

Livestock waste: an environmental problem or a public-health threat

Dr. Himangi Gupta¹, Dr. Arivazhagan Anbazhagan¹, and Dr. Suraj Dhankar²

¹M.V.Sc. Scholar, Division of Veterinary Public Health and Epidemiology (ICAR - Indian Veterinary Research Institute)

²M.V.Sc. Scholar, Division of Veterinary Pathology (ICAR - Indian Veterinary Research Institute)

DOI:10.5281/Veterinarytoday.18600299

Introduction

Livestock production generates enormous quantities of waste in the form of manure, urine, slurry and slaughter residues. When managed properly, livestock waste is a valuable agricultural input, contributing nutrients, organic matter and energy. When mismanaged, however, it becomes a significant source of environmental pollution and an emerging public-health threat. With the intensification of livestock production and increasing proximity between animals and human settlements, particularly in peri-urban and urban areas, the risks associated with livestock waste are growing rapidly.

Scale of livestock waste generation

Globally, livestock systems are a major source of nutrient loading in the environment. The Food and Agriculture Organisation (FAO) estimates that livestock manure contributed approximately 125 million tonnes of nitrogen globally in 2018, a substantial increase compared to 1990 levels (FAO, 2020). In many regions, manure production exceeds the nutrient absorption capacity of surrounding agricultural land, leading to nutrient accumulation and environmental leakage (FAO, 2018).

In developing countries, livestock waste management infrastructure has not kept pace with growth in animal numbers. As a result, untreated manure is often discharged directly into the environment, especially in smallholder and peri-urban systems.

Livestock waste as a public-health concern

Livestock waste is not merely an environmental pollutant; it is a recognised vehicle for pathogens, chemical residues and antimicrobial resistance determinants. Animal faeces can contain zoonotic bacteria such as *Salmonella spp.*, *Escherichia coli*, *Campylobacter spp.*, *Listeria monocytogenes* and *Clostridium spp.*, as well as parasites and helminth eggs, all of which may survive for extended periods in manure (Abdugheni et al., 2023).

Human exposure occurs through multiple pathways, including contamination of drinking water, irrigation of crops with polluted water, handling of manure, and contact with contaminated soil. Studies have demonstrated that poorly managed livestock waste significantly increases the risk of food-borne and water-borne diseases, particularly in communities living close to livestock operations (Burkholder et al., 2007).

Water contamination and nitrate-related health risks

One of the most serious public-health impacts of livestock waste is groundwater contamination with nitrates. Excessive application or improper disposal of manure leads to nitrate leaching into groundwater, especially in areas with shallow water tables. The World Health Organisation has set a guideline value of 50 mg/L nitrate in drinking water, above which there is an increased risk of

infant methemoglobinemia and other adverse health effects (WHO, 2011).

Numerous studies have linked intensive livestock farming to elevated nitrate levels in groundwater, particularly in peri-urban agricultural zones (Ward et al., 2018). In India, groundwater monitoring reports have identified nitrate contamination as a widespread issue, raising concerns about combined contributions from agriculture and livestock waste (Central Ground Water Board, 2022).

Antimicrobial resistance and manure

Livestock waste also plays a crucial role in the environmental spread of antimicrobial resistance (AMR). Antibiotics administered to animals are often excreted unchanged or as active metabolites, entering manure and slurry. Research shows that manure contains not only antibiotic residues but also antibiotic-resistant bacteria and resistance genes, which can persist in soil and water after land application (Oliver et al., 2020; Marutescu et al., 2022).

The World Health Organisation has identified misuse of antimicrobials in food-producing animals as a key driver of AMR, with environmental pathways increasingly recognised as important transmission routes to humans (WHO, 2017).

Occupational and community exposure

People working in livestock-related occupations, including farmers, manure handlers, slaughterhouse workers and waste collectors, face higher risks of exposure to zoonotic pathogens. In informal settings, lack of protective equipment and limited health surveillance further increase vulnerability. Beyond occupational exposure, surrounding communities are affected through shared water sources and environmental contamination, making livestock waste a community-level public-health issue rather than an isolated farm problem.

Managing livestock waste: prevention over cure

Scientific evidence shows that effective waste management can significantly reduce public-health risks. Technologies such as composting, anaerobic digestion (biogas), controlled storage and proper timing of manure application reduce pathogen loads and nutrient losses (FAO, 2018). Anaerobic digestion additionally provides renewable energy and reduces greenhouse gas emissions.

However, implementation remains limited due to financial constraints, weak regulation and fragmented institutional responsibilities between environmental, agricultural and health sectors.

Conclusion

Livestock waste is both an environmental challenge and a public-health threat. While its negative impacts are often framed in terms of pollution and climate change, the human health implications, through zoonotic pathogens, contaminated water and antimicrobial resistance, are equally significant. Addressing livestock waste management through an integrated One Health approach, linking animal health, environmental protection and public health, is essential to reduce disease risks and protect vulnerable populations.

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