



Poultry Farms and Their Waste Disposal Techniques in Virudhunagar District, India: Issues and Challenges

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The poultry industry in Virudhunagar district, Tamil Nadu, significantly contributes to the region's economy and food security. However, the rapid growth of poultry farming has resulted in considerable waste management issues, leading to environmental harm, contamination of groundwater, and public health concerns. This study examines the waste disposal methods utilized by poultry farms in Virudhunagar, with a particular emphasis on sustainable approaches like composting, anaerobic digestion, and organic fertilizer production. Using a descriptive research design and a mixed-methods approach, the study surveyed 75 poultry farmers to assess their waste disposal practices, awareness levels, and challenges faced. The findings suggest that landfilling

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and open-area disposal continue to be the primary waste management practices, with minimal adoption of more sustainable alternatives. The study identifies several barriers to the adoption of environmentally friendly practices, including financial limitations, lack of technical knowledge, and insufficient resources. The research emphasizes the urgent need for increased awareness, financial assistance, and technical training to promote sustainable waste management in the poultry sector of Virudhunagar.

Keywords: Anaerobic digestion; landfilling, sustainable alternatives.

1. INTRODUCTION

The poultry industry's remarkable growth has positioned it as a cornerstone of global food security and economic development (Santhi et al., 2011). Contributing significantly to the availability of protein-rich food, poultry farming has witnessed a surge in demand, particularly in developing countries like India, where it serves as a vital source of income, employment, and nutrition. Studies highlight that poultry farming accounts for a substantial share of agricultural GDP in many nations, underlining its economic significance (FAO, 2021). However, this expansion comes with pressing challenges, particularly in waste management, as large-scale poultry production generates significant quantities of manure, feathers, bedding materials, and uneaten feed (Are et al., 2017). If not managed effectively, these wastes pose serious environmental threats, such as soil degradation, water contamination, and air pollution, underscoring the urgency of implementing sustainable disposal methods (Sapkota et al., 2007).

In India, the poultry sector has grown exponentially, with an annual production exceeding 100 billion eggs and over 4 million tons of broiler meat (Ministry of Animal Husbandry, 2023). Despite this growth, the waste management practices in many regions remain inadequate, leading to environmental degradation and public health issues. This is particularly critical in rural districts like Virudhunagar in Tamil Nadu, where poultry farming is deeply integrated into the local economy. Several studies have reported groundwater contamination from poultry farm runoff, the emission of ammonia and other gases, and the proliferation of disease-causing pathogens due to improper waste disposal methods (Awasthi et al., 2020; Tiwari et al., 2019). Furthermore, traditional practices, resource constraints, and a lack of awareness among farmers exacerbate these challenges (Smith & Wheeler, 1979).

Sustainable waste management techniques such as composting, anaerobic digestion, and biochar production have shown promise in mitigating the adverse environmental effects of poultry farming (Chastain et al., 2001). Composting, for instance, can convert poultry waste into nutrient-rich organic fertilizer, while anaerobic digestion produces biogas as an alternative energy source. However, their adoption in rural areas like Virudhunagar is inconsistent due to disparities in farm size, financial capability, access to technology, and the availability of technical expertise (Ravindran et al., 2021). These barriers highlight the need for localized and context-specific strategies to improve waste management practices.

This study seeks to investigate the current waste disposal practices of poultry farms in Virudhunagar district, evaluating their effectiveness, environmental impact, and practical feasibility. It also explores the challenges faced by poultry farmers in adopting improved methods and identifies opportunities for implementing sustainable waste management systems. By providing a comprehensive analysis, this research aims to contribute to the development of environmentally sound and economically viable solutions, aligning with broader sustainability goals and offering actionable insights for policymakers, farmers, and stakeholders in the poultry sector.

