

## Environmental and Health Effects of Poultry Farm Operations in Diye-Bay, Zarmaganda Community of Jos South Local Government Area, Plateau State, Nigeria

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### Abstract

*Poultry farms are rich sources of generating solid, gaseous and liquid waste materials, which if improperly managed may degrade the environment and pose public health risks. This study investigated the environmental and health effects of poultry farm operations in Diye-Bay, Zarmaganda community of Jos South LGA. Purposive and simple random techniques were used to select poultry farmers and household heads, respectively. Data were collected using structured questionnaire, administered to 386 household heads. Descriptive statistics of frequency counts, means, and percentages was computed using the SPSS-23 software to analyze the data collected. Results showed that 60% of the male gender participated in the study; 56% were within the age bracket of 41-60 years old; 64% of them were married; 95% attended formal education and highly literate; 34% took to farming and 29% also engaged in trading; yet about 50% of them earned less than N100,000 monthly income. Results further showed that 64% of poultry farmers owned less than 201 birds, and 72% of them obtained less than 601 crates of eggs monthly. The popular environmental effects of poultry farm operations perceived by respondents were: rooster noise nuisance (ranked 1), water pollution (ranked 2), emission of GHGs (ranked 3), and global warming (ranked 4), among others; while the perceived health effects include itching of body parts (ranked 1), vector breeding (ranked 2), zoonotic diseases (ranked 3), breathing difficulty (ranked 4). Sequel to these environmental and public health concerns, the popular strategies for mitigation as advanced by the respondents were, policy and regulations (ranked 1), health surveillance (ranked 2), proper waste handling (ranked 3), and adequate farmer education (ranked 4). The paper called on the relevant authorities to regulate farm activities in order to safeguard the environment and public health.*

**Keywords:** Environmental, health effects, public health, poultry farms, pollution

### INTRODUCTION

Poultry farming is the rearing of domesticated birds for meat, eggs and feathers, which has been a staple protein supply of food and nutritional security for a wide range of people since the advent of agriculture (Barrenetxea, 2003; Grznic, Piotrowicz-Cieslack, Klimkowicz-Pawlas, Gorny, Lawniczek-Walpotrykus, Tankiewicz, Krupka, Siebielec, & Wolska, 2022). The

rearing of birds originated many years back, which emanated through collection of their eggs and chicks from their natural habitat and eventually culminated into domesticating them (Ajala, Ogunjimi, Famuwagun, & Adebimpe, 2021). It is one of the most efficient animal husbandry methods where birds are kept either using extensive method, semi-intensive method or intensive managing systems. Global poultry meat output from domesticated birds

has been estimated to reach 137.8 million tons in 2021, with the USA producing 22.765 million tons, China 19.5 million tons, Brazil 14.076 million tons and European Union 13.769 million tons, among others (Food Agriculture Organization, FAO, 2022; Himu & Raihan, 2023). However, global production reached 133.4 million tons in 2020, with a significant environmental and health footprint (Grzinic et al., 2022).

Poultry farming is one of the major urban agricultural practices in Nigeria and the country's standing poultry population is about 180 million birds, a substantial increase from 151 million birds in 2018 (FAO, 2018; Ajala, Ogunjimi, Famuwagun, & Adebimpe, 2021). Poultry farming is a vital approach towards providing urban residents with the required protein intake in form of eggs and meat (Akin, 2014). Poultry production has made a tremendous change in order to meet the increasing demand for safe distribution of eggs and meat. The increase in demand has also multiplied the number of poultry farms. Acosta-Alba (2012) observed that poultry farming is capable of addressing four core scopes: food safety, food consumption, food access and food permanency. However, poultry farming has been associated with health and environmental impacts.

The rapid expansion of poultry farms, often located in residential areas and without adequate regulation has its environmental and health impacts. Large-scale poultry farming has been linked to outbreak of epidemics such as respiratory diseases, particularly, tuberculosis, Severe Acute Respiratory Syndrome (SARS) and Avian Influenza (H5N1) as well as Salmonella (Hu et al., 2017; Bupwatda, 2023). Akin (2014) stated that in the year 2006, there was an outbreak of Avian Influenza in Nigeria in many farms, and it also spread to humans. Thousands of poultry were destroyed in order to reduce the outbreak in the nation with serious socio-economic consequences on the farmers.

