



CLIMATE CHANGE AND LIVESTOCK HEALTH: A REVIEW OF THE GLOBAL PERSPECTIVE

Climate Change

Zala

Akshardipsinh

Ashoksinh

Dr. Pina Bhatt

Ph.D. Student, Silver Oak University, Ahmedabad, Gujarat, India

Pro Vice Chancellor, Silver Oak University, Ahmedabad, Gujarat, India

ABSTRACT

Climate change is a long-lasting change in the weather patterns of a place or the entire planet. Climate change's impact on human societies is known by world but its effects on livestock is equally serious and unheeded. This review paper aims to explain the complex network of consequences that climate change have both direct and indirect impact on livestock health. Heat stress, a prevalent outcome of climate change, adversely affects both the quality and quantity of livestock product, especially milk. To mitigate effects on livestock populations, proactive measures can be implemented ensuring food security and sustainable agricultural practices.

KEYWORDS

Climate change, Livestock, Heat stress, Forage, Direct and Indirect impact

INTRODUCTION

Climate change is a long-lasting change in the weather patterns of a place or the entire planet. It can make weather patterns less predictable and cause regions to experience lower or higher than average temperatures. Climate change can also lead to more frequent and severe weather events such as storms, floods and droughts. Although the Earth's climate has changed throughout history, the current warming trend is happening much faster than usual and is mainly caused by human activities such as burning fossil fuels. Fossil fuels release greenhouse gases in the atmosphere, which trap heat and cause the planet to warm.

Climate change is one of the most important global challenges of our time. It has many consequences besides temperature rise and melting ice caps. It affects ecosystems and species all over the globe. Climate change's impact on human societies is known by world but its effects on livestock is equally serious and unheeded. This review paper aims to explain the complex network of consequences that climate change has on livestock.

The anticipated rise in surface temperatures as projected by the IPCC is predominantly driven by global atmospheric warming and escalating greenhouse gas concentrations, particularly carbon dioxide. This temperature surge, coupled with variations in precipitation pattern, has a profound impact on livestock, influencing aspects such as rainfall patterns, forage availability, production levels, reproductive performance and overall health. Livestock health is particularly susceptible to the effects of rising temperatures and changing precipitation patterns, highlighting the intricate relationship between climate factors and animal wellbeing. (Henry et al.,2012; sawalhah et al.,2019)

Review of Literature

The livestock sector in India is expected to face an increasingly formidable challenge due to the gradual effects of climate change. Projected temperature increases of 2.3 to 4.8°C across the country, along with the associated rise in precipitation, are poised to intensify heat stress in dairy animals. This heightened heat stress is anticipated to have detrimental effects on the productive and reproductive performance of these animals, ultimately reducing the economic feasibility of maintaining high-yielding dairy cattle in certain regions (Sirohi and Michaelowa, 2007).

Climate change can have various impacts on the well-being of livestock. One notable consequence is heating stress, which can result in metabolic disturbances, oxidative stress, immune suppression, and, in extreme cases, fatalities among livestock due to heightened temperatures and humidity. The changing climate can modify the accessibility and nutritional value of livestock feed, directly influencing their health, productivity, and overall welfare. The shifting climate patterns may elevate the occurrence of parasites and diseases that impact livestock, potentially causing diminished fertility, reduced

milk production, and heightened susceptibility to illnesses.

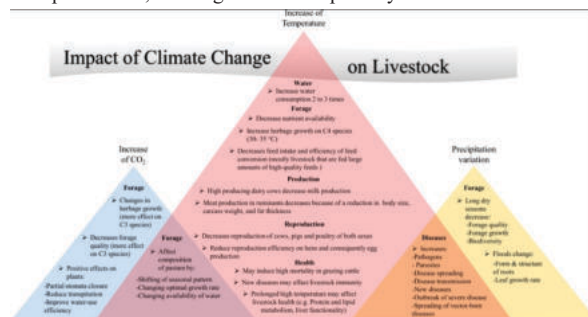


Figure 1: Shows Various Ways In Which Climate Change Can Impact Livestock (Source: United States Environmental Protection Agency (EPA))

As per Cheng et al.,2022 stated the impact of climate change on livestock shows both directly and indirectly. Direct consequences involve diminished feed intake, lowered production of animal milk and meat, compromised reproductive processes, stress from diseases and parasites, and increased mortality rates. Indirect effects encompass alterations in forage quality, availability of feed-grain, and shifts in disease and pest distributions, all of which can affect animal health, growth, and reproductive capabilities.

