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Original Research

Poultry farm waste management practices: Environmental challenges, health concerns, and farmers' perspectives in Chattogram, Bangladesh

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Abstract

Poultry farming in Bangladesh involves raising birds mainly for meat and eggs. Poultry industry produce huge waste and causes environmental pollution. This study was commenced to investigate knowledge, perception, and attitudes toward waste management practices related to environmental Pollution and Public Health safety among poultry farmers. A well-structured questionnaire was used to elicit information from 35 randomly selected commercial poultry farms. The data revealed that 46% of farmers are between (30-39) years, 69% of farmers are married, and the education level of farmers is average. 71% of farmers rear broilers due to their high growth rate. 54% of farmers preferred semi-paka houses and rear poultry on concrete floors (74%). Farmers using litter materials such as sawdust 77%, and 60% of farmers changed litter materials in 30 days intervals. Biosecurity practice in this area was fair level (66%). Around 65% of farmers dispose of dead birds through burial. Around 69% of farmers throw litter materials on agricultural land. The majority of farmers were aware of the risk of human disease (97%), water pollution (94%), and air pollution (97%) from poultry wastes. A small percentage of farmers received training on farm management (14%), waste management, and Biosecurity (9%). Not a single farmer had waste management facilities such as pit's flush system, manure storage system, box type manure storage and zero percent of farmers were aware of the Environmental Protection Act. Perception of farmers on environmental issues associated with farming such as flies, noise problems, water pollution, gas production, etc. was high. Constraints to the adaptation of integrated waste management practices such as insufficient funds, shortage of labor, manure price, vehicle facilities, and waste disposal facilities were not severe.

1. Introduction

Poultry farming in Bangladesh is the mode of keeping various types of birds for meat, egg, feathers, or sale. Poultry birds are broadly used in Bangladesh for meat and eggs. The weather conditions are immensely friendly for poultry farming. Total poultry population in Bangladesh is 3857 lakh in number (Hamid *et al.*, 2017). Although the poultry industry has an extensive effect on both livelihood and economic effect in Bangladesh. The sector supports approximately 20% of rural employment (Sobur *et al.*, 2024). It has some negative effects on our environment related to a large-scale accumulation of poultry wastes including manure and litter which may pose public health and environmental problems (Rodić *et al.*, 2011). Similarly, Bangladesh is projected to produce 1,560,000 metric tons of waste from poultry each year (Miah *et al.*, 2016). About 3079 metric tons of poultry manure are produced daily from 42 million chickens in Bangladesh (Joardar *et al.*, 2020). Farmers in Bangladesh are not concerned or knowledgeable about the waste management of poultry although it has posed serious environmental pollution problems (Begum *et al.*, 2023).

Globally, an excess of 90% of poultry waste is spread as fertilizer on land close to the poultry farms. Poultry waste is contributing 33.7 million metric tons of CO_2 eq. /year or 0.0337 gigatons (Gt) CO_2 eq. /year which represents 0.64% of agricultural greenhouse gas emissions (Seidavi *et al.*, 2019). This practice could negatively affect environmental protection and safety through surface and groundwater pollution at high levels (Gržinić *et al.*, 2023). Water-borne diseases can also spread from the poultry manure. Moreover, improper management of poultry wastes also causes air pollution through offensive odors and promotes the breeding of flies and rodents (Ayilara *et al.*, 2020). The environmental consequences of excreta in litter include the release of ammonia and GHG nitrous oxide (Saggar *et al.*, 2004).

Natural resource base, public health, social equity, and economic growth can be hampered by negative livestock system effects (Randolph *et al.*, 2007). Necessary precautions must be taken along the poultry production, marketing, and processing chains, poultry meat, and eggs; otherwise, it can spread infectious agents that are harmful to humans (Thornton *et al.*, 2010).

The positive significant effect of education and farming experience on the farmers' perceptions increases their knowledge in handling environmental challenges relating to commercial poultry farming practices to provide a safe environment in society. Using

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appropriate biosecurity measures including management and physical measures can help to reduce the risk of entrance, induction, and spread of diseases, infections, or infestations within a population. According to previous studies (Adomako *et al.*, 2024; Islam *et al.*, 2024; Fraser *et al.*, 2010) biosecurity helps in improving the health status of poultry by preventing the introduction of new disease pathogens by assessing all possible risks to animal health. Poultry waste in Cameroon poses a significant public health risk due to antimicrobial resistance (AMR), with E. coli strains showing resistance to several key antibiotics classified under the WHO's Watch group (Moffo *et al.*, 2021).

A clear understanding of the perception of poultry farmers on the environmental issues associated with commercial poultry farming is a useful first step because good perception helps the farmers maintain an appropriate environment in the farming area. According to (Adnan *et al.*, 2019), the perception on waste management is a vital indicator of the adaptation process. In Bangladesh, very limited numbers of studies have so far been done to understand the status of farmer's perception or knowledge about poultry waste management.

The objectives of this study were to assess the current knowledge, perceptions, and attitudes of poultry farmers toward waste management strategies in Bangladesh. Additionally, the study aims to evaluate the farmers' understanding of public health risks and zoonotic diseases associated with poultry waste. By examining these aspects, the research seeks to provide insight into the existing gaps in farmers' awareness and practices, with the goal of promoting safer and more sustainable poultry farming methods that minimize environmental and public health risks.

2. Materials and Methods

2.1 Ethical approval

No ethical approval is required for this study.

2.2 Study area

The study was conducted in Mirsharai Upazila, located within the Chattogram district in the Chattogram division of Bangladesh from February to May 2021 (Figure 1). Mirsharai Upazila encompasses two administrative Thanas and two Pauroshavas, with geographic coordinates of 22.7722 °N latitude and 91.5750 °E longitude. For this study, 35 poultry farms were randomly selected from the region, providing a representative sample for the analysis.

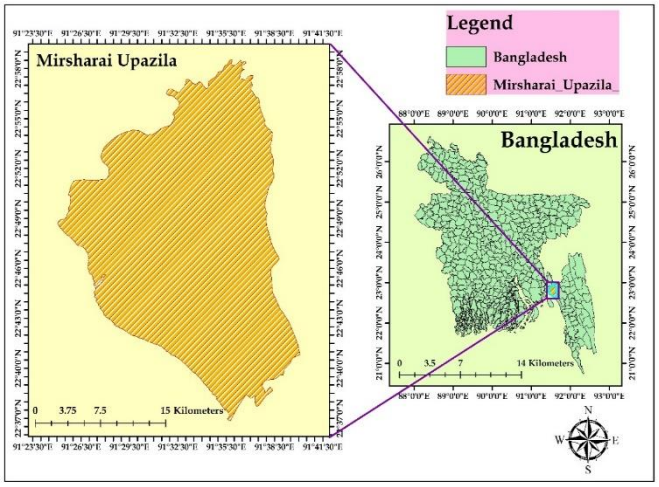

Figure 1. Map of the study area.

2.3 Data collection procedure

A structured questionnaire was developed, designed to capture comprehensive data in line with the study's objectives. The questionnaire was rigorously pre-tested with experts to ensure clarity, relevance, and ease of understanding for the respondents. Data collection was carried out from February to May 2021 through personal interviews with poultry farmers. The questionnaire gathered information on socio-demographic characteristics of farmers, knowledge and practices related to litter and waste management, housing and litter management practices, biosecurity measures, personal hygiene, knowledge of zoonotic diseases, and the environmental and health impacts of poultry waste. Additional insights were obtained through direct observation and informal discussions during farm visits.

2.4 Statistical analysis

The data collected were entered and organized using Microsoft Excel 2019. Descriptive statistical methods were employed to analyze the data, with frequencies and percentages calculated for key variables. The results are presented in the form of graphs and tables to facilitate interpretation and comparison.

3. Results and Discussion

3.1 Socio-demographic characteristics of farmers

The majority of the farmers (46%) fall within the age range of 30-39 years, followed by the 20-29 age group, which accounts for 34%. The largest portion of the farmers, 36%, belong to the age group of 39 to 45 years. Approximately 97% of the farmers were male, with only 3% being female, indicating low participation of women in poultry farming in this area. This could be attributed to the physical strength required for poultry farming, which is generally lower in women. A significant portion (69%) of the respondents were married. In terms of education, most farmers had completed SSC (31%) or HSC (29%), while 14% and 11% of the farmers held graduate and master's degrees, respectively. About 9% of the farmers were illiterate, and only 6% had completed primary education. These results suggest that the education level of the farmers in this study is moderate. As Kulkarni (2020) noted, education plays a critical role in proper waste management and hygiene, which helps prevent diseases and mitigate potential hazards. Additionally, only 20% of the farmers also owned cattle and goats along with poultry, indicating that large animal farming was not common among them (Figure 2).

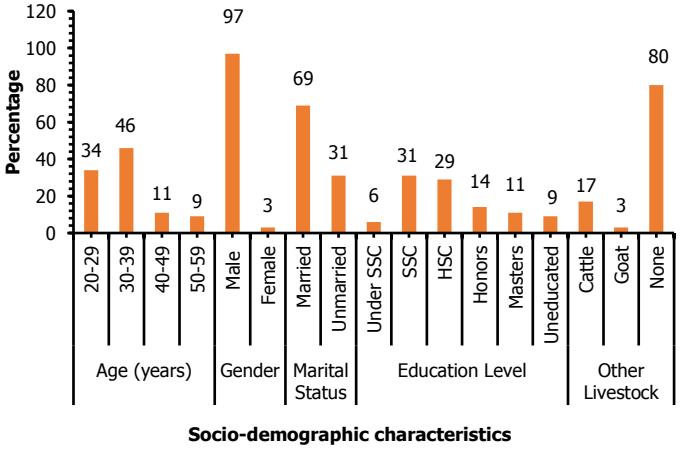

Figure 2. Socio-demographic characteristics of farmers.

The majority of farmers (51.43%) managed very small flocks of 0-1000 birds, while a smaller percentage (5.71%) raised large flocks of over 3000 birds. In terms of experience, approximately 60% of farmers had prior experience in poultry farming, while 40% were new to the field.

Maximum number of farmers who were known for two zoonotic diseases Salmonellosis 46% and Influenza 77% (Figure 3). Epidemiological analyses of human infections with the H_5N_1 avian influenza strain demonstrate that close interaction with domesticated live poultry is a risk factor for human infection with the virus (Al-Eitan *et al.*, 2024; Van Boven *et al.*, 2007). Farmers were well-known about avian influenza in this study area.

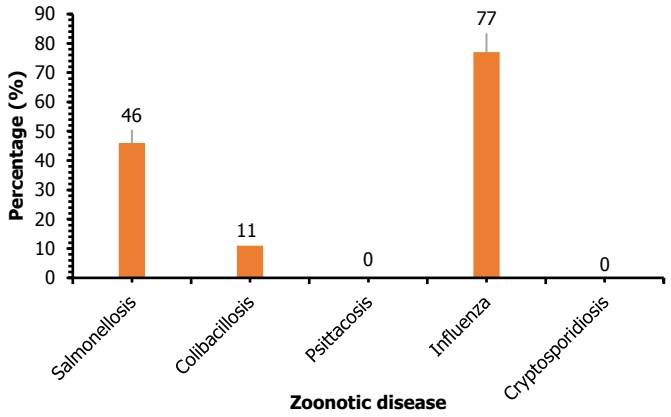

Figure 3. Knowledge about zoonotic infections.

3.2 Farm categories

Based on this study around 71% of poultry farmers preferred broiler rearing due to its upgraded genetic combination from others. These results agree with (Akter *et al.*, 2023) who said that broiler production is more profitable than layer production in this part of the country. This study also showed that around 3% of poultry farmers reared fancy birds (Figure 4).

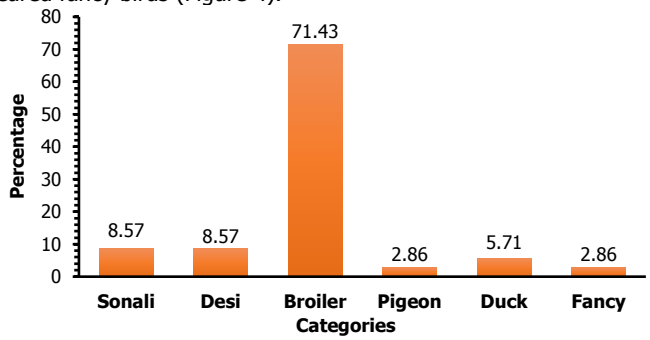

Figure 4. Characteristics of study farms.

The highest number of farms (43%) treated sick birds by both veterinarian and self-whereas only 31% farms were treated by only veterinarian. A small percentage of farm's (9%) were treated by both dealer and self -experience. These results agreed with Radwan *et al.* (2011).

3.3 Housing and litter management

Around 54% people preferred semi paka house and 74% people reared poultry in concrete as floor. Rahima *et al.* (2023) found that similar results as farmer reared birds in concrete floors due to concrete are damp proof thereby making it easier to manage litter. Saw dust was commonly use, around 77% because of its availability. Shao *et al.* (2015) also reported that sawdust was the most popular poultry litter materials used in the world. Most of the respond (94%) clear litter material at a time. In addition, that 89% people expel out whole litter material at a time and whereas 97% people did clear all sorts of materials before replacement. Around 60% people replaced litter in 30 days gaps before entry of new flock. Farmers preferred to use antiseptic as Savlon 27% and Timsen 20% for cleaning the litter materials. Most of the responds (66%) used material to prevent air during cold weather (Table 1).

Table 1. Housing and litter management of study farms.

Parameter	Categories	Frequency (N)	Percentage	95% confidence interval (CI)
House type	Tin shed	14	40	25.6 - 56.7
	Semi Paka	19	54	38.7 - 69.0
	Building	2	6	0.7 - 19.7
Floor type	Concrete	26	74	57.0 - 86.8
	Mud	9	26	13.2 - 43.0
Litter material used	Saw dust	27	77	60.0 - 89.0
	Sand	5	14	4.7 - 30.3
	Rice husk	2	6	0.7 - 19.7
	None	1	3	0.1 - 15.8
Litter removal method	All in All out	33	94	80.8 - 99.3
	None	2	6	0.7 - 19.2
Clean all before replace	Yes	34	97	84.2 - 99.9
	No	1	3	0.1 - 15.8
Remove only top most litter	Yes	4	11	3.0 - 25.8
	No	31	89	74.2 - 97.0
Time of litter change	4 days interval	1	3	0.1 - 15.8
	15 days interval	10	28	15.0 - 44.9
	30 days interval	21	60	42.1 - 75.4
	60 days interval	1	3	0.1 - 15.8
	Not change	2	6	0.7 - 19.7
Litter-treatment method	PLT solution	6	17	6.6 - 33.6
	Yuka	3	9	1.9 - 24.3
	Savlon	10	29	15.8 - 45.4
	Timsen	7	20	9.0 - 37.1
	GPC 8	4	11	3.0 - 25.8
	Potash	1	3	0.1 - 15.8
	None	4	11	3.0 - 25.8
Material used to prevent air	Yes	12	34	19.6 - 51.5
	No	23	66	48.5 - 80.4

3.4 Biosecurity and personnel hygiene

This study showed that, 66% people maintained biosecurity as fair mark. Maximum farmer used Timsen solution as a disinfectant where as 80% people do not use foot bath (Table 2). Application of standard biosecurity measures is vital in protecting poultry birds from any disease (Dorea *et al.*, 2010) because good biosecurity in any farm keep freeing off any vulnerable diseases and increasing production performance.

Table 2. Biosecurity status of the farms.

Types	Level/ Name/ categories	Frequency (N)	Percentage	95% CI (%)
Biosecurity	Good	6	17	6.7 – 33.3
	Fair	23	66	48.7 – 80.3
	Poor	6	17	6.7 – 33.3
Disinfectants use	Savlon	10	29	15.7 – 45.8
	Timsen	12	34	19.9 – 50.9
	GPC 8 3	9	26	13.2 – 42.1
	Blis.Pow.	1	3	0.1 – 15.8
	None	3	8	1.7 – 21.9
Foot bath	Use	7	20	9.2 – 36.1
	Not use	28	80	63.9 – 90.8

Personal hygiene like the use of face musk, change of clothing, washing hands, use of separate footwear, and gloves. Around 46% of people used facemasks while standing on the farm, and zero percent not farmers were shown did not change their clothes before entrance and exit, 46% of farmers used hand wash for cleaning their hands where whereas 20% of people used separate footwear before and after farm entry. Using gloves as a health safety measure is used in only 11% of farmers (Table 3). A study conducted in Bangladesh found that while workers on commercial farms and in urban markets had access to gloves and masks, they often did not use them. Furthermore, handwashing was not performed in 88% (606 out of 689) of observed exposure events (Alam *et al.*, 2019)

Table 3. Status of personal hygiene of working staffs.

Name	Use	Frequency (N)	Percentage	95% CI (%)
Facemask	Yes	16	46	30.4 – 62.2
	No	19	54	37.8 – 69.6
Cloth Change	Yes	0	0	0.0 – 9.9
	No	35	100	90.1 – 100.0
Handwash	Yes	16	46	30.4 – 62.2
	No	19	54	37.8 – 69.6
Separate footwear use	Yes	7	20	9.2 – 36.1
	No	28	80	63.9 – 90.8
Gloves	Yes	4	11	4.3 – 25.4
	No	31	89	74.6 – 95.7

3.5 Waste management

The waste generated in farm by several means like dung (17%) from cattle, goat, waste feed (49%), dead bird (20%) and litter (46%) (Table 4). Joardar *et al.* (2020) showed about 3079 metric tons poultry manures are produced daily from a total of 42 million chickens in Bangladesh.

Table 4. Waste generated in the study farms.

Name	Waste produce	Frequency (N)	Percentage	95% CI (%)
Dung	Yes	6	17	6.7 – 33.3
	No	29	83	66.7 – 93.3
Waste feed	Yes	17	49	33.9 – 64.5
	No	18	51	35.5 – 66.1
Broken eggs	Yes	0	0	0.0 – 9.9
	No	35	100	90.1 – 100.0
Feather	Yes	0	0	0.0 – 9.9
	No	35	100	90.1 – 100.0
Dead birds	Yes	7	20	9.2 – 36.1
	No	28	80	63.9 – 90.8
Hatchery	Yes	0	0	0.0 – 9.9
Waste	No	35	100	90.1 – 100.0
Litter	Yes	16	46	30.4 – 62.2
	No	19	54	37.8 – 69.6

Among the selected farms, no farms has dedicated waste management system. A majority of farmers (65%) buried the dead birds followed by throwing (20%) and burning (3%). In the case of litter materials, a maximum (69%) of farmers threw out litter material on agricultural land whereas 16 % of farmers sold or used litter in fish culture. A small percentage (3%) of farmers dispose of the litter materials in the river (Table 5). Ahmed *et al.* (2023) reported that there were several ways of disposing of poultry waste which include burial, rendering, incineration, compositing, feed for livestock, fertilizer, or source of energy which is in agreement with current findings in this area.

Table 5. Waste management systems of study farms.

Name	Using procedure	Frequency (N)	Percentage	95% CI (%)
Disposal of dead birds	Burning	3	9	2.8 – 21.1
	Burial	23	65	50.4 – 78.6
	Throwing	7	20	9.2 – 36.1
	Selling	2	6	0.7 – 18.8
Disposal of litter materials	Agriculture land	24	69	53.5 – 81.2
	Fish culture	5	14	4.9 – 30.1
	Sell	5	14	4.9 – 30.1
	River	1	3	0.1 – 15.8

3.6 Farmers knowledge on environmental effect of poultry waste

All (100%) the farmers were aware about the noise problems produced from poultry farms. Most of the farmers were concern about the poultry farms related water pollution (94%), air pollution (97%), pest infestation (97%) and risk of human disease (97%). Only 46% farmers were aware about the depletion of ozone layer due to poultry farm waste (Table 6). Anosike (2007) reported that poultry production activities enhance environmental pollution of air, water and foul odor emission which causes huge discomfort to both the human and animal lives. Wyer *et al.* (2022) was also said that ammonia emissions from poultry waste can have multiple health hazards including nasal irritation and cough for both human and animal.

Table 6. Farmer's awareness about health and environmental effects of poultry wastes.

Name	Aware/Not aware	Frequency (N)	Percentage	95% CI (%)
Depletion of ozone layer	Aware	19	54	38.7 – 69.3
	Not Aware	16	46	30.7 – 61.3
Water pollution	Aware	33	94	83.9 – 98.7
	Not Aware	2	6	1.3 – 16.1
Air pollution	Aware	34	97	88.7 – 99.8
	Not Aware	1	3	0.2 – 11.3
Prevalence of poultry diseases	Aware	34	97	88.7 – 99.8
	Not Aware	1	3	0.2 – 11.3
Pest infestation	Aware	34	97	88.7 – 99.8
	Not Aware	1	3	0.2 – 11.3
Risk of human diseases	Aware	34	97	88.7 – 99.8
	Not Aware	1	3	0.2 – 11.3
Noise	Aware	35	100	90.1 – 100.0
	Not aware	0	0	0.0 – 9.9

Only 14% farmer received training on farm management. Around 91% farmers had no training on waste management and biosecurity (Table 7). This observations in not consistent with finding of previous studies (Rahman *et al.*, 2022; Modak *et al.*, 2019) where 21% and 36% farmers received biosecurity and farm management training. According to a study in 2023 in Mymensingh district, 35% of the farmers had received training for the management of their poultry farms, while 65% had not received any training on poultry farm management (Begum *et al.*, 2023).

Table 7. Farmers receive training.

Name	Training	Frequency (N)	Percentage	95% CI (%)
Farm management	Yes	5	14	4.7 – 28.7
	No	30	86	71.3 – 95.3
Waste management	Yes	3	9	2.1 – 21.3
	No	32	91	78.7 – 97.9
Biosecurity	Yes	3	9	2.1 – 21.3
	No	32	91	78.7 – 97.9

None of the farms under this study had manure storage system, box type manure spreader, incinerator; pits flush system, automated dry system and fumigation facilities. Al-Amin *et al.* (2009) reported that 90% of storage systems were uncovered in poultry industries which are closely related with this study area finding. None of the farmer under this study had any kind of awareness on environmental protection agency, environmental protection laws and their tasks.

All the farmers (100%) were agreed that technology can help to recycling waste and technology subsequently increases the working efficiency. Knowledge level in case of manure and dead poultry wastes, storage system of litter materials, poultry house management, dead birds that spreading diseases, noise problem related to neighbors is well known. Knowledge level about litter management is mediocre. Using of poultry litter and dead bird buried system knowledge is at fair level. Perception level on odor problem from poultry house, sickness to farmers and their Neighbors, fly problem, aquatic life, contaminate ground water, pollution of drinking water, Global warming and climate change is High level.

3.7 Constraints of adoption of integrated waste management practices

The different constraints that are facing by farmers towards the adoption of integrated waste management practices. Around 3% farmers mentioned that insufficient fund, shortage of labor, lack of extension of information and contacts, lack of demand of manure from livestock farmers and lack of vehicle and transport costs are the severe constraints in adopting integrated waste management practices. Around 26 and 20% farmers thought that inadequate waste storage facilities and difficulty of burring waste during rainy seasons also act as severe constraints respectively in adoption of integrated waste management practices. In this finding 70-90% farmer do not have severe problem about insufficient fund, labor shortage, lack of extension information and lack of manure demand, inadequate knowledge of waste management, whereas 30-69 % farmer do not face severe problem on waste storage area, vehicles problems, land problem, waste disposal facilities (Figure 5).

The majority of respondents expressed concern about the effects of odor from poultry houses, with 94% agreeing that it produces flies and causes discomfort to neighbors, while only 3% disagreed or were undecided, leading to a high decision on this matter. Similarly, 97% agreed that odor from poultry waste can cause sickness to farmers and their neighbors, resulting in a high decision as well. Furthermore, 94% agreed that dead birds buried in the ground can decay, potentially contaminating groundwater and harming aquatic life, with only 3% disagreeing or undecided. Additionally, 97% agreed that poultry waste produces poisonous gases that can cause respiratory problems, and the same percentage agreed that these gases

contribute to global warming and climate change. In both cases, only 3% were undecided, leading to a high decision regarding these issues.

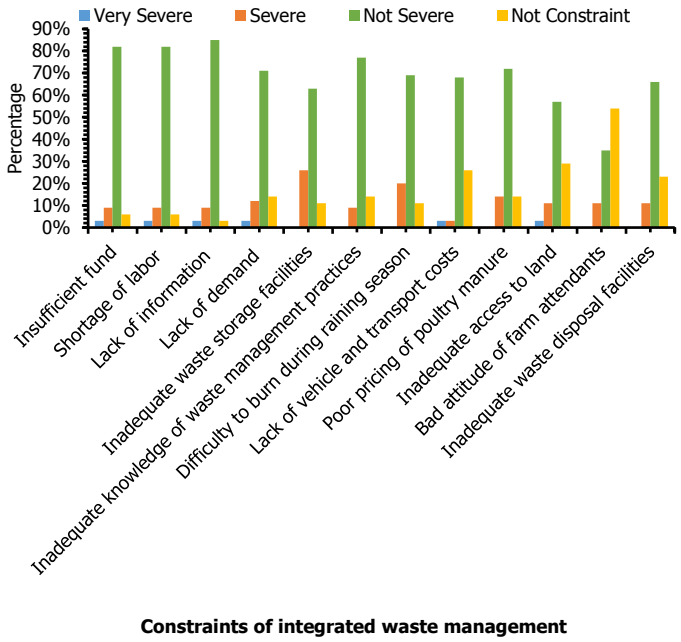

Figure 5. Overview of Constraints to adoption of integrated waste management practices.

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Table 8. Perception of commercial poultry farmers on environmental issues associated with poultry farming.

Statement	Strongly agree	Agree	Disagree	Undecided	Decision
Odor from poultry house produces flies and causes discomfort to the neighbors.		94%	3%	3%	High
Odor from poultry wastes can cause sickness to farmers and their neighbors	3%	97%			High
Dead birds buried in the ground can decay and contaminate the ground water and harm to aquatic life		94%	3%	3%	High
Poultry wastes produce poisonous gases which can cause respiratory problems.		97%		3%	High
Poultry wastes produce gases which contribute to global warming and climate change		97%		3%	High

4. Conclusions

Knowledge level of waste management was well known by the farmers in the present study area. Perception of commercial farmers on environmental issues associated with poultry farming was high. None of farmer had waste management facilities. None of them were aware about the task of Environmental Protection agency. All the farmers were agreed that using technology could help in recycling waste with increasing working efficiency. Bio security level was fair among the farmers in this area. Highest percentage of farmers was known about two zoonotic disease name's salmonellosis and avian influenza. All farmers agreed with recycling waste by using technology and aware with health and environmental effect on poultry wastes.

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Data availability

All relevant data are within the manuscript.

Informed consent statement

No informed consent was required to conduct the study.

Conflict of interest

The authors declare no conflict of interest.

Authors' contribution

Conceptualization, data curation, formal analysis, investigation, methodology, and writing original draft: Kazi Shams Al Arefin; **Data analysis, editing of draft:** Fahad Bin Islam; **Formal analysis, review, and editing:** Dibakar Chowdhury; **Data collection and writing the original draft:** Bristi Devnath; **Preparation of final manuscripts, data analysis, review and editing:** Kazi Abdus Sobur. All authors critically reviewed the manuscript and agreed to submit final version of the article.

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