1.1 Statement of the Problem

The poultry industry has experienced remarkable growth globally and within India, emerging as a crucial component of rural economies and a reliable source of nutrition (FAO, 2022). In Tamil Nadu, particularly in the Virudhunagar district, this expansion has significantly contributed to local economic development by generating employment and ensuring a steady supply of affordable protein (Ramesh et al., 2020). Despite these socio-economic benefits, the rapid intensification of poultry farming has also

brought about substantial waste management challenges.

Poultry farms produce various types of waste, including manure, feathers, bedding materials, and uneaten feed, which can accumulate rapidly if not managed properly (Singh & Sharma, 2019; Chinta et al., 2013). Studies highlight that improper disposal of such waste contributes to environmental pollution, such as contamination of water bodies through nutrient runoff, emission of greenhouse gases, and air quality deterioration due to offensive odors (Bolan et al., 2010). These issues are exacerbated in regions with inadequate infrastructure for waste processing and recycling, as is the case in Virudhunagar (Kumar & Jayaraman, 2023).

Traditional waste handling methods, such as open dumping and unscientific composting, often fail to address the growing scale of poultry waste (Parthasarathy & Pradhan, 1982). Consequently, communities near poultry farms experience adverse effects, including health hazards such as respiratory illnesses and waterborne diseases caused by leachate contamination (Jha et al., 2021). Furthermore, unmanaged poultry waste threatens the local ecosystem, disrupting soil and water quality and affecting biodiversity (Gupta et al., 2018).

The environmental repercussions of these waste management shortcomings are notable, with groundwater contamination, soil degradation, and pathogen spread posing risks to long-term ecological stability. While sustainable waste management methods, such as composting, anaerobic digestion, and organic fertilizer production, offer potential solutions, their adoption within local poultry farms remains low, hindered by financial, technical, and informational constraints (Ghaly & Alhattab, 2013).

This research seeks to address this critical gap by assessing the effectiveness, sustainability, and practicality of current waste disposal practices among poultry farms in Virudhunagar. By identifying the barriers preventing effective waste management and exploring alternative solutions, this study aims to support the implementation of more environmentally and economically sustainable waste management practices within the district's poultry sector, fostering a cleaner, more resilient agricultural environment.

2. REVIEW OF LITERATURE

Zhang et al. (2023) explored various innovative technologies to transform poultry waste into valuable by-products. They discussed methods like anaerobic digestion, pyrolysis, and microbial conversion, which are aimed at reducing environmental pollution while generating usable resources such as bioenergy and organic fertilizers. The study highlighted that, despite the growing environmental concerns, technological advancements can turn poultry waste into wealth by promoting sustainability and mitigating the adverse impacts of improper waste disposal.

A review by Zhang and Ren (2023) provided an in-depth look at several waste-to-energy technologies like anaerobic digestion and incineration, focusing on their ability to convert poultry waste into biogas and heat energy. They also discussed the potential of using poultry waste as a raw material for biofuels, highlighting both the environmental and economic benefits of such practices in addressing the challenges posed by increasing waste generation in poultry farming.

A review published by Adeli et al. (2017) examined the environmental concerns associated with poultry farming, specifically focusing on the management of waste materials. The study discussed the risks of water contamination and the spread of diseases due to poor waste management practices. The authors suggested various sustainable methods, such as composting and anaerobic digestion, to mitigate these risks and promote environmentally friendly practices.

A study by Leytem et al. (2020) focused on the composition of poultry waste, including manure and litter. It highlighted significant nutrient losses, such as nitrogen and phosphorus, and their impact on both soil and air quality. The study emphasizes the need for efficient management techniques to minimize ammonia emissions and nutrient leaching, which can cause pollution and harm to human health.

Singh et al. (2018) highlights the complexities of poultry waste management, emphasizing issues like nitrate and heavy metal contamination in crops, soil, water, and air, along with odor problems and food safety concerns related to disposing of dead or diseased poultry. They suggest that effective management of

poultry waste not only benefits the industry but also minimizes harm to people and the environment.