Direct Impact Of Climate Change On Livestock

Ali et al., 2020 highlighted the pressing issue of climate change's direct impact on livestock, particularly regarding reduced feed intake. Livestock exhibits diminished appetite, gut motility and rumination in response to elevated environment temperatures, resulting in decreased feed consumption. And godde et al., 2021 reiterated that decline in feed consumption directly stems from the difficulties posed by rising temperature and heat stress on livestock welfare. Other than this alterations in feedstuff crops yields, shifts in pasture composition and forage production and changes in forage quality due to climate change exacerbate the challenge of diminished feed intake in livestock.

Bernabucci u.,2019 emphasized the significant influence of climate change on the decreased production of animal milk and meat in livestock. Changes in environmental conditions, such as rising temperatures and humidity, directly influence the quality and regularity of livestock feed, resulting in diminished milk and meat output. Heat stress, a prevalent outcome of climate change, adversely affects both the quality and quantity of livestock product, especially milk. Elevated temperatures alter the composition of milk, affecting its organic and inorganic constituents, leading to financial losses for producers and diminished quality for consumers. Moreover, heat stress alters livestock behaviour, causing decreased activity, increased water consumption and reduced feed intake, ultimately impacting growth

rates, fertility and overall production efficiency in livestock.

Disruption caused by hyperthermia affects reproductive processes in both male and female livestock, resulting in reduced sperm production quantity and quality of males and decreased fertility in females. Heat stress disturbs physiological and cellular aspects of reproductive function, either by directly increasing body temperature or through physiological adaptations aimed at reducing hyperthermia. This stress induces an elevation in intracellular reactive oxygen species (ROS) and decrease in glutathione (GSH) levels, posing the threat to embryo viability. Oxidative stress contributes to several pregnancy related disorders such as preeclampsia, spontaneous abortion, intrauterine growth retardation resulting in pregnancy loss, defective embryogenesis and teratogenicity. (Gupta et al.,2007; Chandra et al.,2015)

Babayani et al., 2022 studied the profound impact of climate change on livestock health, particularly in relation to diseases and parasites. Alterations in environmental conditions driven by climate change influence the development, survival and distribution of parasites, there by shaping the dynamics of disease transmission in livestock. Parasitic disease has the potential to limit the geographical range of host species, endanger protected species and disrupt trophic interactions, resulting in significant implications for livestock health and production. With climate change continue to drive alterations in environmental suitability for parasites and affecting host parasite interactions, the risk of disease incidence and transmission in livestock is sensitive.

Indirect Impact Of Climate Change On Livestock

According to FAO 2016, the indirect consequences of climate change on livestock are diverse and affect numerous aspects that impact animal well being and efficiency. These secondary effects encompass fluctuations in crop yields for animal feed, modifications in the composition of pastures and production of forage, changes in the quality of forage, reduced water availability, heightened water consumption, shifts in disease patterns, and alterations in resource availability driven by factors such as temperature fluctuations and CO₂ levels. Furthermore, climate change can result in diminished productivity, altered metabolic processes, adjustments in production methodologies, and hurdles concerning animal health and resistance to disease. These secondary effects collectively contribute to the intricate array of challenges faced by livestock as a result of shifting environmental conditions, underscoring the necessity for adaptive strategies to ensure the resilience and sustainability of livestock production systems.

