and their consequences. It encompasses alterations in procedures, behaviors, and frameworks aimed at lessening potential harm or capitalizing on opportunities arising from climate change (IPCC, 2001).

**Livestock:** Are animals, including cows and bulls, raised on farms primarily for milk, meat, and profitability (Ibd). Climate change refers to significant and enduring variations in the average state or variability of the climate, which may result from natural processes, external forces, or persistent alterations in atmospheric composition or land use due to human activities (IPCC, 2007).

**Livestock production:** Involves the management and breeding of animals by agricultural operations, focusing on products like milk, eggs, meat, and skin (Ibd).

### 2.2. Impacts of Climate Change on Livestock Production and Productivity in Ethiopia

The relationship between livestock and climate change is closely intertwined, potentially impacting the costs and returns of livestock production (Iqbal, 2013). The anticipated effects of climate change are expected to worsen the vulnerability of livestock systems, compounded by existing factors such as rapid population and economic growth, increased food demand, and heightened competition over limited resources (Iqbal, 2013).

Various sources suggest the detrimental impact of climate change on smallholder livestock farmers' productivity in Ethiopia. The FAO (2008) predicts an increase in animal diseases, particularly in Africa, which already faces a substantial burden of such diseases. Shambel's (2017) study underscores the threat climate change poses to livestock production in Ethiopia, citing deteriorating quality and reduced availability of natural pastures due to changing climate conditions. Additionally, unreliable water sources, drying up due to high temperatures and reduced rainfall, further compound the challenges faced by livestock owners (Shambel, 2017).

Studies like that of Wassie and Fekadu (2014) highlight climate variability as a primary contributor to the livestock crisis in Southern Ethiopia, impacting natural resources crucial for livestock farming. Habte *et al.*, (2022) find that climate variability negatively affects livestock productivity in Southeastern Ethiopia, with increasing drought occurrences exacerbating challenges such as water accessibility, feed availability, and disease risks.

The vulnerability of livestock species to climate variability varies based on their adaptive mechanisms (Fereja, 2016). For instance, research by Wako *et al.*, (2017) reveals higher mortality rates among cattle and sheep during drought conditions compared to goats and camels, suggesting species-specific responses to climate stressors.

Climate change affects livestock productivity by disrupting ecosystem services such as water availability and altering forage quality and quantity

(Gashaw *et al.*, 2014; Hidosa & Guyo, 2017; Kefyalew & Tegegn, 2012). It also contributes to disease outbreaks, heat stress in animals (Bagath *et al.*, 2019; Morand, 2015), and reduces livestock species diversity (Yilma *et al.*, 2009). Diminished feed resources and conducive environments for disease transmission further exacerbate the susceptibility of livestock species to pathogens and vectors (Desalegn, 2016; Yilma *et al.*, 2009).

### 2.3. Smallholder livestock farmers adaptation Strategies to climate change in Ethiopia

To mitigate the adverse effects of climate variability and change on livestock production, adaptation strategies have been developed and implemented in Ethiopia. These strategies are crucial for minimizing the negative impact of climate variability and change on livestock farming. Traditionally, smallholder livestock farmers have relied on their environmental knowledge to adapt to various ecological and climatic changes (Tewodros, 2018). However, challenges such as increasing population, urbanization, environmental degradation, and higher animal consumption have diminished the effectiveness of these traditional coping mechanisms (Sidahmed *et al.*, 2008).

Studies like that of Tessema *et al.*, (2013) shed light on the adaptation strategies adopted by smallholder farmers in Eastern Hararghe Zone, which include production adjustments, breeding strategies, market responses, institutional and policy changes, as well as advancements in science and technology, capacity building for livestock keepers, and improvements in livestock management systems.

In terms of coping strategies for climate change, there are varying findings among pastoralist farmers in Ethiopia. For example, Mengistu and Haji (2016) highlight herd mobility and migration as common drought coping strategies among Ethiopian Borana pastoralists. Conversely, Tsige (2018) suggests that reducing livestock numbers through selling is the primary coping measure adopted by farmers in Hawassa Zuria woreda. Despite historical norms discouraging selling of cattle and other animals within the Gadaa system, recent studies indicate attempts by East Guji pastoralists to sell animals during early drought stages (Kebebew *et al.*, 2001).