Poultry farming is becoming an increasingly relevant agricultural activity in Jos city due to its economic benefits and the rising demand for the products. The continued expansion of Jos in recent times has led to increasing demand for protein. This has, no doubt exacerbated rapid growth of poultry farming in Jos metropolis. However, this expansion of poultry farms, often located in residential areas, which in most cases, without adequate regulations and planning, has raised serious concerns to both the environment and human health (Bupwatda, 2023). Personal observations over the years by these investigators have revealed that poor waste management, odour emissions, soil contamination, proliferation of disease vectors, crowing rooter noise, groundwater and surface water contamination are obviously some of the environmental and health challenges attributed to poultry operations in the neighbourhoods of Bukuru, Rayfield and Zarmaganda, among others, which is also confirmed by the Plateau State Ministry of Environment (2022).

Despite these concerns, there is limited empirical data on the extent and nature of the environmental and health effects of poultry farm operations in the study area. This gap in knowledge has stifled effective policy development and the implementation of suitable practices to protect the environment and safeguard public health. It is against this backdrop that this study set out to specifically: characterize the demographic and socio-economic composition of the residents of Diye-Bay, Zarmaganda community of Jos South LGA; determine the number of birds being bred in the area; assess the quantity of egg production in the area; analyze residents' perceived environmental and health effects of poultry farm operations in the neighbourhoods; and recommend strategies for mitigating the menace.

It is hoped that the outcomes of this study will be very significant to the local authorities and policymakers in designing effective

environmental and public health regulations for successful poultry farming operations, devoid of environmental degradation and public health concerns. The timely intervention by the concerned authorities will enhance the achievement of Sustainable Development Goal 12 of the United Nations, which emphasizes "Responsible consumption and production, in relation to biohazardous waste and sustainable management practices, especially in urban areas".

## METHODOLOGY

### *Study Area*

Zarmaganda community is located in Jos South LGA, bounded by Bukuru in the West, Barkin-Akawo in the West, Rayfield to the East and Giring to the North. Figure 1 shows Jos South LGA with Zarmaganda (inset). Diye-Bay is one of the fast growing towns in Zarmaganda (Bupwatda, 2023). The study area is situated on an average elevation of up to 1,250 meters above mean sea level (MSL), and is generally noted for its near temperate climate, with mild, cool, and friendly weather of 22.5°C, which attracts many citizens and foreign nationals.

The area experiences two distinct seasons, Wet and Dry. Wet season prevails from April to October, while Dry season spans from November to March. Wet season is warm with annual rainfall of between 1300- 1500mm per annum. Dry season is cold and dusty with dessicating effect on human skin, surface water and plants. While Wet season favours environmental pollution and water-borne diseases (eg cholera,

typhoid and malaria), Dry season exacerbates air-borne ailments such as dry cough, common cold and pneumonia. The Daily Trust of Saturday 22 December 2012 gives favourable environmental conditions that favour poultry farm operations in Jos to include: cooler weather which reduces heat stress in layers and broilers; the relatively dry weather which reduces the prevalence of some poultry diseases; and abundant water supply which enhances bird health and hygiene.

### *Materials and Methods*

The study adopted a mixed research designed which is cross-sectional, as longitudinal survey was not convenient. The main instrument of data collection was structured questionnaire, supported by field observations and the use of digital camera. The questionnaire was given to two medical Statisticians who validated it. Their input led to addition of five question items to the 25 drafted, making 30 in all. Therefore, the Content Validity Index obtained was 0.83 which is more than the acceptable range of 0.700. The questionnaire contain relevant information sought to accomplish the stated objectives such as: personal information of the respondent, number of birds being bred, quantity of egg production per month, the perceived environmental and health effects of poultry farm operations, and possible measures that need to be taken to mitigate the menace in the study area. However, 20 copies of questionnaire were administered to the neighbourhood with the aim of detecting any difficulty for amendment before the commencement of data collection.

