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RESEARCH ARTICLE

Biosecurity Within Poultry Farms in the Ashanti Region of Ghana

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Abstract A study was conducted to evaluate the awareness and application of biosecurity among poultry farmers in the Ashanti Region of Ghana. Sanitation measures, traffic control and isolation practices were investigated with well-structured questionnaires made up of open and close ended questions distributed to the managers of 10 large-scale farms (over 10,000 birds), 10 medium-scale farms (5000–10,000) and 10 small-scale farms (50–5000) using purposive sampling technique. Areas covered in the survey included Asokore Mampong Municipal, Atwima Nwabiagya Municipal, Kumasi Metropolitan Assembly and Ejisu Municipal. Even though not all the farmers were educated to higher levels, they all had an idea or were aware of the biosecurity concept. Eighty percent of the farmers had moderate to excellent levels of awareness of the biosecurity concept but a few (20%) of them had a lesser degree of knowledge on biosecurity. Washing of feeders and waterers was done on a daily basis by all the farmers (100%). Almost all (90%) the farmers did not have farm gate wheel dips at the entrance of their farms. With regards to stocking densities, there was less congestion in the poultry pens on all the farms. Very few (20%) of the farmers did not possess any personal protective equipment (PPE). All the respondents (100%) regularly inspected and culled sick birds into isolated pens for treatment by a veterinarian. Medications were administered either via the drinking water (80%) or through injections (20%). All the respondents (100%) checked and removed dead birds from the pens daily. Most (96.7%) of the farmers discarded their dead birds by burying them. Majority (76.7%) of the farmers did not allow customers into their poultry pens but a few broiler farmers did allow them. In conclusion, the data obtained from this survey proved that all the respondents were aware of the biosecurity concept and most of the farmers had moderate to high knowledge on biosecurity. Isolation was practiced fully as a biosecurity measure, however, sanitation and traffic control were partially practiced by the farmers as biosecurity measures due to lack of appreciation for these measures and lack of resources. This presents a danger to the overall health of birds in the region and eventually to the consumers of the end products from these birds.

Keywords Biosecurity · Sanitation · Isolation · Traffic control

Introduction

Biosecurity can be described as the control of the danger of pests and diseases entering, emerging, establishing, or spreading and causing harm to animals, plants, human health, the economy or the environment as a whole [1]. It is an expression coined from two words: 'Bio' meaning life, and 'Security' meaning protection, with the two main objectives of biosecurity being bio-exclusion and bio-containment [2]. Good biosecurity is vital to the successful performance of any poultry production system [3]. Biosecurity is critical in the chicken business for reducing illness and virus transmission. To promote the adoption of farm biosecurity techniques, a "biosecurity culture" is required [4]. Poultry farm-level biosecurity varies from simple measures such as cleaning the shed to more technologically advanced

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measures such as using high pressure water sprayers to disinfect vehicles passing through the farm gate [5].

When it comes to biosecurity, farmers often focus on the most serious clinical disease outbreaks, such as Avian Influenza, however, the expenses of "everyday" subclinical infections can add up to be just as high over time, and they are far more prevalent and common than catastrophic events [6]. Biosecurity should be encouraged to limit the entry and spread of diseases [7, 8].

Adherence to biosecurity measures is an issue in all types of poultry production and ineffective compliance is normally connected to the absence of knowledge and or understanding [4]. Biosecurity measures are designed to prevent the introduction and spread of disease-causing organisms into a flock or herd and when these measures are implemented, it will not only significantly reduce the risk of disease introduction, but also the prevalence of the financial losses that may occur would be drastically reduced [9].

Nyaga [10] lists three biosecurity measures which when put in place would prevent the entry of disease-causing pathogens into poultry flock or the spread of these pathogens from infected places or birds. They include: isolation of premises and poultry from sources of infection, controlling traffic flow in and out of sensitive and defenseless areas to limit exposure and sanitation of equipment, housing, protective clothing for poultry workers, and sustaining personal hygiene.

Consistent application of these measures is essential for the success of all types of poultry flock. The adoption of these measures will not only significantly reduce the risk of disease introduction, but also reduce the magnitude of the financial losses that may occur following infection in a flock [4, 9]. Studies have shown that in theory, if these practices are adhered to by all personnel entering the farm premises, and are teamed with infectious disease monitoring and disinfection as well as sanitation procedures, pathogens can be reduced to non-infective levels [6].

Putting these biosecurity measures in place to prevent diseases in poultry farms and other production units is not only beneficial to the farmer but also to the consumer and the country at large, as it helps to ensure public safety. There is, however, no documentation on the level of biosecurity within poultry farms in Ghana, and the knowledge of farmers on this subject.

