Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 05, Issue: 06 (NOV-DEC, 2025)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Environmental Impact of Poultry Production in India

Dr. A Ameeta Devi[1], Dr. Ishwar Bhabhor[2] and *Pooja Nitharwal[3]
[1]Sr. Scientist cum Head, ICAR-KVK, Chandel
[2]Scientist, Animal Science, Krishi Vigyan Kendra, Devataj, Anand
[3]Master's Scholar, Department of Livestock Production and Management. School of Agriculture Sciences, Nagaland University, Medziphema Campus, Nagaland
***Corresponding Author's email: nitharwalpooja138@gmail.com**

India's poultry industry has expanded rapidly over the past four decades, transitioning from small backyard systems to one of the world's leading commercial poultry sectors. This growth has been driven by improved genetics, vertically integrated production systems and increasing consumer demand. While the industry contributes significantly to food security, rural livelihoods and national economic development, its rapid intensification has also led to escalating environmental concerns. Major impacts include air pollution from ammonia emissions, greenhouse gases and particulate matter; water pollution from nutrient runoff, pathogens and processing effluents and soil contamination due to heavy metals, excess nutrients and antibiotic residues from over-applied poultry litter. These challenges are especially critical in India, where inadequate waste management systems, weak regulatory enforcement and limited farmer awareness exacerbate environmental degradation. Addressing these issues is essential for ensuring sustainable poultry production that balances economic growth with environmental and public health protection.

Introduction

India's poultry industry has undergone a major transformation over the past four decades, shifting from a traditional backyard activity to a highly commercialized agricultural sector. This expansion has been driven by rising incomes, rapid urbanization, advancements in breeding and management technologies and the emergence of vertically integrated production systems (R. Chatterjee *et al.*, 2015). As a result, chicken meat production has grown at 9% annually and egg production at 6%, positioning India as the third-largest producer of eggs with 88 billion annually and the fifth-largest producer of chicken meat at 3.5 million tonnes, with 80% of output concentrated in commercial operations located primarily in southern and western states such as Andhra Pradesh and Tamil Nadu (T. Nanda Kumar *et al.*, 2022). This national growth parallels global trends in both broiler and layer sectors, where genetic improvements and commercial intensification have accelerated production. For example, Pakistan's broiler population increased from 72.80 million birds in 1991 to 795 million in 2010, with meat production rising from 111,772 to 587,000 metric tons between 1995 and 2010, while the commercial layer population grew from 9.55 million to 27.50 million birds during the same period (Tahir Hameed *et al.*, 2017). Similarly, genetic selection in India has led to a more than 400% improvement in broiler growth rates since 1957 and a 50% reduction in feed conversion ratios, enabling broilers to reach 2.4–2.6 kg in just six weeks and

facilitating the development of high-yielding layer varieties capable of producing 310–340 eggs per cycle (M. Zuidhof *et al.,* 2014). Beyond commercial gains, poultry production plays a crucial role in supporting food security and rural livelihoods, with evidence indicating that rural poultry contributes 19–50% of household income and accounts for nearly 80% of poultry stocks in developing countries (E. Sonaiya *et al.,* 2007). These systems provide essential protein, micronutrients and a readily marketable asset that can be sold during financial emergencies, thereby strengthening household resilience (A. Mottet *et al.,* 2017). Particularly beneficial for women, children, and marginalized communities, small-scale poultry farming offers a low-input, high-impact pathway to improved nutrition and economic empowerment, with consistent evidence of its potential to alleviate poverty across regions such as Africa, Asia, and India (E. F. Guèye *et al.,* 2000).