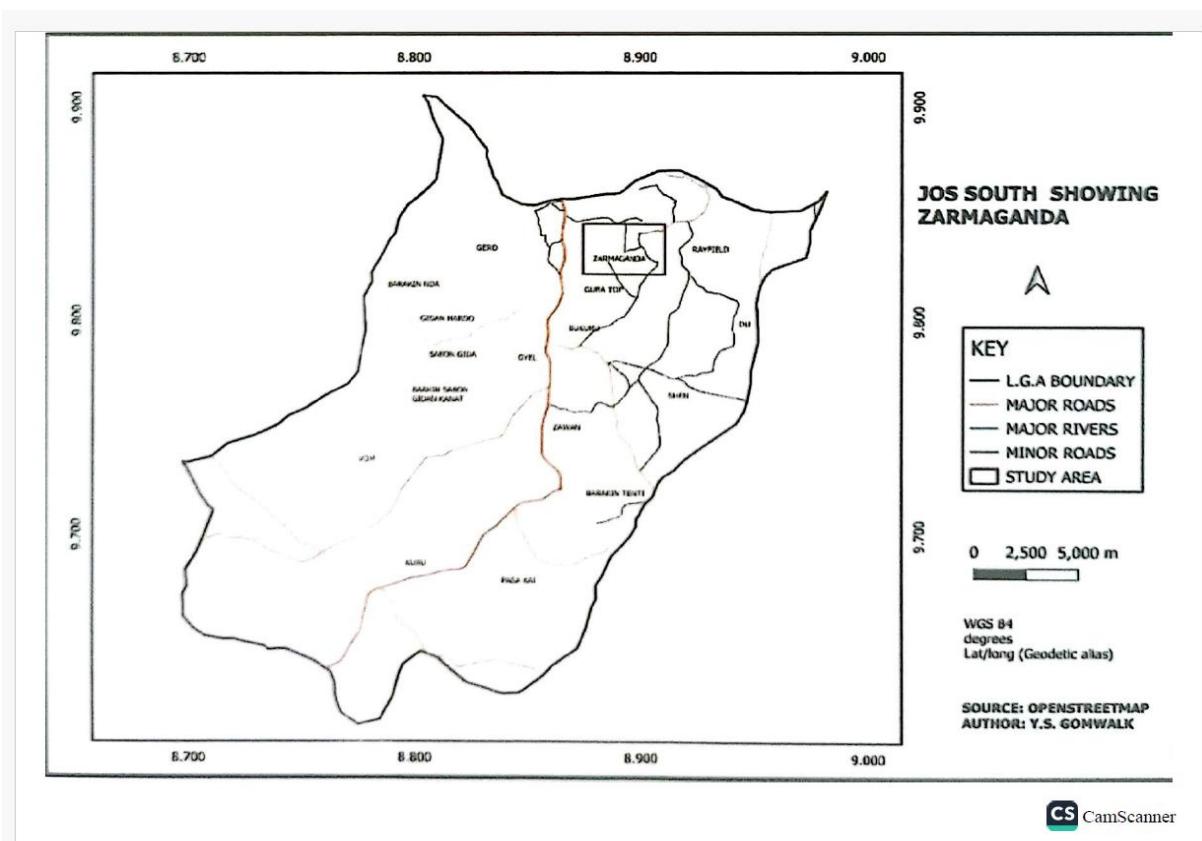
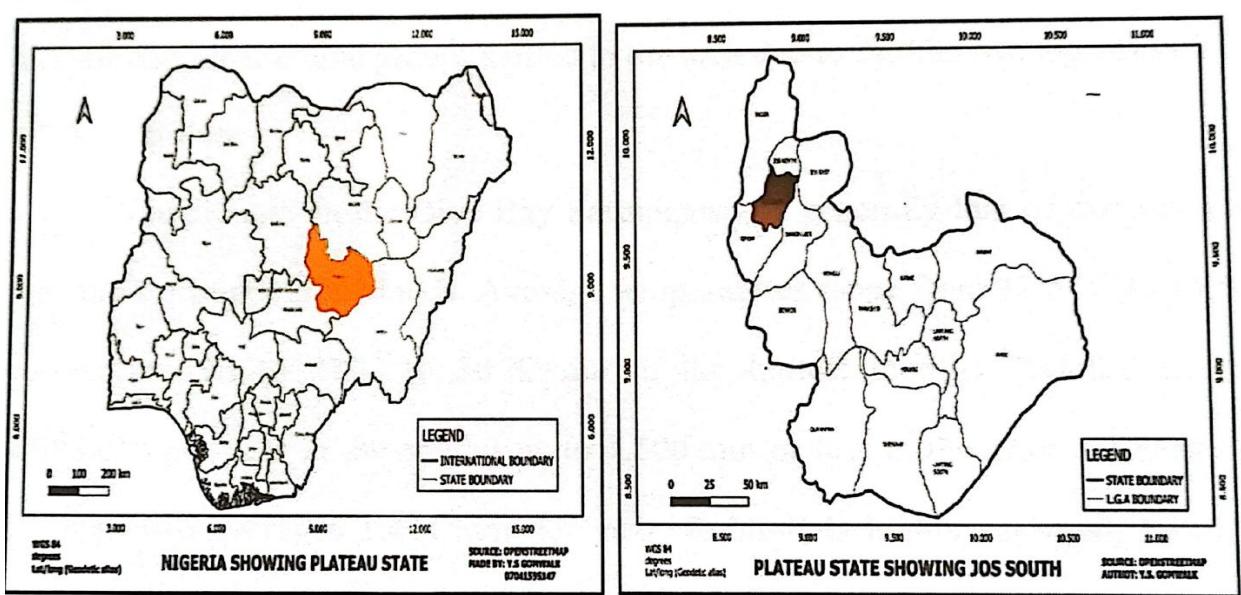


