

Poultry Wastes Management Strategies and Environmental Implications on Human Health in Ogun State of Nigeria

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Abstract Many poultry farms are established within 1 km distance of the residential households in Ogun state of Nigeria. These farms, despite their immense socio-economic benefits in terms of production of eggs, meat and employment generations often constitute some environmental risks to both human and animal lives through water/soil and air pollution. These waste products are produced in form of hatchery wastes, birds' excrement, litters and on-farm mortalities, among others. This study therefore examined the types and quantities of poultry wastes that are generated by the farms and the management strategies being used by the farms. It also assessed the implications of the wastes being generated on the environment. The determinants of the level of impact of poultry wastes on human health were also examined. The sample for the study comprised 240 poultry farmers and 250 individuals (victims) of environmental pollution who were randomly selected from across the five poultry zones in the 20 local government areas of Ogun State of Nigeria. Results showed that about 55% of the respondent poultry farms indicated that they generated below 200kg of faecal materials per month while the average monthly generated faecal wastes stood at 400kg. Similarly, the poultry farms lost about 4 crates of stale/broken eggs per month while the majority (84.58 %) of the farms lost 5 crates and below. About 65 % of the farms sold, flushed away, or burnt their poultry wastes while others either buried the wastes or used a combination of two or more disposal methods. About 63 % of the residents of the affected households either resolved to permanently shut their doors and windows (particularly those that are in adjacent position to the directions of the poultry farms) or make verbal complaints to the headship of the farms to register their protest against the foul odours. Similarly, about 19 % of the residents made formal reports by documenting their complaints and forwarding same to government quarters for a redress while about 18% of them simply chose to engage the management of the farms in open confrontations in protest of the environmental pollution. On the whole, the number of poultry birds being kept, farming

experience of the managers of the farm, system of farming operations, quantities of the generated faecal materials and the number of dead chicks/chickens were all significant determinants at 1% level. Similarly, the distance between the poultry farms and the residential households, frequency of visits by sanitation officials, frequency of clearance of poultry wastes by the farm attendants and the number of cracked/stale eggs were significant determinants (at 5%) of the level of impact of the wastes on human health. To mitigate the health risk that poultry wastes caused to the environment and the health of the residents of the households in the localities, there is the need for the management of poultry farms to recognize and respect 1 km resident-poultry unit distance, maintain proper and timely hygiene and observe high level of discipline in the way and manners they dispose the wastes.

Keywords Poultry wastes, Environmental Pollution, Human Health, Implications, Mitigation, Ogun State of Nigeria

1. Introduction

Poultry is one of the most developed animal industries in Nigeria. Historically, the growth of poultry industry began as a result of its high level of energy and protein, rapid turnover rate and short incubation period (i.e. 21 days) which are advantages of poultry over other livestock animals [17]. Despite an increase in intensive chicken keeping in early 1980's, the withdrawal of subsidy by government on the prices of day-old chicks and feed ingredients led to a general decline in the number of poultry birds particularly under commercial production in the country. The ever-increasing cost of feeds and management forced many commercial poultry establishments to fold-up. However, the discovery of a better feed formulation and management alternatives has made the poultry business attractive to new investors [1].

The types of poultry that are commonly reared in Nigeria are chickens, ducks, guinea fowls, turkeys, pigeons and more recently, ostriches. Those that are of commercial or economic importance, given the trade in poultry, however, are chickens, guinea fowls and turkeys. The main poultry products from the Nigerian poultry sub-sector are parent stocks, commercial day-old chicks, frozen chicken and table birds. The parent stocks are sold either directly to farms or through distributors or agents. Similarly, commercial day-old chicks are also sold either directly to farms or through distributors or agents. Some of the agents are operators of the poultry shops who market various types of poultry inputs.

There is no up-to-date or comprehensive information on the size of the poultry sector in Nigeria. The scarcity and, in some cases, the inaccuracy of the available information represents major limitations to a comprehensive overview of the sector. In Nigeria, before the outbreak of Highly Pathogenic Avian Influenza (HPAI) in 2006, the poultry population was estimated at around 150 million, with a large majority of local chickens and a minority of exotic breeds [23].