Questionnaire-based surveys have been used by several researchers to evaluate biosecurity measures in animal farms. Serrazin et al. [7] used questionnaire-based survey to evaluate biosecurity and management practices in selected Belgian cattle farms. Damiaans et al. [8] used questionnaire to assess the level of implementation, attitudes, strengths, weaknesses and constraints of biosecurity practices in Belgian veal calf farming. Sahlström et al. [9] used questionnaire to evaluate biosecurity on Finnish cattle, pig and sheep farms. Laanen et al. [10] assessed comparable perspectives on disease prevention and on-farm biosecurity of pig, cattle and poultry farmers in Belgium with a known interest in research using online questionnaire. Nöremark and Sternberg-Lewerin [11] used questionnaire to investigate how professionals visiting animal farms in Sweden in their daily work perceive the on-farm conditions for biosecurity, the factors that influence their own biosecurity routines and what they describe as obstacles for biosecurity.

The main goal of this study was to evaluate the awareness and implementation of biosecurity measures within various poultry farms in the Ashanti Region of Ghana. The specific objectives of this study were to evaluate awareness of the biosecurity concept among poultry farm managers, and the implementation of the following biosecurity measures (i) traffic control, (ii) isolation and (iii) sanitation, in the farms.

Material and Methods

Study Areas

The study was conducted in four different locations in the Ashanti Region of Ghana between January 2021 and August 2021. The areas studied were Asokore Mampong Municipal, Atwima Nwabiagya Municipal, Kumasi Metropolitan Assembly and Ejisu Municipal as shown in Table 1. The study was conducted in this region because it has the most developed poultry value chain clusters in Ghana (https://www.rvo.nl/sites/default/files/2019/12/Update-poultry-report-ghana-2019.pdf).

The Ashanti region lies between longitude 0 15–2 25 West and Latitude 5 50–7 40 North. It has a total land area of 24,389 square kilometer with a population density of 148.1 persons per sq km. The region experiences double rainfall seasons in a year, with peaks in May/June and October. Mean annual rainfall is between 1100 and 1800 mm. The mean annual temperature ranges between 25.5 °C in the southern districts and 32^0C in the northern parts of the region. Humidity is high averaging about 85% in the southern districts and 65% in the northern part of the region

Table 1 Number of farms chosen from each district

Scales of production	Districts			
	Asokore Mampong	Atwima Nwabiagya	Kumasi Metropolitan	Ejisu Municipal
Small	1	2	5	2
Medium	0	3	4	3
Large	2	5	3	0
Total	3	10	12	5

(https://mofa.gov.gh/site/directorates/regional-directorates/ashanti-region), (Figs. 1 and 2).

Target Population and Sample Size In order to achieve the objectives of the research, the study was divided into sections; survey of 10 large-scale farms, 10 medium-scale farms and 10 small-scale farms (Table 1). A total of 30 respondents were involved in the survey; these were farm managers from each of the 30 farms. According to USDA Global Agricultural Information Network [12], commercial poultry production in Ghana can be categorized into large scale (over 10,000 birds), medium scale (5000–10,000) and small scale (50–5000 birds) enterprises. The survey was conducted on these three categorizations. The farms were selected using purposive sampling technique and the study areas were identified with the help of the Executives of the Ghana National Association of Poultry Farmers (GNAPF) which is a farmer based organization (FBO) with all poultry farmers in Ghana as members.

Data Collection Semi-structured questionnaires were administered to 10 large-scale farms, 10 medium-scale farms and 10 small-scale farms. The questionnaire was administered to poultry farmers in the study area to investigate their knowledge, levels of awareness and attitudes toward biosecurity practices. The questionnaire administered was made up of both close ended and open-ended questions. All questionnaires were composed of two sections: Section A was on the demographics of the respondents, and Section B was on the biosecurity profile of the various farms. Local language was used to explain the questionnaire to respondents who could not read and/or write. Gestures were also used to further explain the questionnaire to farmers who could not grasp the concept.

Stocking density was calculated as follows:

= Number of birds in a poultry house/Dimensions of poultry house (m^2) (http://www.fao.org/3/y5169e/y5169e05.htm).

Data obtained from the survey were analyzed descriptively using the Statistical Package for Social Sciences (SPSS) version 26.0 (2019) and were organized using Microsoft Excel Spreadsheet. Results were presented in tables and values were grouped in frequencies and percentages.