Overview of Poultry Industry in India

India's poultry industry has evolved from a traditional backyard activity into a major commercial agri-based sector over the past four decades, emerging as the world's fourth-largest egg producer and fifth-largest broiler producer. This rapid growth, reflected in annual increases of 4–6% in egg production and 8–10% in broiler production, has been supported by the development of high-yielding layer strains producing 310–340 eggs and broiler varieties capable of reaching 2.4–2.6 kg in six weeks. According to FAO classifications, India's poultry production systems fall into four categories village or backyard production, commercial production with low biosecurity, large-scale commercial production with high biosecurity and industrial integrated systems—where backyard units contribute 17.8% (18.41 billion) of the country's 103.32 billion eggs and chicken accounts for nearly 95% of total egg output (U. Rajkumar *et al.,* 2021). The sector's increasing commercialization has been driven by vertically integrated production models, contract farming, and organized marketing networks that enhance economies of scale and improve profit margins (S. Saran *et al.,* 2005). Beyond commercial expansion, the poultry industry plays a crucial developmental role by supporting rural livelihoods, improving nutrition, empowering women, and generating employment opportunities, with backyard poultry emerging as a particularly effective tool due to its low investment needs, rapid turnover and adaptability to varied climates (U. Pica-Ciamarra *et al.,* 2010). Rising production has improved national food security, increasing annual per capita availability to 60 eggs and 2.5 kg of meat, while poultry farming has grown five times faster than agricultural crop production, enabling India to gain a strong foothold in global poultry markets (J. S. Toor *et al.,* 2022). However, the industry continues to face challenges such as high feed costs—constituting 65–70% of broiler and 75–80% of layer production expenses—along with disease management, biosecurity limitations and the ongoing need for technological upgrades and supportive policies to maintain growth. Although specific regional data for production hotspots such as Tamil Nadu, Telangana, Maharashtra, Andhra Pradesh and Karnataka, as well as precise contributions to agricultural GDP, are not detailed in available literature, the sector exhibits substantial potential for future expansion and industrialization due to the significant gap between recommended and actual poultry consumption levels in India.

Major Environmental Impacts of Poultry Production

Air Pollution:- Poultry production generates significant air pollution through multiple pathways, with ammonia emissions from litter being the most critical concern, as concentrations above 15 ppm cause respiratory diseases, ammonia blindness in birds, and

contribute to enhanced viral infections Mahdi S. Mohammad Al-Kerwi *et al.,* 2022. Dust and particulate matter accumulate in closed housing systems, with high-rise cage houses generally having poorer air quality and higher ammonia emissions compared to manure belt systems H. Xin *et al.,* 2010. Greenhouse gas emissions include carbon dioxide, nitrous oxide and methane, though these are comparatively lower than ruminant production M. Kacprzak *et al.,* 2022. The intensity of these air pollutants varies significantly based on factors including geographic location, seasonal conditions, ventilation technologies, humidity levels, litter quality and stocking density, with nitrogen transformation from crude protein ingestion to ammonia volatilization representing a complex process that affects both animal welfare and environmental sustainability.

Water Pollution: - Poultry production causes significant water pollution through multiple pathways, with identifying nutrient and pathogen pollution as leading causes of water quality impairment in U.S. freshwater resources. The primary contamination mechanisms include runoff from poultry litter and manure, nitrate and phosphorus contamination of groundwater, and wastewater discharge from processing plants Roxana Mitroi *et al.,* 2021. A. Leip *et al.,* 2015 quantified the livestock sector's contribution to water pollution at 73% for both nitrogen and phosphorus contamination, while H. Abah *et al.,* 2019 found that 85% of surveyed farmers acknowledged that improper disposal of poultry litter causes surface water contamination. This pollution can result in eutrophication of freshwater resources and poses risks to public health through degradation of drinking water sources and recreational waters.

Soil Contamination: - Soil contamination represents a major environmental impact of poultry production, primarily resulting from over-application of poultry litter as fertilizer, heavy metal accumulation from feed additives and pathogen loading that compromises soil health. C. Williams *et al.,* 1999 demonstrated that excessive land application of poultry waste leads to significant accumulation of copper and zinc in soils, as these trace elements are added in excess to poultry feed to enhance growth rates and are subsequently excreted in manure, with repeated applications causing toxicity levels that can harm certain crops. M. A. Herrero *et al.,* 2008 quantified this contamination, documenting soil accumulations of up to 261 kg/ha of zinc, 2500 ppm of phosphorus, and 220 kg/ha of nitrates in areas with intensive poultry production. T. Crippen *et al.,* 2016 found that soil beneath poultry facilities exhibited mean increases in physiochemical parameters ranging from 2-297 fold, with significant elevations in copper, zinc and other contaminants even after litter removal. Beyond chemical contamination, G. Gržinić *et al.,* 2022 highlighted that poultry litter contains pathogenic microorganisms, pharmaceuticals including antibiotics and other pollutants that can lead to the formation of antimicrobial-resistant pathogen strains, fundamentally altering soil microbial communities and compromising long-term soil health and ecosystem function.