In a 2015 study, D.O. Onu, E.I. Ofor, and B.O. Okpara discuss the environmental challenges posed by poultry waste, which includes bird feces, offal's, deceased chicks, and spoiled eggs. These wastes contribute to pollution, degrade surface and groundwater, and release unpleasant odors, affecting the health and well-being of both humans and animals.

Ahmad (2021) describes land disposal as a common method for managing large volumes of poultry waste. However, this practice can lead to local environmental issues, attracting flies and pests, generating foul odors, and spreading diseases, thereby creating significant health risks for nearby communities.

3. METHODOLOGY

This study uses a descriptive research design to evaluate waste disposal methods in poultry farms, focusing on existing practices, challenges, and awareness among local farmers. A mixed-methods approach is adopted, combining quantitative survey data with qualitative insights to give a well-rounded understanding of waste management in Virudhunagar's poultry industry. Snow ball sampling technique is utilized to select 75 respondents actively engaged in poultry farming, ensuring representation of different farm sizes and locations within the district. Data will be gathered through a structured interview schedule, which will capture quantitative information on socio-economic characteristics, current waste disposal methods, knowledge of sustainable practices, and challenges faced. Additionally, secondary data from academic sources, government publications, and industry reports will provide context on waste management practices in rural Indian poultry farming.

4. OBJECTIVES OF THE STUDY

1. To analyze the socio-economic profile of poultry farm entrepreneurs in Virudhunagar district.
2. To identify and assess the methods currently employed by poultry farmers for waste disposal.
3. To evaluate the level of awareness among poultry farmers regarding sustainable waste disposal techniques.

4. To examine the challenges and limitations faced by poultry farmers in adopting sustainable waste management practices.

5. ANALYSIS AND INTERPRETATION

5.1 Demographic Profile of the Participants

Analyzing the demographic characteristics of poultry farm owners is essential for understanding their approaches to waste management. Demographic factors, including gender, age, education level, and years of experience in poultry farming, are crucial in influencing attitudes and practices regarding sustainable waste disposal. These factors can affect access to resources, openness to new waste management techniques, and overall awareness of environmental impacts, thus shaping the adoption of effective waste disposal methods in the sector.

The Table 1 shows that of respondents are male, comprising 90.67 per cent of the sample. Nearly half of the respondents (48%) are in the 30–40 age group, reflecting a predominantly middle-aged workforce. In terms of educational background, 52 per cent have completed higher secondary education. Additionally, 36 per cent of the respondents have between 6 and 10 years of experience in poultry farming.

5.2 Farm Size

Farm size, measured by the number of birds, plays a key role in determining the resources, management practices, and waste disposal methods used in poultry farming. Larger farms may have greater capacities for waste management infrastructure, while smaller farms might rely on more traditional or resource-limited approaches.

The Table 2 narrates that most poultry farms are medium-sized, with 42.67% of respondents having 500–1000 birds. Farms with 1000–5000 birds are next, representing 37.33% of respondents. Smaller farms, holding fewer than 500 birds, make up 16% of the sample, while only 4% of respondents run large farms with more than 5000 birds. This distribution suggests that the poultry industry in the area is largely made up of small to medium-sized operations, which could impact the adoption and types of waste management practices used.

Table 1. Demographic profile of the participants

S. No.	Demographic factors	No of respondent	Percentage (%)
Gender			
1	Male	68	90.67
2	Female	7	9.33
Age			
1	Less than 30 Years	12	16.00
2	30 to 40 Years	36	48.00
3	40 to 50 Years	17	22.67
5	Above 50 Years	10	13.33
Educational Qualification			
1	Primary education	4	5.33
2	Secondary education	18	24.00
3	Higher secondary	39	52.00
4	Undergraduate/ Diploma	14	18.67
Experience in Poultry Farming			
1	Less than 2 years	8	10.67
2	2–5 years	21	28.00
3	6–10 years	27	36.00
4	More than 10 years	19	25.33

Source: Primary data

Table 2. Farm size

S. No.	Number of Birds	No of Respondent	Percentage (%)
1	Less than 500	12	16.00
2	500–1000	32	42.67
3	1000–5000	28	37.33
4	More than 5000	3	4.00
Total		75	100.00

Source: Primary data

Table 3. Types of waste generated

S.No	Types of waste	Frequently		Occasionally		Rarely		Mean
		N	%	N	%	N	%	
1	Manure	39	52.00	32	42.67	4	5.33	2.47
2	Feathers	48	64.00	24	32.00	3	4.00	2.60
3	Bedding material	16	21.33	28	37.33	31	41.33	1.80
4	Uneaten feed	15	20.00	36	48.00	24	32.00	1.88

Source: Primary data

5.3 Types of Waste Generated

Identifying the types and frequency of waste produced in poultry farms is crucial for planning appropriate waste management solutions. Poultry waste varies in type and generation rate, which influences disposal methods and sustainability practices. The Table 3 highlights the main types of waste produced in poultry farming.

The study reveals that, feathers are the most commonly generated waste, with 64 per cent of respondents reporting frequent occurrence and a

mean score of 2.60, indicating a regular need for disposal solutions. Manure is also commonly generated, with 52 per cent of respondents reporting it as frequent, yielding a mean score of 2.47, suggesting it also requires routine management.

5.4 Waste Disposal Practices Followed

Poultry farms utilize a range of waste disposal methods, each varying in environmental impact and practicality. The following Table 4 outlines the primary disposal techniques followed by the respondents.

Table 4. Waste disposal practices

S. No.	Practices	No of Respondent	Percentage (%)
1	Landfilling	31	41.33
2	Incineration	14	18.67
3	Disposal in open areas	27	36.00
4	Composting	3	4.00
Total		75	100.00

Source: Primary data

Table 5. Awareness of the impacts of non-sustainable waste disposal

S. No.	Impacts	Aware		Not Aware	
		N	%	N	%
1	Environmental Pollution	63	84.00	12	16.00
2	Spread of Pathogens	17	22.67	58	77.33
3	Public Health Risks	21	28.00	54	72.00
4	Loss of Biodiversity	6	8.00	69	92.00
5	Economic Costs	13	17.33	62	82.67

Source: Primary data

The study pinpointed that that landfilling is the most prevalent method, with 41.33 per cent of the respondents indicating its use, likely due to its accessibility and ease of implementation. Open-area disposal is the second most common practice, employed by 36 per cent of the respondents, though this method can have negative environmental implications. Incineration is used by 18.67 per cent of the respondents, possibly chosen for its efficiency in reducing waste volume, although it raises environmental concerns due to emissions. Finally, composting is adopted by only 4 per cent of the respondents, showing that this environmentally beneficial approach has low utilization among poultry farms, suggesting an area for potential improvement in sustainable waste management.

5.5 Awareness of the Impacts of Non-Sustainable Waste Disposal

The awareness about the consequences of non-sustainable waste disposal is crucial for fostering responsible waste management among poultry farmers. Recognizing the full scope of these impacts not only aids in mitigating pollution but also promotes practices that safeguard both environmental and public health. The Table 5 summarizes the respondents' levels of awareness regarding the various negative effects associated with improper waste disposal.

The study pinpoints that environmental pollution is the most widely recognized impact of non-sustainable waste disposal, with 84 per cent of the respondents acknowledging its importance. This suggests that farmers are generally aware of pollution issues related to poor waste

management. However, awareness of other impacts is much lower. For instance, only 22.67 per cent of the respondents understand the spread of pathogens linked to improper disposal, and just 28 per cent of the respondents recognize the associated public health risks, pointing to a gap in awareness around specific health impacts.

5.6 Awareness of Sustainable Waste Disposal Techniques

Assessing poultry farmers' awareness of sustainable waste disposal techniques is crucial for encouraging the adoption of environmentally responsible practices. The Table 6 measures respondents' familiarity with various methods, from "fully aware" to "not aware at all." This analysis offers valuable insights into the extent of knowledge regarding sustainable waste management within the poultry sector, identifying specific areas where educational outreach may be most effective.

The findings pinpoint that incineration has the highest awareness among respondents, with 34.67 per cent of the respondents indicating full awareness and a mean score of 3.85, suggesting that this method is relatively well-known in the community. Composting ranks next, with 21.33 per cent of the respondents fully aware and a mean score of 3.39, indicating moderate familiarity but also a need for further education. Organic fertilizer production shows lower levels of awareness, with only 12 per cent of the respondents fully aware and a mean score of 2.75. Lastly, anaerobic digestion demonstrates the least familiarity, with just 9.33% fully aware and a mean score of 2.43.

Table 6. Awareness of sustainable waste disposal techniques

S. No	Disposal techniques	Fully aware		Aware		Somewhat aware		Slightly aware		Not aware at all		Mean
		N	%	N	%	N	%	N	%	N	%	
1	Composting	16	21.33	21	28.00	19	25.33	14	18.67	5	6.67	3.39
2	Anaerobic digestion	7	9.33	9	12.00	13	17.33	26	34.67	20	26.67	2.43
3	Incineration	26	34.67	23	30.67	17	22.67	7	9.33	2	2.67	3.85
4	Organic fertilizer production	9	12.00	11	14.67	19	25.33	24	32.00	12	16.00	2.75

Source: Primary data

Table 7. Problems in adopting sustainable waste management practices

S. No.	Problems	Total score	Garret mean score	Garret's rank
1	Lack of financial resources	5986	52.97345	I
2	Time consuming	5934	52.51327	II
3	Lack of technical knowledge	5878	52.0177	III
4	High implementation cost	5700	50.44248	IV
5	Limited availability of resources/equipment	5629	49.81416	V
6	Insufficient training/support	5200	46.0177	VI

Source: Computed data

5.7 Problems in Adopting Sustainable Waste Management Practices

The adoption of sustainable waste management practices in poultry farming is often impeded by various challenges that hinder effective implementation. Identifying and understanding these challenges is essential for developing strategies to overcome them and promote more sustainable practices in the industry. To systematically analyze the obstacles faced by poultry farmers, this study applies Garrett's Ranking Method, which helps to prioritize these challenges based on the experiences and perceptions of respondents.

The results derived from Garrett's Ranking Method reveal the most significant barriers poultry farmers face when attempting to implement sustainable waste management practices. The primary challenge, ranked first, is the lack of financial resources, with a mean score of 52.97. This suggests that the majority of farmers perceive financial constraints as a major obstacle to the adoption of sustainable waste management techniques. The second most significant barrier, with a mean score of 52.51, is the time-consuming nature of sustainable waste management practices. This highlights the concern among farmers regarding the extensive time and labor required to implement and maintain proper waste disposal systems.

6. CONCLUSION

The findings of this study underline the pressing need for effective waste management solutions in the poultry farms of Virudhunagar district. While farmers acknowledge the environmental and health risks associated with improper waste disposal, their understanding of the broader impacts—encompassing environmental, health, and economic dimensions—remains limited. Practices such as landfilling and open-area disposal continue to dominate, exacerbating environmental degradation. However, more sustainable practices, including composting and organic fertilizer production, remain underutilized. Major barriers to the adoption of these sustainable methods include financial constraints, a lack of technical expertise, and the time-intensive nature of alternative practices.

To overcome these challenges, the study advocates for the implementation of targeted awareness campaigns, the provision of financial incentives or subsidies, and the introduction of technical training for poultry farmers. These measures would not only improve waste management practices but also foster the long-term sustainability of the poultry industry in Virudhunagar, contributing to both environmental protection and economic development. Collaboration between policymakers, local authorities, and stakeholders is essential to

establish a sustainable waste management framework that balances economic feasibility, environmental health, and social benefits.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

1. OpenAI. (2024). Response generated by ChatGPT on poultry waste management. Retrieved November 26, 2024, from <https://chat.openai.com>

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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