Fig. 1 The map of Ghana showing the Ashanti region in "yellow" color

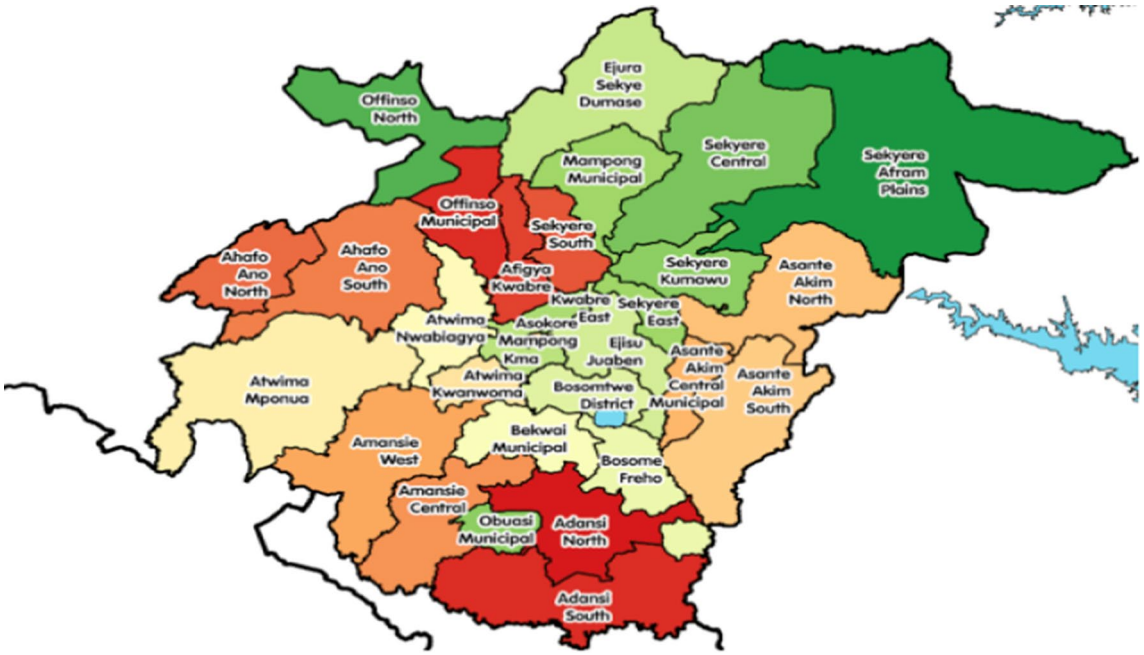

Fig. 2 The map of Ashanti region with the four study areas in the "middle of the map"

Table 2 Demographics of Respondents

Demographics	Category	Frequency (%)
Gender	Male	23 (76.7)
	Female	7 (23.3)
Age in years	20–30	1 (3.3)
	31–40	11 (36.7)
	41–50	6 (20)
	Above 50	12 (40)
Educational background	No education	1 (3.3)
	Basic Education	7 (23.3)
	Secondary Education	9 (30.0)
	Tertiary Education	11 (36.7)
	Others (Diploma, O level, etc.)	2 (6.7)
Poultry production experience (years)	Below 3	4 (13.3)
	3–6	5 (16.7)
	7–10	8 (26.7)
	11–15	1 (3.3)
	Above 15	12 (40)

Results and Discussion

Demographics of Respondents

Out of the 30 respondents who were involved in study, majority (76.7%) were males (Table 2). This was because poultry farming is labor exhaustive and so it does not encourage women to engage in it [13, 14]. Also, males are bread winners in the family and have to be involved in productive occupations to cater for the needs of their family.

Majority (56. 7%) of the respondents were between the ages of 31 and 50 indicating that they were still in their active and productive ages. It confirms the observation by Lestari et al. [15] who reported that an increase in one's age can affect the increase in knowledge gained. Eze et al. [13] stated that, the use of biosecurity measures increases as age increases. Older farmers have higher accumulated capital and more contacts with extension workers, all of which may enhance their adoption and use of biosecurity measures than younger farmers. Older farmers are assumed to have gained knowledge and experience over time and are better able to adopt biosecurity practices that would enhance the production of their birds.

Close to 80% (79.7%) of the respondents were educated beyond the secondary education level. This meant that most of the farmers were well educated. According to Tasie et al. [14], the well-educated are more likely to adopt innovations and biosecurity measures faster than others, since the practice of biosecurity and disease management requires some level of literacy and technical knowledge. Moffo et al. [16] also confirmed this by stating that, education and farmers' attitudes are of great importance.