Environmental Challenges Specific to India

India faces a complex set of environmental challenges linked to inadequate waste management systems that struggle to keep pace with rapid urbanization and population growth. Existing waste infrastructure is already overwhelmed by current waste volumes (Sunil Kumar *et al.,* 2017) and this pressure is expected to intensify as an estimated 600 million people migrate to cities by 2030, expanding peri-urban zones where poultry farms are becoming increasingly congested (P. Amerasinghe *et al.,* 2013). These challenges are further intensified by weak regulatory frameworks and insufficient environmental monitoring, as countries lacking strong policy implementation face severe environmental and public health consequences from improper waste disposal (Anunay A. Gour *et al.,* 2022). The situation is

compounded by extremely low awareness of environmental regulations, with studies showing that zero percent of farmers were aware of Environmental Protection Acts (Kazi Shams Al Arefin *et al.,* 2024). Smallholder farms are particularly vulnerable due to the absence of adequate waste treatment facilities and many farmers administer treatments without veterinary guidance, reflecting poor knowledge of antibiotic use (G. Sharma *et al.,* 2020). This leads to concerning practices such as using antibiotic-contaminated litter as fertilizer, which contributes to the spread of antibiotic resistance through animal waste entering the environment (C. Manyi-Loh *et al.,* 2018). Additionally, 69% of farmers dispose of litter directly on agricultural fields, perpetuating a cycle of environmental contamination that poses risks to ecosystem integrity and food safety (Kazi Shams Al Arefin *et al.,* 2024).

Conclusion

The transformation of India's poultry sector into a major commercial industry has brought substantial economic, nutritional and social benefits, including enhanced food security, rural income generation and employment creation. However, the environmental consequences associated with intensified production—such as air, water and soil pollution—underscore the need for sustainable management strategies. India's unique challenges, including insufficient waste treatment infrastructure, overcrowded peri-urban production zones, weak regulatory compliance, and widespread misuse of antibiotics, heighten environmental risks and threaten long-term sustainability. Strengthening environmental monitoring, improving farmer education, promoting scientific waste management practices and enforcing clear regulatory frameworks are crucial steps toward mitigating these impacts. By addressing these gaps, India can support continued growth of the poultry industry while safeguarding ecosystem health, public safety and future food security.

References

1. Abah, H. O., Nwankwo, A. U. and Orgem, C. M. (2019). Waste management practices in selected poultry farms and its effect on the environment and human health in Makurdi, Nigeria. *International Journal of Environment, Agriculture and Biotechnology*. *4*(1).
2. Al-Kerwi, M. S. M., Mardenli, O., Jasim, M. R. M. and Al-Majeed, M. A. (2022, July). Effects of harmful gases emitted from poultry houses on productive and health performance. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1060, No. 1, p. 012082). IOP Publishing.
3. Amerasinghe, P., Bhardwaj, R. M., Scott, C., Jella, K. and Marshall, F. (2013). *Urban wastewater and agricultural reuse challenges in India* (Vol. 147). IWMI.
4. Arefin, K. S. I., Chowdhury, D., Islam, F. B., Devnath, B. and Sobur, K. A. (2024). Poultry farm waste management practices: Environmental challenges, health concerns, and farmers' perspectives in Chattogram. *Bangladesh. Journal of Bioscience and Environment Research*. *1*(2): 32-38.
5. Chatterjee, R. N. and Rajkumar, U. (2015). An overview of poultry production in India. *Indian Journal of Animal Health*. *54*(2): 89-108.
6. Crippen, T. L., Sheffield, C. L., Byrd, J. A., Esquivel, J. F., Beier, R. C. and Yeater, K. (2016). Poultry litter and the environment: Physiochemical properties of litter and soil during successive flock rotations and after remote site deposition. *Science of the Total Environment*. *553*: 650-661.
7. Gour, A. A. and Singh, S. K. (2023). Solid waste management in India: a state-of-the-art review. *Environmental Engineering Research*. *28*(4).