Climate change significantly influences fluctuations in crop yields for animal feed, thereby impacting livestock production. Variations in temperature, atmospheric carbon dioxide concentrations, and occurrences of extreme weather events can cause fluctuations in crop yields utilized for animal feed. Although heightened CO₂ levels may stimulate plant growth. They can also diminish the nutritional value of crops such as alfalfa and soyabean, thereby affecting the quality of animal feed. Events like floods and droughts can inflict damage on crops, leading to diminished availability and quality of feed for livestock. Moreover, escalating temperatures, alterations in precipitation process, and heightened pest pressures resulting from climate change can further disrupt feed production, ultimately affecting the health and productivity of livestock. (Khurshid et al.,2023; Babinszky et al., 2011; Bekele S., 2017)

Mac Doland and Simon emphasized that farmers residing in Ethiopia's semi- arid and arid lowlands, characterized by limited diversified assets and a heavy reliance on rain fed agriculture are particularly susceptible to the impacts of climate change. These farmers, alongside their livestock, encounter considerable hurdles as they become casualties of climate change, facing heightened risks stemming from alterations in rainfall patterns, rising temperatures and the more frequent occurrence of extreme weather events such as droughts. The dependence in rain fed agriculture in these areas intensifies the susceptibility of both farmers and their livestock to the detrimental consequences of climate change. (Bogle et al., 2023)

The paper by Naqvi et al., 2015 investigates into the critical relationship between climate change, water availability and its implications for livestock and emphasized how diminished availability of water resulting from climate change profoundly affects livestock production. Projections indicate that elevated temperatures

and extreme events like floods and droughts will diminish the quality of water suitable for animal consumption, leading to heightened concentrations of nutrients and pollutants in water sources. This decline in water availability can detrimentally impact livestock health and production by including heat stress, diminishing feed intake and directly interfering with physiological and metabolic functions. Livestock exhibit particular sensitivity to alterations in water quality and availability, as increased salt levels in water and feed can depress feed intake and production, thereby compounding the challenges imposed on livestock by climate change.

CONCLUSION

In conclusion both direct and indirect effects of climate change on livestock pose complicated issues which is require for comprehensive understanding as well as proactive mitigation and adaptation plans. Direct consequences that effect livestock health, welfare and productivity include diminished feed intake, lowered production of animal milk and meat. Compromised reproductive process, stress from disease and parasites and increased mortality rates. The problems faced by livestock producers are further exacerbated by indirect effects such as changes in fluctuations in crop yields for animal feed, modifications in the composition of pastures and production of forage, changes in the quality of forage, reduced water availability. we can work to ensure the welfare of livestock populations, protect food security and promote sustainable agricultural practices in a changing climate by realising the interconnectedness of the direct and indirect effects of climate change on livestock and taking proactive measures. Strategies such as improved water management, diversified feed sources, selective breeding for heat tolerance and early warning systems for diseases outbreaks can help mitigate the adverse effects of climate change on livestock.