The diversification of livelihood options, however, is not widely practiced as a drought coping strategy among pastoral groups in Ethiopia (Sandford & Habtu, 2000). Nevertheless, Kebebew *et al.*, (2001) note efforts towards income diversification among Borana pastoralists to mitigate drought consequences.

Habte *et al.*, (2022) emphasize the climate-related challenges faced by pastoralists/agro-pastoralists in Ethiopia, including issues related to rainfall/water accessibility, feed quality and availability, animal

disease risks, and heat stress, all of which contribute to reduced livestock performance. In response, farmers have adopted coping strategies such as temporary migration/nomadism to areas with better pasture, reducing livestock numbers, reserving grazing/standing hay, and shifting to browse livestock species like camels and goats. These adaptive measures are aimed at addressing feed and water shortages and mitigating climate-related challenges in the country.

### 3. CONCLUSION

Ethiopia boasts the largest livestock population in Africa, yet this sector's productivity is highly vulnerable to the impacts of climate change and associated risks. Therefore, this study aims to synthesize and summarize impacts of climate change on livestock productivity and adaptation strategies employed by small-scale farmers in Ethiopia. This is crucial to establish a shared understanding for further development and implementation of appropriate adaptation strategies to mitigate climate change impacts on livestock productivity.

This study indicated that an escalating trend in the intensity and frequency of drought occurrences in Ethiopia, particularly in pastoralist and agro-pastoralist regions. This exacerbates climate-related challenges such as limited rainfall and water access, reduced feed quality and availability, heightened risk of animal diseases, and increased heat stress, ultimately leading to diminished livestock performance. Therefore, addressing these challenges necessitates collaborative adaptation programs involving intended beneficiaries to bolster traditional coping mechanisms among pastoralist and agro-pastoralist communities in response to the adverse impacts of climate change. Furthermore, extensive research is crucial to identify and select camel and goat breeds suited for specific purposes in drought-prone areas. Such initiatives are essential for enhancing the resilience of Ethiopia's livestock sector in the face of climate change.

### REFERENCES

- Anita, W., Dominic, M., & Neil, A. (2010). Climate change and agriculture impacts, adaptation and Mitigation: Impacts, adaptation and Mitigation: OECD publishing
- Bagath, M., Krishnan, G., Devaraj, C., Rashamol, V., Pragna, P., Lees, A., & Sejian, V. (2019). The impact of heat stress on the immune system in dairy cattle: A review. *Research in veterinary science*, 126(9).
- Belay, A., John W. R., Teshale, W., & John, F. M. (2017). Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. *Agric & Food Secur*, 6(24).
- CSA. (2020). Agricultural Sample Survey 2019/20 [2012 E.C.]. Volume II report on livestock and livestock characteristics (private peasant holdings).