The production of poultry products results in hatchery wastes, manure (bird excrement), litter (bedding materials such as sawdust, wood shavings, straw and peanut or rice hulls), and on-farm mortalities. The processing of poultry results in additional waste materials, including offal (feathers, entrails and organs of slaughtered birds), processing waste water and bio-solids. Most of these by-products can provide organic and inorganic nutrients that are of value if managed and recycled properly, regardless of flock size. However, they also give rise to potential environmental and human health concerns as the sources of elements, compounds (including veterinary pharmaceuticals), vectors for insects and vermin, and pathogenic micro-organisms. With the probable exception of veterinary pharmaceuticals, these factors are also relevant to small flocks, including small family flocks that may be partially housed in containment structures.

Specific concerns that are well documented include degradation of nearby surface and/or groundwater, resulting from increased loading of nutrients such as nitrogen and phosphorus (and potassium in some locations). Air quality issues are less well understood and include the fate and effect of ammonia, hydrogen sulphide, volatile organic compounds (VOCs) and dust particulates emitted from poultry production facilities. Greenhouse gas emissions and health effects associated with nuisance odorants are also emerging and/or relevant issues, owing to global climate change and increasing human populations in close proximity to poultry operations, respectively.

Waste by-products such as excreta or bedding material that are generated by the worldwide annual production of more than 40 million metric tonnes of poultry meat and 600 billion eggs are generally applied as the final step of a producer's waste management strategy. Under proper land application conditions, the nutrients and organisms in poultry wastes pose little environmental threat.

Environmental contamination occurs when land application of poultry wastes is in excess of crop utilization potential, or is done under poor management conditions causing nutrient loss from environmental factors such as soil erosion or surface run-off during rainfall.

The use of poultry wastes for urban agriculture has become an issue because of its perceived benefits that include higher production output, which consequently ensures food security and poverty reduction among the under-privileged. Despite these benefits, the use of poultry wastes has been associated with environmental pollution and threat to human health, such as the recently reported cases of human deaths relating to the transmission of poultry bird flu. However, [4] concluded that poultry wastes are a resource for urban agriculture but if contaminated could cause dermatitis among users. They do not provide a better substitute for industrial manure.

According to [12] faecal decomposition generates several irritating chemicals, including hydrogen sulphide, methane, and ammonia, which in a poultry house, are nauseating to the caretaker, irritate the eyes, and affect the chickens. Studies have shown that high levels of ammonia also increase the severity of respiratory disorders, such as pneumonia, by directly damaging the respiratory tract. Arsenicals are fed to chickens to grow larger birds more quickly using less feed. Some arsenicals are also approved for improved pigmentation and disease prevention. Arsenic is classified by the U.S. Environmental Protection Agency (EPA) as a Class 'A' human carcinogen. It has been linked to elevated risk of liver, bladder, kidney, and lung cancers when ingested. Arsenic ingestion is also associated with mucous membrane damage, eye irritation, darkening and lesions of the skin, liver inflammation and damage, among others.

Activities in livestock production facilities cause environmental problems such as odour nuisance and land pollution resulting from improperly discharged manure. In addition, some odorous substances from these facilities may present health hazards [9];[20]. Odour is caused by a large number of chemical components produced during animal growth and present in livestock manure [21]; [22]; [19]. All these are potential forms of environmental pollution in Nigeria as the country's livestock industry expands.

The general objective of this study therefore was to examine the determinants of the level of impact of poultry wastes on human health. Specifically, the types and quantum of wastes being generated and various management strategies being used by poultry farms were examined.

2. Methodology

2.1. Area of Study

The study was conducted in the five poultry zones in Ogun state of Nigeria. The state was created in February 1976, bounded in the south by Lagos and the Atlantic Ocean, in the north by Oyo State, in the east by Ondo State and in the west

by Republic of Benin. Ogun state (also called Gateway state) is noted for the production of arable crops such as maize, cassava, melon, and poultry farming activities. Some of the major socio- economic activities of the people are fishing, carpentry and construction works. A large number of the people are traders while some people also engage in

transport business and civil service. Ogun State is made up of Yoruba people who are largely Egbas, Ijebus, Yewas, Aworis, Eguns and Remos. There are 20 local government areas (Figure 1) and an estimated 3,728,098 human population live in the state [18].



Source: Ministry of Information, Abeokuta, Ogun State of Nigeria

Figure 1. Map of Ogun State showing the study area

2.2. Methods of Data Collection

Both primary and secondary sources of data were used in this research work. Oral interview and structured questionnaire were used to collect primary data. Information that bothers on poultry wastes disposal mechanisms and implications on the environment were collected from the respondents. In addition, academic journals, bulletins and other related publications were useful sources of information. Multi-stage sampling techniques were used in selecting the respondent poultry farmers and the victim heads of households who lived within 1 km distance from the poultry farms. To ensure an even distribution of the sample, all the five poultry farming zones in Ogun state were carefully put into consideration in the course of collecting data. The first stage involved the identification of the zones through the assistance of the Ogun state chapter of Poultry Association of Nigeria (PANOG). The zones are: Egba, Ijebu, Yewa, Ota, and Remo. The second stage involved the selection of the poultry farms based on their scales of operation: small scale, medium or large scale. Finally, a simple random selection, by the farmers' scale of operation was done. On the whole, 240 farmers, comprising 120 small scale farmers, 60 medium scale and another 60 large scale farmers were sampled for the study (Details in Table 1 below). This sample represented about 43 percent of 558 registered poultry farmers in the

state (in 2012). It is thus hoped that findings obtained from this study will give a good representation of poultry industry in the state. On the side of the victims of pollution of poultry wastes, 50 individuals (household heads) whose houses were located within 1 km distance from the poultry farms were randomly sampled in each of the five zones; thus giving a total of 250 individuals (representing about 31 percent) out of the 807 heads of households in the locality. These individuals were examined to determine the level/degree of impact of poultry wastes' pollution on their health status. All data were collected between March and October 2012.

2.3. Methods of Data Analysis

Descriptive and inferential statistical methods were used in the analysis of data. Descriptive statistics comprised the use of frequency distribution tables, means, line graphs, bar charts and other measures of central tendencies. These methods were used to describe the types and quantities of poultry wastes that were generated by the poultry farmers and some of their socio-economic parameters. The methods were again used to describe the various management strategies being practiced by the poultry farms in the study area.

Table 1. Method of sample collection for the study

Zone	Scale of Farming Operation	No of registered farms	Sampled poultry farmers	Sampled Household Heads (Victims)	Sampled Farming Communities
Egba	Small Scale	105	42	50	Adatan, Alabata, Osiele, Farm settlement
	Medium Scale	33	16		Osiele, Olomore, Idi-aba
	Large Scale	14	10		Farm settlement, Osiele, Owode- egba
Ijebu	Small Scale	53	18	50	Ago-Iwoye, Atan, Eruwon
	Medium Scale	30	16		Idomila, Ijebu-Ode, Atan
	Large Scale	17	14		Eruwon, Oru, Ogbogbo
Yewa	Small Scale	64	24	50	Ayetoro, Idiroko, Owode
	Medium Scale	28	12		Ilaro, Owode Yewa
	Large Scale	11	6		Ayetoro, Ilaro, Igbogila
Ota	Small Scale	41	14	50	Sango, Ota, Iyesi
	Medium Scale	19	8		Igbesa, Sango, Ifo
	Large Scale	19	20		Ifo, Sango, Ota
Remo	Small Scale	66	22	50	Ayepe, Iperu, Sagamu
	Medium Scale	23	8		Sagamu, Ikenne, Ilisan
	Large scale	35	10		Ogere, Iperu, Farm settlement
TOTAL		558	240	250	

Source: Field survey, 2012

Multinomial logit model was however employed to examine the determinants of the level or degree of impact of poultry wastes on human health. Generally, this model is considered appropriate when the response takes multiple possible values, which in this case, represent the various implications of poultry wastes on human health (the victims) in the neighbourhood. According to the medical records of the local health centres of the affected farming communities, the most common health problems exhibited by these ‘victims’ of poultry wastes included: malaria, sneezing, and restiveness. Therefore, the model used here is capable of handling polytomous responses i.e. where the responses are more than 2. This position is supported by [13]. Thus, ‘victims’ exhibiting malaria as symptoms of sickness are represented by *i*, those exhibiting sneezing as symptoms are represented by *j* while those showing restiveness as symptoms are represented by *k*.

All the relevant explanatory variables were captured by X_1, \dots, X_{12} .

The model is expressed mathematically thus;

$$\text{Logit}(Y_{ijk}) = \alpha + \beta_1 X_1 + \dots + \beta_{12} X_{12} + e_i \dots \dots \quad (1)$$

where,

Y = the probability that a selected individual is a ‘victim’ of poultry wastes’ pollution in his environment

ijk = indicates *i*th victim suffering from malaria, *j*th victim suffering from sneezing

and *k*th victim suffering from restiveness respectively

α = the constant

β_i = The predictor variable coefficient

X_1, \dots, X_{12} = The observed predictor variable values, that is, the independent (explanatory) variables

X_1 = Distance of poultry farm to residential households (Meters)

X_2 = Number of poultry birds (Units)

X_3 = Frequency of visit of poultry sanitation officials (per month) (Units)

X_4 = Age of poultry farm manager (Years)

X_5 = Quantities of water used (Litres)

X_6 = Number of farm labour (Family and Hired) (Man- day)

X_7 = Poultry farming experience of the farm manager (Years)

X_8 = System of operation of the farm (Deep Liter = 1, others = 0)

X_9 = Quantity of faecal materials generated (Kg)

X_{10} = Number of dead chicks/chicken (Numbers)

X_{11} = Frequency of waste clearance (per month)

X_{12} = Number of cracked/stale eggs (Number)

e_i = Random (stochastic) factor external to the model.

Descriptive statistical analysis revealed that there were three major types of poultry wastes being generated on the farms in the study area. These include faecal wastes, stale/broken eggs and dead birds/chicks. About 55% of the sampled respondents indicated that they generated below 200 kg of faecal material per month while the average monthly generated faecal wastes stood at 400kg (Table 2). Similarly, the poultry farms lost about 4 crates of stale/broken eggs per month while the majority (84.58 %) of the farms produced 5 crates and below. Again, about 83.34% of the farms lost up to 10 dead birds/chicks per month while the average monthly mortality rate stood at 7.4 % (Table 2). All these constituted a significant proportion of poultry wastes’ pollution in the study area. This further confirmed earlier claims [19];[20] that odours that emanate from huge quantities of poultry wastes that are continually being generated by the farms often heighten the level of risk to human existence in the localities. It therefore poses some challenges to the officials of the Ministries of Health and Environment and Habitat to ensure that adequate monitoring and assessment of the activities of these poultry farms are carried out from time to time towards ascertaining a minimal but safe compliance level.

Table 2. Types and quantities of poultry wastes generated per month

Types	Frequency	Percentage
Faecal wastes		
< 200 kg	134	55.83
200-400 kg	92	38.33
> 400 kg	14	5.84
Average: 400 kg		
Stale/Cracked eggs		
Less than 5 crates	203	84.58
5-10 crates	19	7.92
>10 crates	18	7.50
Average = 4.16		
Dead birds/chicks		
< 5 birds	102	42.50
5-10 birds	98	40.84
11-15 birds	14	5.83
16-20 birds	14	5.83
> 20 birds	12	5.00
Average: 7.4		

Source: Field survey, 2012

4.2. Waste Management Strategies

Most of the poultry farms have devised series of management strategies towards getting rid of their poultry wastes so as to mitigate their effects on the environment. For instance, some sell, bury, flush away or even burn off while others simply recycle or use a combination of two or more management alternatives. In this study, it was observed that about 65 % of the farms either sell, flush away, or burn their

4. Results and Discussion

4.1. Types and Quantities of Poultry Wastes Generated by the Poultry Farmers

poultry wastes while others either buried the wastes or use a combination of two or more disposal methods.

On the whole, 14.17 % recycled the wastes (as manure) for crop production. This could become an environmental issue when the manure is applied to the land in excess of the receiving crop’s threshold level and the ability to utilize the nutrients [8]. It was also discovered that about 5.0 % of the farms buried the wastes in the ground. This may, however, lead to groundwater contamination [7] and thus constitutes a source of risk to human life. This serves as warning signals to the owners of residential houses in their efforts at properly locating their wells and boreholes on their compounds. However,[3] noted that burning of poultry wastes could cause atmospheric pollution which might pose some danger to human and livestock animals’ lives.

Again, it should be noted that flushing of poultry wastes in form of slurry into nearby pits, streams and rivers can cause damaging effects to both the human and aquatic lives and even water qualities downstream. Flushing may also cause a reduction in the quantity of dissolved oxygen and high water turbidity. This often threatens the natural habitats of many organisms in the nearby water masses. Huge quantities of organic and inorganic nutrients that are released as slurry are capable of permanently distorting the aquatic ecosystem. Biological effects include the release of untreated pathogenic microorganisms (faecal coliform) into the environment [14]. Table 3 and Fig. 2 showed that none of the farms had an environment-friendly poultry waste management system that is capable of completely mitigating the effect of the odour being generated by the wastes. The implication of this is widespread air, water and land pollution with the attendant health risks to both the human and animal lives in the localities. However, in an effort to provide a timely and cheap poultry waste management option, the farms should be encouraged to engage in land application of the wastes as farm manure on their crop farms. This therefore requires that the poultry farms should also have crop farming enterprises such as vegetable farms, tree crop farms and/or orchards where they could occasionally apply the poultry wastes as manure to keep the soil fertile. This will prevent wastes’ pile-up and thus mitigate the degree of environmental pollution in the neighbourhood. This position had earlier been supported by [8] in his study on ‘Poultry waste Management in Developing Countries’.

Table 3. Waste Management strategies by farmers.

Waste management method	Frequency	Percentage
Selling	48	20
Burying	12	5
Flushing into pit, streams and rivers	51	21.25
Burning	56	23.33
Recycling in crop production process	34	14.17
Others (Combinations of methods)	39	16.25
Total	240	100

Source: Field Survey, 2012.

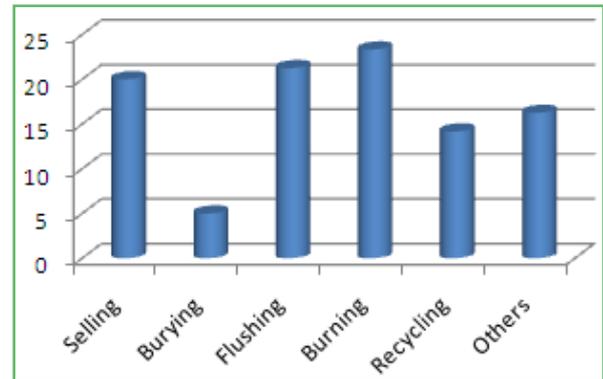


Figure 2. Poultry wastes management practices in the study area

4.4. Poultry Wastes and Coping Strategies

Establishing poultry farms within 1km distance of residential houses has been a source of concern to the members of the households, the farms and even the government, among others. Unarguably, the generation and disposal of the wastes by these farms pose major challenges to all the stakeholders, including the Ministries of Health, Environment and Habitat. This study revealed that the most common symptoms being manifested by the residents of the households in the study area were restiveness, malaria and sneezing. These symptoms are capable of reducing the productivity of the affected individuals (victims) who are economic agents and by extension, the national economy. It is therefore important to examine the strategies by which the victims can cope well with the challenges of environmental pollution occasioned by poultry wastes. About 63 % of the residents of the affected households either resolved to permanently shut their doors and windows (particularly those that are in adjacent positions to the directions of the poultry farms) or make verbal complaints to the headship of the farms to register their protest against the foul odours. Similarly, about 19 % of the residents made formal reports by documenting their complaints and forwarding same to government quarters for a redress while about 18% of them often chose to engage the management of the farms in open confrontations in protest of the environmental pollution (Figure 3).

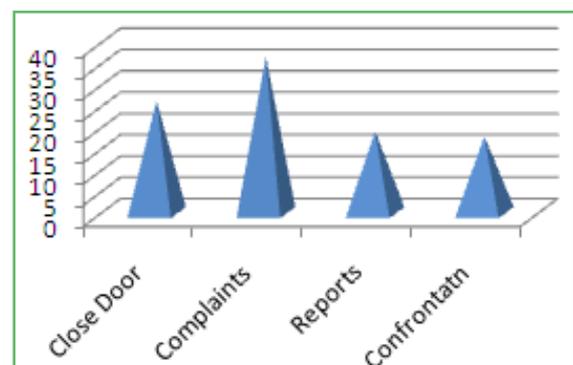


Figure 3. Poultry Wastes and coping Strategies among Neighbouring Households

4.5. Poultry Wastes and Human Health: The Relationship

The proximity of many poultry farms to residential households has often raised a lot of concerns on human and the environment. On many occasions, residents living within 1 km distance of the farms complain of restiveness, malaria, sneezing and/or nausea. Cases of cholera outbreak, reptiles' (mostly snakes) and wild animals' attack are also common. All these have severe implications on the productivity of the victims of the attack and by extension, the national economy. This section therefore examined the determinants of the level of impact of poultry wastes on human health. Multinomial logit model was used to capture the relationship. On the whole, the number of poultry birds being kept, farming experience of the manager of the farm, system of farming operations, quantities of the generated faecal materials and the number of dead chicks/chickens were all significant determinants at 1% level. Similarly, the distance between the poultry farms and the residential households, frequency of visits by sanitation officials, frequency of waste clearance by the farm attendants and the number of cracked/stale eggs were significant determinants (at 5%) of the level of impact of poultry wastes on human health (Table 4). The magnitude of the log-likelihood function also confirmed the goodness of fit of the model and the relevance of the identified determinant variables. These findings therefore pose a huge challenge to the poultry farms, the local health officials, the residential households and indeed government, in an effort

towards ensuring a safe and secure environment for the citizenry. This position was partly corroborated by [5], [10] and [11].

5. Conclusion and Recommendations

In this study, the researchers highlighted the poultry wastes management strategies and environmental implications on human health in Ogun state of Nigeria. Particular reference was made of the quantities and forms of poultry wastes being generated, the common management strategies being used by the farms and the determinants of the level of impact of poultry wastes on human health. It was however observed that despite the huge benefits that abound in poultry industry, the wastes that are continually being generated in form of either birds' excrement, offals, dead chicks/chickens, stale or broken eggs constitute some environmental nuisance that are harmful to both animal and human health[1];[3]. The effects of poultry production activities include the degradation of nearby surface and /or underground water, and pollution of the environment through the emission of foul odour; thus causing a huge discomfort to both the human and animal lives [4]. This is a major source of concern to members of residential households, particularly those living within 1km distance of the poultry farms, the government and other stakeholders in poultry, environment and health industries.

Table 4. Determinants of the level of impact of poultry wastes on human health in the environment: Multinomial Logit model analysis

Variable	Co-efficient	Std Error	t-value
Constant	4.136*	1.157	3.575
Distance of Poultry farm (X ₁)	3.532**	1.341	2.634
Number of poultry birds (X ₂)	10.101*	3.089	3.269
Frequency of visit of sanitation officials (X ₃)	0.097**	0.050	1.940
Age of Poultry farm (yrs) (X ₄)	0.672	0.426	1.577
Quantity of water used/month (Litres) (X ₅)	0.108	0.068	1.588
Farm labour used (man-hour) (X ₆)	0.058	0.034	1.580
Farming experience of farm manager (yrs)(X ₇)	3.012*	0.186	16.194
System of operation of the farm (X ₈) (Dummy:Deep litters=1;Others=0)	2.634*	0.534	4.933
Quantities of faecal materials generated (Kg) (X ₉)	0.178*	0.019	9.368
Number of dead chickens/chicks (No) (X ₁₀)	9.800*	0.702	13.960
Frequency of waste clearance/month (X ₁₁)	12.743**	5.956	2.140
Number of cracked/stale eggs (X ₁₂)	9.221**	3.452	2.671
Log-likelihood function		57.312	

Source: Field survey 2012

*Means significant at 1% level

**Means significant at 5% level

On the whole, it was observed that the distance of poultry farms from the residential areas, frequency of visits by sanitation officials and frequency of clearance of poultry wastes were some of the significant determinants of the level of impact of poultry wastes on the environment. To mitigate the effect of these wastes on the environment therefore, there should be a strict enforcement by supervisory agencies of the existing sanitation/health policies aimed at environmental preservation and protection, especially as recommended by the State and Federal Environmental Protection Agencies in Nigeria. Poultry farms that contravene 1 km resident-poultry unit distance should be asked to relocate to far distant places to reduce or eliminate the chances of environmental pollution/health hazards. Again, there is the need to ensure that all poultry farms have sufficient access to adequate supply of water and other sanitary wares that can be deployed for keeping their environment clean and safe at all time. Finally, poultry wastes should be cleared from the farms on daily basis to avoid accumulation of the wastes which could pose some health risks to the environment. This position had earlier been supported by [4]. It is therefore hoped that if these necessary precautionary measures are taken with the required levels of seriousness and in compliance with the appropriate existing government regulations, the negative implications of the poultry wastes on both human and animal lives will be mitigated.

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