Figure 1: Jos South with Zarmaganda (inset)



Source: GIS Lab, University of Jos

The population of the study area was given as 55,348 people as at 2006 (NPC, 2006), but based on annual growth rate of 2.5% per annum, the projected population as at 2023 was 98,412 or 16,402 households, with a significant households operating poultry farm (Bupwatda, 2023). Yemane (1968) formula was applied to determine the sample size, at 5% level of significance thus:

$$n = N \div 1 + (Ne)^2$$

where  $n$  = sample size;  $N$  = population size;  $e$  = the level of significance. Therefore, a sample of 398 households was obtained. Purposive technique was used to select poultry farmers and simple random sampling was employed to administer the 398 copies of questionnaire to the poultry farmers based on wilful acceptance. This exercise was carried out with the help of four trained field assistants from the Department of Geography and Planning, comprising male and female students. The investigators also participated actively in questionnaire administration. This led to recovery of 398 copies of questionnaire for analysis. However, only 386 were duly returned, while the remaining 12 copies were not fully completed by the respondents, hence were not included for analysis. Descriptive statistics (frequency counts, mean, and percentages), aided by Statistical Package for Social Sciences (SPSS) 22-software was used to analyze the data. Modified 4-point Likert scale was applied to determine the criterion mean for comparison.

Criterion mean was obtained when the average of the 4 points were determined, which is 2.50  $[(4+3+2+1) \div 4]$ . When the mean of a declarative statement is 2.50, we affirm it as significant, but if it is less than 2.50, we reject such a statement as weak. The outcomes of the analysis were presented by means of Tables and followed by dome explanation of the results presented.

## RESULTS AND DISCUSSION

### *Demographic and Socioeconomic Characteristics Respondents*

Table 1 shows the distribution of respondents by demogrspic and socio-economic characteristics. Results showed that almost three-fifths (59.6%) of the participants at the study were male gender, while female gender accounted for the remaining 40.4%, which is in line with African tradition that every male is the head of his household and can be the only person to divulge any information about the family business to visitors. The result on gender disagrees with the reported findings by Haruna, Jibrin, Kalla, and Suleiman (2007) who found 77% female gender participating in poultry farm operations in Jos North LGA. The result on age of the respondent shows that over one-half (55.7%) were within the age bracket of 41-60 years old, followed by those within 21-40 years (31.3%), and those in less than 21 years (10.9%), while 60 years and plus accounted for the remaining 2.1%. The result further shows that 64.5% of the respondents were married while 35.5% were not married or were still single.

From the Table, it is also obvious that 94.6% of the respondents have had formal education, with only 5.4% not privileged. This means most of the respondents in the study area are literate, in line with earlier finding reported of Jos North by Haruna et al. (2007). This implies that education is important among poultry farmers because it enables them adopt improved agricultural practices and innovation for improved productivity. Many (33.7%) of the respondents engaged in farming activities, including poultry farming, followed by trading (29.0%), civil service (22.8%), housewifery (8.0%), and artisanry (6.5%), like mansory, brick laying, vulcanizing, carpentry, tailoring, informal mining, stone breaking and house-helping. The result further shows that 64.5% of the respondents have been residing in the study

area for 5-15 years, followed by those above 15 years, and those that are less than 5 years old in the study area. This means there are many house owners in the study, which partly explains why they have been at the same spot all these years and one could speculate that they are most likely to be the operators of poultry farms there. In terms of average monthly earning, almost one-half (49.7%) of

the respondents earn less than N100,000, followed by those who earn N100,000-N199,999, while only 13.2% earn N200,000 and above monthly from their various streams of income. This implies that majority of the poultry farmers in the study area fall within the low-income earners (LIE), which consequently may hinder them from expanding their business venture.