REFERENCES

1. Abdela, N., & Jilo, K. (2016). Impact of climate change on livestock health: A review. *Global Veterinaria*, 16(5), 419-424.
2. Ali, M. Z., Carlile, G., & Giasuddin, M. (2020). Impact of global climate change on livestock health: Bangladesh perspective. *Open veterinary journal*, 10(2), 178-188.
3. Babayani, N. D., Rose Vineer, H., Walker, J. G., & Davidson, R. K. (2022). Climate and Parasite Transmission at the Livestock-Wildlife Interface. *Frontiers in Veterinary Science*, 8, 816303.
4. Babinszky, L., Halas, V., & Versteegen, M. W. (2011). Impacts of climate change on animal production and quality of animal food products. *Climate change socioeconomic effects*. Rijeka: InTech, 165-190.
5. Baumgard, L. H., Rhoads, R. P., Rhoads, M. L., Gabler, N. K., Ross, J. W., Keating, A. F., ... & Sejian, V. (2012). Impact of climate change on livestock production. *Environmental stress and amelioration in livestock production*, 413-468.
6. Bekele, S. (2017). Impacts of climate change on livestock production: A review. *Journal of Natural Sciences Research*, 7(8), 53-59.
7. Bernabucci U. (2019). Climate change: impact on livestock and how can we adapt. *Animal frontiers: the review magazine of animal agriculture*, 9(1), 3-5. <https://doi.org/10.1093/af/vfy039>
8. Bogale, G. A., & Erena, Z. B. (2022). Drought vulnerability and impacts of climate change on livestock production and productivity in different agro-Ecological zones of Ethiopia. *Journal of Applied Animal Research*, 50(1), 471-489.
9. Chandra, V., Sejian, V., & Sharma, G. T. (2015). Strategies to improve livestock reproduction under the changing climate scenario. *Climate change impact on livestock: adaptation and mitigation*, 425-439.
10. Cheng, M., McCarl, B., & Fei, C. (2022). Climate change and livestock production: a literature review. *Atmosphere*, 13(1), 140.
11. Escarcha, J. F., Lassa, J. A., & Zander, K. K. (2018). Livestock under climate change: a systematic review of impacts and adaptation. *Climate*, 6(3), 54.
12. Godde, C. M., Mason-D'Croz, D., Mayberry, D. E., Thornton, P. K., & Herrero, M. (2021). Impacts of climate change on the livestock food supply chain: a review of the evidence. *Global food security*, 28, 100488. <https://doi.org/10.1016/j.gfs.2020.100488>
13. Khurshid, N., Ajab, S., Tabash, M. I., & Barbulescu, M. (2023). Asymmetries in climate change and livestock productivity: non-linear evidence from autoregressive distribution lag mode.
14. Lacetera, N. (2019). Impact of climate change on animal health and welfare. *Animal Frontiers*, 9(1), 26-31.
15. MacDonald, M., & Simon, J. (2011). Climate, food security & growth: Ethiopia's complex relationship with livestock.
16. Mondal, S., & Reddy, I. J. (2018). Impact of climate change on livestock production. In *Biotechnology for sustainable agriculture* (pp. 235-256). Woodhead Publishing.
17. Mottet, A., Henderson, B., Opio, C., Falcucci, A., Tempio, G., Silvestri, S., ... & Gerber, P. J. (2017). Climate change mitigation and productivity gains in livestock supply chains: insights from regional case studies. *Regional Environmental Change*, 17(1), 129-141.
18. Naqvi, S. M. K., Kumar, D., De, K., & Sejian, V. (2015). Climate change and water availability for livestock: impact on both quality and quantity. *Climate change impact on livestock: Adaptation and mitigation*, 81-95.
19. Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate risk management*, 16, 145-163.
20. Thornton, P. K., van de Steeg, J., Notenbaert, A., & Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agricultural systems*, 101(3), 113-127.
21. Summer, A., Lora, I., Formaggioni, P., & Gottardo, F. (2019). Impact of heat stress on milk and meat production. *Animal Frontiers*, 9(1), 39-46.
22. Rust, J. M. (2019). The impact of climate change on extensive and intensive livestock production systems. *Animal Frontiers*, 9(1), 20-25.
23. Wolfenson, D., & Roth, Z. (2019). Impact of heat stress on cow reproduction and fertility. *Animal Frontiers*, 9(1), 32-38.
24. Renaudeau, D., Collin, A., Yahav, S., De Basilio, V., Gourdiere, J. L., & Collier, R. J.

- (2012). Adaptation to hot climate and strategies to alleviate heat stress in livestock production. *Animal*, 6(5), 707-728.
25. Rashamol, V. P., Sejian, V., Bagath, M., Krishnan, G., Archana, P. R., & Bhatta, R. (2020). Physiological adaptability of livestock to heat stress: an updated review. *Journal of Animal Behaviour and Biometeorology*, 6(3), 62-71.
26. Naqvi, S. M. K., & Sejian, V. (2011). Global climate change: role of livestock. *Asian Journal of Agricultural Sciences*, 3(1), 19-25.
27. Chauhan, D. S., & Ghosh, N. (2014). Impact of climate change on livestock production: A review. *Journal of Animal Research*, 4(2), 223-239.
28. Abdela, N., & Jilo, K. (2016). Impact of climate change on livestock health: A review. *Global Veterinaria*, 16(5), 419-424.
29. Gaughan, J., & Cawdell-Smith, A. J. (2015). Impact of climate change on livestock production and reproduction. *Climate change Impact on livestock: adaptation and mitigation*, 51-60.
- Link**
30. <https://www.climatehubs.usda.gov/animal-agriculture-changing-climate>
31. <https://education.nationalgeographic.org/resource/climate-change/>
32. <https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply>