MSI Journal of Multidisciplinary Research (MSIJMR)

Livestock production and environmental health: negative impacts and sustainable strategies for a resilient future

José Juan Diaz Ortiz[1], Armando Pacheco Hernández[2]*, Aurora Sarahí Silva Flores[1], Ana Elena González Barboza[1], Rafael Alexis Fonseca Rendón[1], Luis Fernando González Barboza[1]

[1] Universidad para el Bienestar Benito Juárez García, sede Pajacuaran, Michoacán, México

[2]* Universidad de Oriente (UNIVO), Departamento de Investigación, San Miguel, El Salvador, Centroamérica

Investigador Académico, Departamento de Investigación, Universidad de Oriente (UNIVO), San Miguel, 3301, El Salvador, C.A.*

Correspondence: Armando Pacheco Hernández

OPEN ACCESS

Received: 24-April-2025

Accepted: 30-April-2025

Published: 05-May-2025

This article is published by **MSI Publishers** in **MSI Journal of Multidisciplinary Research (MSIJMR)**

ISSN 3049-0669 (Online)

Volume: 2, Issue: 5 (May-2025)

ABSTRACT: Livestock production is an essential component of the global food system, but its intensification has generated significant environmental and health impacts. This review of literature (2020-2025) analyzes the main negative effects of livestock on environmental and human health. First, high greenhouse gas emissions stand out, particularly methane and nitrogen oxides, from intensive systems. Secondly, water and soil pollution due to excess nutrients and manure generates eutrophization and affects the quality of drinking water. In addition, the expansion of the agricultural border has contributed to deforestation, especially in tropical areas, causing loss of biodiversity and degradation of ecosystems. From the health point of view, the intensive use of antibiotics in animals has favored the appearance of resistant bacteria, while exposure to contaminants derived from livestock negatively affects human health. Faced with these challenges,

sustainable alternatives such as regenerative livestock, agroforestry systems, and the use of digital technologies for more efficient and ecological production are analyzed. Literature coincides with the need to adopt comprehensive public policies that promote sustainable livestock practices, reduce their environmental footprint and protect public health. This transition requires a multidisciplinary approach and active collaboration between governments, producers, researchers and consumers.

Keywords: sustainable livestock, livestock emissions, environmental health, animals in animals, biodiversity.

Introduction

Livestock production plays a fundamental role in the global economy, providing food and employment to millions of people. However, their expansion and intensification of productive systems have generated a growing concern about the negative effects that this activity has on the environment and human health. Greenhouse gas emissions, water pollution, soil degradation and intensive use of natural resources are compromising environmental health and, therefore, public health (FAO, 2023).

Livestock is one of the main sources of greenhouse gas emissions (GHG). According to the United Nations Food and Agriculture Organization (FAO), livestock represents approximately 12% of GHG Global Emissions, being the cattle responsible for 62% of these emissions (FAO, 2023). These emissions come mainly from enteric fermentation and manure management, processes that release methane and nitrous oxide, gases with a significantly greater global heating potential than carbon dioxide (Forbes, 2023).

The intensification of livestock production has also led to greater water and soil pollution. In regions with high livestock density, such as the As Conchas reservoir in Galicia, Spain, alarming concentrations of dangerous bacteria have been detected in the water, attributable to the spills of purines and avian excrements. This pollution not only affects water quality, but also represents a risk to human health, being associated with high diseases and rates of cancer in nearby communities (El País, 2025).

The expansion of livestock has contributed significantly to soil degradation and loss of biodiversity. The conversion of forests into grasslands and the overexploitation of land for the production of feed have led to deforestation and soil erosion. In addition, the intensive use of fertilizers and pesticides in crops destined for animal feed has caused the contamination of aquatic and terrestrial ecosystems, affecting the biodiversity and health of ecosystems (Wikipedia, 2025).

The environmental effects of livestock production have direct and indirect consequences on human health. Exposure to pollutants such as nitrates, nitrites and antibiotic-resistant bacteria can cause respiratory, gastrointestinal diseases and other health problems. In addition, antimicrobial resistance, exacerbated by the indiscriminate use of antibiotics in livestock, represents a growing threat to public health worldwide (El País, 2025).

Given these challenges, it is imperative to adopt sustainable practices in livestock production. The implementation of technologies and management methods that reduce GHG emissions, improve efficiency in the use of resources and minimize environmental pollution is essential to mitigate the negative impacts of this activity. FAO highlights the potential to reduce the emissions of the livestock sector by up to 30% through the use of existing best practices and technologies (FAO, 2013).

The transition to a more sustainable livestock production requires the support of effective public policies and greater social awareness. It is essential that governments implement regulations that promote responsible practices, and that environmental education is promoted to sensitize the population about the importance of a balance between animal production and the conservation of the environment (parliamentary gazette, 2021).

Livestock production, although essential for food security, represents one of the main sources of pressure on ecosystems and human health. It is crucial to recognize and address the environmental impacts of this activity through the adoption of sustainable practices, the strengthening of public policies and the promotion of environmental education. Only through a comprehensive and collaborative approach can a resilient and healthy future for present and future generations be guaranteed.

Literature review

Livestock production has established itself as an essential pillar for world food security, contributing significantly to the supply of protein and other essential nutrients. It supports the livelihoods of over 1.3 billion people globally and is a central component of many national economies. However, the growing intensification and expansion of this sector have brought significant environmental impacts that demand rigorous analysis and urgent response. In recent years, the environmental and health-related consequences of livestock production have been the focus of an increasing number of scientific studies. These contributions emphasize the pressing need to develop and implement sustainable livestock systems. This literature review synthesizes recent academic contributions (2020–2025) on the environmental consequences of livestock, with emphasis on greenhouse gas emissions, pollution of water and soil, deforestation and biodiversity loss, implications for human health, and sustainable alternatives.

Greenhouse Gas Emissions

One of the most widely studied impacts of livestock production is its significant contribution to greenhouse gas (GHG) emissions. Recent estimates suggest that the sector is responsible for approximately 11% to 17% of total anthropogenic GHG emissions worldwide (FAO, 2023; Rivera-Ferre et al., 2022). Livestock emit methane (CH_4), primarily from enteric fermentation in ruminants, and nitrous oxide (N_2O) from manure management and fertilized soils. These gases are particularly problematic because of their high global warming potential—CH_4 is about 28 times more potent than CO_2 over a 100-year period, and N_2O is nearly 300 times more potent.

Alemayehu et al. (2021) analyzed the environmental performance of different livestock systems and found that intensive systems tend to have a higher carbon footprint due to increased reliance on imported feed, synthetic fertilizers, and energy-intensive infrastructure. Poor manure management practices in these systems also lead to excessive GHG emissions. In contrast, extensive and pasture-based systems

can reduce emissions per unit of product under well-managed conditions, especially when integrated with carbon sequestration practices such as silvopastoral systems.

Water and Soil Pollution

The environmental footprint of livestock extends beyond the atmosphere. The sector is a significant source of water and soil contamination. The accumulation of nutrients, heavy metals, and pathogens in water bodies near livestock farms poses serious environmental and public health concerns. According to Chen et al. (2023), the widespread use of fertilizers, the discharge of untreated manure, and the nutrient runoff from feedlots and pastures are major contributors to the contamination of rivers, lakes, and groundwater.

The overabundance of nitrates and phosphates in aquatic environments disrupts natural nutrient cycles and fosters algal blooms, leading to eutrophication. This phenomenon depletes oxygen levels in water bodies, resulting in dead zones that are inhospitable to most aquatic life. Bilali and Allahyari (2022) highlight that these effects are particularly pronounced in rural communities that depend on local water sources for drinking and irrigation. The contamination of soils through excessive manure application and pesticide residues also degrades soil fertility, alters microbial communities, and increases the risk of heavy metal accumulation in crops.

Deforestation and Loss of Biodiversity

The link between livestock expansion and deforestation is well documented. In tropical regions such as the Amazon Basin, the clearing of forests for pastureland and soybean cultivation (used primarily as animal feed) is a leading driver of deforestation. Lovejoy and Nobre (2020) emphasize that this process is not only causing the loss of native forests but also destabilizing the climatic balance of the region. They warn that continued deforestation could push the Amazon past a tipping point, resulting in irreversible ecosystem collapse.

Segovia et al. (2021) further argue that livestock-driven land-use change reduces ecological resilience. When natural habitats are replaced with monocultures or simplified pastures, the diversity of plant and animal species declines sharply. This

loss of biodiversity weakens ecosystem services such as pollination, pest control, and disease regulation, making ecosystems and human societies more vulnerable to climate extremes and emerging health threats.

Impacts on Human Health

Environmental degradation associated with livestock production directly and indirectly affects human health. Air pollution from ammonia emissions, particulate matter, and volatile organic compounds emitted by animal farms contributes to respiratory diseases, particularly in populations living near production facilities. Hernández et al. (2021) demonstrate that long-term exposure to such pollutants is linked to increased rates of asthma, bronchitis, and even certain types of cancer.

Moreover, contaminated water sources can transmit pathogens such as E. coli, Salmonella, and Campylobacter, resulting in gastrointestinal illnesses. The intensive use of antibiotics in animal husbandry further compounds these risks. Van Boeckel et al. (2022) report that antimicrobial use in livestock—often administered prophylactically to promote growth and prevent disease—has accelerated the spread of antimicrobial resistance (AMR). The emergence of resistant bacterial strains is recognized by the World Health Organization as one of the major global health threats, potentially undermining decades of progress in infection control and antibiotic therapy.

FAO (2022) has raised urgent concerns about the need to regulate antibiotic use in agriculture. Without strong international policies, resistant bacteria can easily spread from animals to humans through food, water, and direct contact, increasing the burden on healthcare systems and leading to higher mortality rates.

Sustainable Alternatives

Despite the serious environmental and health challenges posed by livestock production, recent research offers promising strategies to mitigate its impact. A growing body of literature advocates for the transition to more sustainable and integrated systems. Teague et al. (2022) explore the potential of regenerative livestock practices, including rotational grazing, composting of manure, and

enhancing soil organic carbon. These practices not only reduce GHG emissions but also restore soil health and enhance biodiversity.

Mottet et al. (2020) emphasize the importance of breeding and genetic selection for more efficient animals that require less feed and produce fewer emissions. Such strategies, combined with improved feeding practices and precision livestock farming, can substantially enhance the resource-use efficiency of the sector.

Fernández-Giménez et al. (2023) highlight the growing role of digital technologies in monitoring and managing livestock systems. Remote sensing, GPS tracking, and real-time environmental sensors allow producers to better understand the ecological impact of their operations and implement adaptive management strategies. These tools support data-driven decision-making, enabling early detection of pollution events, optimizing pasture rotation, and reducing input waste.

In addition to technological and management innovations, the transition to sustainable livestock systems requires supportive public policies and consumer awareness. Regulatory frameworks that incentivize best practices, penalize pollution, and promote circular economies are essential. Educational initiatives and certification programs can also encourage sustainable consumption and support markets for environmentally responsible animal products.

Conclusion

The scientific evidence analyzed in this review makes it clear that livestock production, although essential for food security, also constitutes a considerable source of environmental impacts and risks to public health. Greenhouse gas emissions, soil contamination and bodies of water, deforestation, and intensive antibiotics use are just some of the problems identified. However, viable solutions are also glimpsed that can guide the transition to a more sustainable model. Strategies such as regenerative livestock, the adoption of smart technologies and the strengthening of normative frameworks offer concrete paths to mitigate these effects. It is essential to promote interdisciplinary research, international cooperation and political commitment to ensure that the livestock production of the future is environmentally responsible, economically viable and socially fair.

References

1. Chen, Y., Wang, L., & Zhang, Y. (2023). Nutrient pollution in livestock-dominated watersheds. Science of the Total Environment, 858, 159877.
2. El Bilali, H., & Ben Hassen, T. (2024). Regional agriculture and food systems amid the COVID-19 pandemic: The case of the near east and north Africa Region. Foods, 13(2), 297.
3. El País. (2025). El informe científico del embalse de As Conchas: 97 millones de bacterias "muy peligrosas" por litro de agua. Recuperado de https://elpais.com/clima-y-medio-ambiente/2025-04-17/el-informe-cientifico-del-embalse-de-as-conchas-97-millones-de-bacterias-muy-peligrosas-por-litro-de-agua.html
4. FAO. (2013). Gran potencial para reducir las emisiones de gases de efecto invernadero de la ganadería. Recuperado de https://www.fao.org/partnerships/news-archive/news-article/es/c/209389
5. FAO. (2022). The State of Food and Agriculture 2022. Rome: Food and Agriculture Organization of the United Nations.
6. FAO. (2023). La ganadería representa 12% de las emisiones de gases con efecto invernadero. Recuperado de https://www.eleconomista.com.mx/empresas/La-ganaderia-representa-12-de-las-emisiones-de-gases-con-efecto-invernadero-FAO-20231208-0030.html
7. Fernández-Giménez, M., Kemp, D., & Xu, J. (2023). Smart livestock farming for sustainability. Agricultural Systems, 205, 103592.
8. Forbes. (2023). Ganadería vacuna emite 3.8 gigatoneladas de CO2 a la atmósfera al año: FAO. Recuperado de https://www.forbes.com.mx/ganaderia-vacuna-emite-3-8-gigatoneladas-de-co2-a-la-atmosfera-al-ano-fao/
9. Gaceta Parlamentaria. (2021). Gaceta Parlamentaria, año XXV, número 5925, viernes 10 de diciembre de 2021. Recuperado de https://gaceta.diputados.gob.mx/Gaceta/65/2021/dic/20211210.html
10. Hernández, G., Jiménez, L., & Rivas, C. (2021). Livestock pollution and human health risks. International Journal of Hygiene and Environmental Health, 235, 113772.

11. lemayehu, G., Tsegaye, D., & Solomon, T. (2021). Environmental impacts of livestock production. Journal of Environmental Management, 298, 113573.
12. Lovejoy, T. E., & Nobre, C. (2019). Amazon tipping point: Last chance for action. Science Advances, 5(12), eaba2949.
13. Mekouar, M. A. (2023). Food and Agriculture Organization of the United Nations (FAO). Yearbook of International Environmental Law, 34(1), yvae031.
14. Mottet, A., Teillard, F., & Tempio, G. (2020). Pathways to sustainable livestock. Global Food Security, 25, 100346.
15. Rivera-Ferre, M. G., Pereira, L., & Chabay, I. (2022). Livestock and climate change: An integrative approach. Current Opinion in Environmental Sustainability, 55, 101158.
16. Segovia, R. A., Morales, J. F., & Pacheco, J. A. (2021). Biodiversity loss from livestock expansion. Ecological Indicators, 129, 107952.
17. Teague, W. R., Apfelbaum, S., & Lal, R. (2022). Regenerative grazing systems and climate mitigation. Frontiers in Sustainable Food Systems, 6, 774558.
18. Van Boeckel, T. P., Pires, J., Silvester, R., Zhao, C., Song, J., Criscuolo, N. G., ... & Laxminarayan, R. (2019). Global trends in antimicrobial resistance in animals in low-and middle-income countries. Science, 365(6459), eaaw1944.

Wikipedia. (2025). Impacto ambiental de la ganadería. Recuperado de https://es.wikipedia.org/wiki/Impacto_ambiental_de_la_ganader%C3%ADa