- Central Statistical Agency (CSA): Addis Ababa, Ethiopia.
- Desalegn, K. (2016). The climate change impacts on livestock production: A Review. *Global Veterinaria*, 16(2), 206–212
  - FAO (Food and Agriculture Organization). (2008). Climate change for fisheries and aquaculture: Technical background document from the expert consultation held on 7-9 April 2008, Rome. FDRE. 2007. Climate change adaptation programme of action (NAPA) of Ethiopia.
  - FDRE (Federal Democratic Republic of Ethiopia). (2011). Ethiopia's Climate-Resilient Green Economy Strategy (CRGE), Addis Ababa,
  - Fereja, G. B. (2016). The impacts of climate change on livestock production and productivities in developing countries: a review. *International Journal of Research Granthaalayah*, 4(8), 181–187.
  - Gashaw, T., Asresie, A., & Haylom, M. (2014). Climate change and livestock production in Ethiopia. *Adv Life Sci Technol*, 22, 39–42.
  - Habte, M., Eshetu, M., Maryo, M., Andualem, D., & Legesse, A. (2022). Effects of climate variability on livestock productivity and pastoralist's perception: The case of drought resilience in Southeastern Ethiopia. *Veterinary and Animal Science*, 16, 100240, <https://doi.org/10.1016/j.vas.2022.100240>
  - Hidosa, D., & Guyo, M. (2017). Climate Change Effects on Livestock Feed Resources: A Review. *Fish. Livest Prod*, 5, 259.
  - Hirpha, H. H., Mpandeli, S., & Bantider, A. (2020). Determinants of adaptation strategies to climate change among the smallholder farmers in Adama District, Ethiopia. *International Journal of Climate Change Strategies and Management*, 12(4) 463–476.
  - IPCC (Intergovernmental Panel on Climate Change). (2001). Climate Change Impacts, Adaptation and Vulnerability: IPCC Working Group II, Third Assessment Report. Cambridge, Cambridge University Press, Volume 57 09IPCC. 2001 report on Climate Change Impacts. <https://www.google.com.et/>
  - IPCC (Intergovernmental Panel on Climate Change). (2007). IPCC fourth assessment report: climate change 2007 (AR4). Available online at [www.ipcc.ch/publications\\_and\\_data](http://www.ipcc.ch/publications_and_data)
  - Iqbal, A. (2013). Livestock Husbandry. A Sustainable Livelihood in Ethiopia. *International Journal of Economy, Management and Social Sciences*, 2(8), 603-607.
  - Kebebew, F., Synnevaag, G., & Tsegaye, D. (2001). Traditional coping strategies of the Afar and Borana pastoralists in response to drought: Drylands Coordination Group.
  - Kefyalew, A., & Tegegn, F. (2012). The effect of climate change on ruminant livestock population dynamics in Ethiopia. 24(10), 185.
  - Mengistu, D., & Haji, J. (2016). Traditional Coping Strategies of Borana Pastoralists for Climate Extremes: A case of Yabello District, Borana Zone, Ethiopia. *International Journal of Engineering Innovation & Research*, 5(3), 7.
  - Muchuru, S., & Nhamo, G. (2019). A review of climate change adaptation measures in the African crop sector, *Clim Dev*, 11(10) 873–885.
  - Sandford, S., & Habtu, Y. (2000). Emergency response interventions in pastoral areas of Ethiopia.
  - Shambel, B. (2017). Impacts of Climate Change on Livestock Production, 7(8).
  - Sidahmed, A. (2008). *Livestock and climate change: Coping and risk management strategies for a sustainable future*. In: Livestock and Global Climate Change Conference Proceeding.
  - Tessema, Y. A., Aweke, C. S., Endris, G. S. (2013). Understanding the process of adaptation to climate change by smallholder farmers: The case of east Hararghe Zone, Ethiopia. *Agric. Food Econ*.
  - Tsige, F. (2018). Impact of Climate Change on Livestock production and its Adaptation Strategies in Hawassa Zuria and Hula Districts of Sidama Zonen, Southern Ethiopia. (MSc Thesis submitted to the Program of climate change and sustainable agriculture), Hawassa University Unpublished.
  - Tewodros, B. (2018). Adoption of climate-smart agricultural practices: determinants and challenges in gerar jarso woreda of Oromia, Ethiopia, MA thesis, Addis Ababa.
  - Wako, G., Tadesse, M., & Angassa, A. (2017). Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia. *Ecological Processes*, 6(1), 1–12.
  - Wassie, B., & Fekadu, B. (2014). The impact of climate change on pastoral production systems. A study of climate variability and household adaptation strategies in southern Ethiopian rangelands. WIDER Working Paper 2014/028.
  - World Bank. (2017). International Development Association: Project Appraisal Document on a Proposed Credit in the Amount of SDR 121.1 Million (US\$ 170 Million Equivalent) to The Federal Democratic Republic of Ethiopia for a Livestock and Fisheries Sector Development Project (Project Appraisal Document No. PAD2396). Washington DC.
  - Yilma, Z., Haile, A., GuerneBleich, E., & Ababa, A. (2009). *Effect of climate change on livestock production and livelihood of pastoralists in selected pastoral areas of Borana, Ethiopia*. ESAP Proceedings.