**Table 1: Demographic and Socioeconomic Characteristics Respondents**

Variable	Respondent	Percentage
<b>Gender:</b>		
Male	230	59.6
Female	156	40.4
<b>Age (years):</b>		
< 21	42	10.9
21-40	121	31.3
41-60	215	55.7
> 60	8	2.1
<b>Marital status:</b>		
Single	138	35.9
Married	248	64.1
<b>Education level:</b>		
No formal	21	5.4
Primary	45	11.7
Secondary	112	29.0
Tertiary	208	53.9
<b>Main occupation:</b>		
Farming	130	33.7
Trading	112	29.0
Housewife	31	8.0
Civil service	88	22.8
Artisanry	25	6.5
<b>Years of residence:</b>		
<5	53	13.7
5-15	249	64.5
>15	84	21.8
<b>Monthly income (N):</b>		
< 50,000	107	27.7
50,000-99,999	85	22.0
100,000-149,999	86	22.3
150,000-199,999	57	14.8
200,000 +	51	13.2

*Source: Author's Analysis, 2024*

### **Number of Birds Being Bred in the Study Area**

Table 2 displays the number of birds being bred by farmers in the study area. The analyzed result showed that about four-tenth (41.19%) of the respondents own 201-400 birds, another 23.8% own 100-200 birds, 22.8% owned 401-600 birds, while only 12.2% of the studied population own over 600 birds. This finding agrees with Haruna et al.

(2007) study of poultry farmers in Jos North who reportedly operating at small-medium scales. This scale of poultry production requires urgent attention for interventions in order to help them upscale meat and egg production to meet the dietary demands of the residents and beyond to guarantee food security.

**Table 2: Number of Birds Being Bred in the Study Area**

Bird population size	Respondent	Percentage
100-200	92	23.8
201-400	159	41.2
401-600	88	22.8
>600	47	12.2
Total	386	100

*Source: Author's Analysis, 2024*

### **Quantity of Egg Production from Farms in the Study Area**

Table 3 showcases the monthly production of eggs from the poultry farms in the study area. From the Table, it is obvious that 47.0% of the poultry farmers produced less than 400 crates of eggs, followed by the 401-600 crates

category (25.0%), while the 601-800 crates and over 800 crates egg production categories declined to 16.6% and 11.4% respectively. This observed pattern further reinforces the fact that majority of poultry farmers in the study area operate at small-medium scale in the study area.

**Table 3: Quantity of Egg Produced Per Month**

Crate of egg	Respondent	Percentage
<400	182	47.0
400-599	96	25.0
600-799	64	16.6
800+	44	11.4
Total	386	100

*Source: Author's Analysis, 2024*

### **Perceived Environmental Effects of Poultry Farm Operations in the Study Area**

Poultry farming in the residential areas have serious negative effects on the environment, especially air and water pollution. Respondents' perception of the environmental effects of poultry farm operations in the study area was assessed, using six declarative statements on Likert Scale and presented in Table 4. The ranked

results indicated that the farm operations degrade the physical environment manifesting in: crowing rooster noise nuisance (mean = 3.32), water pollution (mean = 3.30), emission of greenhouse gases (GHGs) (mean = 3.22), adds to global warming (mean = 3.06), unpleasant odour (mean = 2.89), and closing windows to cope (mean = 2.54). It is most

likely that the rooter noise nuisance affects people closely living just some few distance away from such farms while the pollution

These findings are in concord with earlier outcomes in the literature. For instance, in a study carried out in Southwestern Nigeria by Olujimi, Akinbile and Adewale (2019), it was found that poultry farms contribute to air and water pollution, through ammonia emissions, fecal waste, and improper disposal of carcasses. Water samples from wells around the farms were found to have elevated levels of nitrates and coliform bacteria beyond WHO

could arise through ammonia emissions, fecal waste, and improper disposal of carcasses from the poultry farms.

acceptable limits. In a similar study, Bamaiyi and Hassan (2020) conducted a research on poultry waste management in parts of Northern Nigeria, including Plateau State and found that majority of small-and -medium scale poultry farmers lacked effective waste treatment systems, thereby contributing to odour, fly infestation and environmental degradation.