8. Gržinić, G., Piotrowicz-Cieślak, A., Klimkowicz-Pawlas, A., Górny, R. L., Ławniczek-Wałczyk, A., Piechowicz, L. and Wolska, L. (2023). Intensive poultry farming: A review of the impact on the environment and human health. *Science of the Total Environment*. *858*: 160014.
9. Guèye, E. F. (2000). The role of family poultry in poverty alleviation, food security and the promotion of gender equality in rural Africa. *Outlook on agriculture*. *29*(2): 129-136.
10. Hameed, T., Asmat, T. M., Tariq, M. M., Bajwa, M. A., Rafeeq, M., Hilal, B. and Bokhari*, F. A. (2017). Study on current status and future trends of commercial poultry production in Pakistan. *Pure and Applied Biology (PAB)*. *6*(1): 190-196.
11. Herrero, M. A. and Gil, S. B. (2008). Consideraciones ambientales de la intensificación en producción animal. *Ecología austral*. *18*(3): 273-289.
12. Kacprzak, M., Malińska, K., Grosser, A., Sobik-Szołtysek, J., Wystalska, K., Dróżdż, D. and Meers, E. (2023). Cycles of carbon, nitrogen and phosphorus in poultry manure management technologies–environmental aspects. *Critical Reviews in Environmental Science and Technology*. *53*(8); 914-938.
13. Kumar, S., Smith, S. R., Fowler, G., Velis, C., Kumar, S. J., Arya, S. and Cheeseman, C. (2017). Challenges and opportunities associated with waste management in India. *Royal Society open science*, *4*(3).
14. Leip, A., Billen, G., Garnier, J., Grizzetti, B., Lassaletta, L., Reis, S. and Westhoek, H. (2015). Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity. *Environmental Research Letters*. *10*(11): 115004.
15. Manyi-Loh, C., Mamphweli, S., Meyer, E. and Okoh, A. (2018). Antibiotic use in agriculture and its consequential resistance in environmental sources: potential public health implications. *Molecules*. *23*(4): 795.
16. Mitroi, R., Stoian, O., Covaliu, C. I. and Manea, D. (2021). Pollutants resulting from intensive poultry farming activities and their impact on the environment. In *E3S Web of Conferences* (Vol. 286, p. 03018). EDP Sciences.
17. Mottet, A. and Tempio, G. (2017). Global poultry production: current state and future outlook and challenges. *World's poultry science journal*. *73*(2): 245-256.
18. Nanda Kumar, T., Samantara, A. and Gulati, A. (2022). Poultry value chain. In *Agricultural value chains in India: ensuring competitiveness, inclusiveness, sustainability, scalability, and improved finance* (pp. 227-252). Singapore: Springer Nature Singapore.
19. Pica-Ciamarra, U. and Otte, J. (2010). Poultry, food security and poverty in India: Looking beyond the farm-gate. *World's Poultry Science Journal*. *66*(2): 309-320.
20. Rajkumar, U., Rama Rao, S. V., Raju, M. V. L. N. and Chatterjee, R. N. (2021). Backyard poultry farming for sustained production and enhanced nutritional and livelihood security with special reference to India: a review. *Tropical Animal Health and Production*. *53*(1): 176.
21. Saran, S., Sashidhar, P. K., Sastry, K. H. and Singh, R. (2005). Indian poultry industry: current scenario and future prospects: a review. *The Indian Journal of animal sciences*. *75*(8).
22. Sharma, G., Mutua, F., Deka, R. P., Shome, R., Bandyopadhyay, S., Shome, B. R. and Lindahl, J. (2020). A qualitative study on antibiotic use and animal health management in

smallholder dairy farms of four regions of India. *Infection ecology & epidemiology*. *10*(1): 1792033.

23. Sonaiya, E. B. (2007). Family poultry, food security and the impact of HPAI. *World's Poultry Science Journal*. *63*(1): 132-138.
24. Toor, J. S. and Goel, R. (2024). Poultry Farming in India with Special Reference to Punjab: An Overview. *Agricultural Science Digest*, *44*(6).
25. Wiliams, C. M., Barker, J. C. and Sims, J. T. (1999). Management and utilization of poultry wastes. *Reviews of Environmental Contamination and Toxicology: Continuation of Residue Reviews*, 105-157.
26. Xin, H., Gates, R. S., Green, A. R., Mitloehner, F. M., Moore Jr, P. A. and Wathes, C. M. (2011). Environmental impacts and sustainability of egg production systems. *Poultry Science*. *90*(1): 263-277.
27. Zuidhof, M. J., Schneider, B. L., Carney, V. L., Korver, D. R. and Robinson, F. E. (2014). Growth, efficiency, and yield of commercial broilers from 1957, 1978 and 2005. *Poultry science*. ***93***(12): 2970-2982.