Only 40% of the respondents had experience in the poultry production business for over 15 years. This was because quite a number of the farmers quit along the line due to various challenges. Some of which included low profitability in the business, outbreak of diseases, relocation to different cities and some others. According to Eze

Table 3 Levels of Awareness of the Biosecurity Concept

Level	Frequency (%)
Very low (1)	4 (13.3)
Low (2)	2 (6.7)
Moderate (3)	10 (33.3)
Good (4)	12 (40.0)
Excellent (5)	2 (6.7)

Table 4 Sanitation Practices on the various farms

Practice	Category	Frequency (%)
Washing of feeders and waterers	Yes	30 (100)
Litter management	Yes	30 (100)
Litter change	Monthly	21 (70.0)
	When there is restocking	5 (16.7)
	When the litter increases	4 (13.3)
Ventilation	Yes	30 (100)
Weeding	Yes	30 (100)
Frequency of weeding	Weekly	9 (30.0)
	Within 3 days	1 (3.3)
	Monthly	20 (66.7)
Disinfection	Yes	8 (26.7)
	No	22 (73.3)
Visitor's protection	Yes	5 (16.7)
	No	25 (83.3)
Possession of PPE	Yes	12 (40)
	No	18 (60)
Footbath (farm entrance)	Yes	3 (10)
	No	27 (90)
Footbath (poultry pen entrance)	Yes	14 (46.7)
	No	16 (53.3)

et al. [13], years of experience has significant influence on biosecurity. Farmers with more experience would be more efficient, and have better knowledge of biosecurity practices. They are able to set realistic time and cost targets, allocate, combine and utilize resources efficiently. As farmers' years of farming experience increases, the probability of farmers having experience in disease management and other farm practices increases. This could be due to the fact that with more experience, the farmer is likely to manage the farm better and make more informed decisions. Ayim-Akonor et al. [17] reported that good awareness of poultry diseases could be predicted by long years of employment on the farm. As respondents stay longer on the farm they acquire more experience in raising birds and they are better able to identify sick birds for isolation and treatment.

Levels of Awareness of the Biosecurity Concept Even though not all the respondents were educated to higher levels, they all had an idea of the biosecurity concept (Table 3). Few (20%) of them had a lesser degree of knowledge as compared to the others. The remaining 80% of the farmers had moderate to excellent levels of awareness of the biosecurity concept. This means that majority of the farmers were well informed of the biosecurity principles. As Moffo et al. [16] commented, knowledge is a positive predictor of behavioral changes. Also, relating it with their level of education, there is a positive correlation. This confirms the study by Tasie et al. [14] which states that, correct and adequate information enhances a farmer's ability to make sound decisions on matters regarding biosecurity on the farm. The high levels of awareness could be attributed to their levels of education. Only few had an excellent awareness because the full concept of biosecurity was not known to the farmers. They only had partial knowledge.

Sanitation Practices Washing of the feeders and waterers was a very common practice carried out on the farms. And this activity was done on a daily basis by all the farms (Table 4). According to Moffo et al. [16], poor farm management renders conditions favorable for emergence of infectious disease carriers, so therefore farmers had to prevent that from happening. This agrees with the findings of Eze et al. [13] that sanitation is vital in poultry houses in order to eradicate infectious pathogens since effective cleaning of the water and feeding troughs can substantially decrease disease transmission by reducing pathogens in the environment below infection level.

With regards to litter management, ventilation and weeding, the farmers were actively involved in these practices (100%). According to Eze et al. [13], the regular cleaning of deep litter is required as this reduces health risks and lead to much less expenditure on vaccines. From our survey results, a number of the farmers who were into broiler production changed their litter more frequently than those who were into layers. That was because, the broilers eat and drink a lot, which make them excrete a lot as compared to the layers. Hence, their litter is changed more frequently because it accumulates waste at a faster rate.

Most of the respondents did not know so much about the use of farm gate wheel dips at the farm entrance, so about 90% of them did not have them at the entrance of their farms. Majority of the farmers (53.3%) also did not have footbath at the entrance of the pens. Majority said it was because it was not a necessary measure and that the cost of maintenance is outrageous. This is because when a disinfectant is put in the wheel dip at the farm entrance, the first few vehicles that enter the farm contaminate the wheel dips and that causes a need to replace it at least thrice a day. They complained of the cost. It confirms the report by Caudell et al. [18], which showed some comments from layer farmers, which stated that they knew they should have footbaths but did not have them. According to them, a lot of money goes into feeding

Table 5 Stocking densities within poultry farms studied under various scales of production

Farms		1	2	3	4	5	6	7	8	9	10
Stocking densities (no of birds/m^2)	Large scale	12	12	15	14	12	12	12	13	11	12
	Medium scale	10	11	10	10	11	12	10	11	9	13
	Small scale	9	11	10	12	9	11	9	12	9	10