**Table 4: Perceived Environmental Effects of Poultry Farm Operations**

Effect	4-SA	3-A	2-D	1-SD	Total	Mean	Decision	Rank
Emission of GHGs	712	420	88	24	1244	3.22	Accepted	3
Unpleasant odour	544	363	156	51	1114	2.89	Accepted	5
Closing window to cope	356	345	194	85	980	2.54	Accepted	6
Water pollution	812	318	132	11	1273	3.30	Accepted	2
Rooster noise nuisance	848	336	68	28	1280	3.32	Accepted	1
Adds to global warming	656	357	128	40	1181	3.06	Accepted	4

*Source: Author's Analysis, 2024*

#### **Perceived Health Effects of Poultry Farm Operations in the Study Area**

Table 5 shows respondents' perception of the health effects of poultry farm operations in the study area. The effects were assessed using six declarative statements on Likert Scale. The ranked results indicated that the farm operations pose serious threats, manifesting in: itching of human body parts (mean = 3.49), vector breeding (mean = 3.28), zoonotic diseases (mean = 3.19), breathing difficulty (mean = 3.13), coughing (mean = 3.05), and aggravates asthmatic cases (mean = 3.04). It is most likely that the itching of body affects people working in the farms and those living just some few distance away from such farms due to prolonged exposure to poultry dust and ammonia from droppings.

Okonkwo and Eze (2018) found in Enugu State, through an empirical study that 43.0%

of poultry workers reported symptoms such as coughing, wheezing, and skin irritation, with statistically significant correlation between years of exposure and health complaints. While in study of Jos North LGA, Adakole, Oche, and Danjuma (2021) found 60.0% of residents living near poultry farms complaining of frequent offensive odour, fly infestation, and increased incidence of respiratory and gastrointestinal illnesses. They concluded that poor environmental hygiene and proximity to poultry farms were major predictors of reported health issues. This implies therefore, that the residents of Diye-Bay, Zarmaganda community are most likely to be inhaling bad air and drinking contaminated water arising from improperly managed poultry farms operating in their neighbourhoods.

**Table 5: Perceived Health Effects of Poultry Farm Operations**

Effect	4-SA	3-A	2-D	1-SD	Total	Mean	Decision	Rank
Vector breeding	740	423	84	18	1265	3.28	Accepted	2
Aggravates asthma	624	381	132	37	1174	3.04	Accepted	6
Breathing difficulty	756	345	52	56	1209	3.13	Accepted	4
Itching of body	884	429	28	8	1349	3.49	Accepted	1
Coughing	620	393	128	36	1177	3.05	Accepted	5
Zoonotic diseases	724	393	82	32	1231	3.19	Accepted	3

*Source: Author's Analysis, 2024*

**Table 6: Strategies for Mitigating the Effects of Poultry Farm Operations**

Action	4 SA	3 A	2 D	1 SD	Total	Mean	Decision	Rank
Policy & regulations	740	423	84	18	1265	3.28	Accepted	1
Proper waste handling	624	381	132	37	1174	3.04	Accepted	3
Health surveillance	756	345	52	56	1209	3.13	Accepted	2
Farmer education	520	486	128	30	1164	3.02	Accepted	4

*Source: Author's Analysis, 2024*

## CONCLUSION AND RECOMMENDATIONS

Poultry farms are reservoirs of waste generation and rich sites for vector breeding which if left unattended to properly, can ultimately degrade the environment, and pose public health risks. This study has established that poultry farms emit gases, pollute air and water sources and inimical to public health. While poultry farming contributes significantly to food security and the local economies in Diye-Bay, Zarmaganda community, its adverse environmental and health impacts cannot be ignored. Sequel to this, the following strategies are proffered (Table 6):

1. The Plateau Environmental Protection and Sanitation Agency (PEPSA) should enforce zoning regulations to keep intensive poultry operations away from homes in line with the national and global standards.
2. The relevant Government Agencies should address the regulatory framework, planning, and waste recycling into biogas

and organic fertilizer to boost crop production.

3. The relevant Government Agencies should implement community health monitoring around poultry farms. This health surveillance strategy can help to curb any emerging health issues arising from improper poultry waste management.
4. There should be mass sensitization of the public using various local communication media on biosecurity, waste handling and responsible antibiotic use. Routine training of poultry farmers should also be promoted on suitable location of farms and how to effectively manage fecal waste and chicken carcasses in line with SDG12, which emphasizes "Responsible consumption and production, in relation to biohazardous waste and sustainable management practices".

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