Table 6 Isolation Practices in the various farms

Practices	Category	Frequency (%)
Discarding of dead birds	Burying them	29 (96.7)
	Burning them	1 (3.3)
Culling of sick birds	Yes	30 (100)
Treatment given	Oral drugs in feed or water	24 (80)
	Injection	6 (20)
Mortality check	Yes	30 (100)

Table 7 Traffic Control Practices

Practices	Category	Frequency (%)
Customer traffic	Yes	23 (76.7)
	No	7 (23.3)
Presence of other animals	Yes	18 (60)
	No	12 (40)
Fence wall	Yes	8(26.7)
	No	22 (73.7)
Birds securely locked up	Yes	28 (93.3)
	No	2 (6.7)
Visitors' records	Yes	2 (6.7)
	No	28 (93.3)

and medication, so they do not get enough money to concentrate on other side costs like footbaths and disinfectants.

Also, the reason they stopped using footbaths at the entrances of the poultry pens was that, the farm laborers were not using them, so the farmers eventually saw no need for their use. Another reason why the farmers did not implement some of these measures was that, they claimed they received no external support from the government and other donors .

According to Ayim-Akonor et al. [17], the wearing of appropriate personal protective equipment (PPE) and adequate farm hygiene practices by farm workers reduces their risk of exposure to occupational health hazards. In spite of that, few farmers (20%) did not possess any PPE. Their reason being that, they did not see any need for wearing coveralls and boots because of the hot weather conditions prevailing in Ghana, which is a tropical country.

Stocking Densities From the results in Table 5, it can be shown that all the farms studied were within or almost in 12–15 birds/m^2 range (https://everythingwhat.com/how-many-chickens-can-you-have-per-square-meter). This means, there was less congestion in addition to the well-ventilated poultry houses used by the farmers. Higher stocking densities are believed to cause low average daily growth, higher condemnation and lowered carcass quality since birds need space in order to carry out required basic social and physical functions which include feeding, exercise, mating and social interactions. Though the farmers could not fully grasp the stocking density concept but through their experience on the farm they were able to practice it.

Isolation Practices Most (96.7%) of the respondents stated that they discarded their birds by burying them (Table 6). According to them, that was a safe and healthy way of preventing the spread of diseases. It agrees with the findings of Eze et al. [13] who reported that dead birds should be buried with the necessary care and precautions so that they will not infect soil and water.

Also, all the farmers were involved in the culling of sick birds and regular check for mortalities. According to Eze et al. [13], procedures should be put in place for emergencies if a bird in the flock falls ill, is injured, or found dead. These birds should immediately be isolated. The prompt actions taken by farmers show that they were aware of the implications of diseases on the farm. This is a good practice as it may help to improve the condition of birds which may lead to increased production. This is consistent with the report by Turkson and Okike [19] that, the prevention of diseases was part of the reasons why farmers would be willing and able to cooperate with the culling of poultry birds during a disease outbreak or if there were any signs of sickness.

Out of the 30 respondents, most (80%) of them gave medication to sick birds either via water or feed because according to them, sick birds were normally not strong enough to take injections.

Traffic Control Practices Almost eighty percent (76.7%) of the farmers did not allow customers into their poultry pens but a few broiler farmers did allow them (Table 7). As stated by the respondents, once in a while, they allowed customers who were ready to buy matured broilers to go into the pen and make their own selections. These were small-scale farmers so they had little regard for biosecurity principles. A study by Ayim-Akonor et al. [17] showed that, farmers who allow retailers onto the farm premises regularly exposed their birds to pathogens circulating on the farm and its environs. The practice also introduces pathogens from carriages

of the retailers such as vehicles and cages, onto the farm premises. According to Eze et al. [13], inhibiting people's movement in the farms reduces the danger of establishing infectious agents on the farm.

Quite a number of the respondents (40%) had other animals on the farm as pets. And some of them (20%) also kept these animals because they strayed to the farm and had remained there. For the remaining farmers (40%), other animals were kept on the farm for security purposes. They did not see the presence of other animals as a threat or a route of transmission of diseases. According to Ayim-Akonor et al. [17], the presence of other animal species provides a supporting environment for breeding infectious pathogens on the farm.

Over 70% of the farmers did not have fence wall around the farms. According to them, erecting a fence wall around a whole farm is expensive and they could not afford it. All the birds were securely locked up in the poultry pens except for 2 farms. They always left the doors to the pens opened whenever they wanted to change the water in the water troughs. This enabled the birds to roam freely outside the pens which could expose them to a higher risk of infections and diseases. This is consistent with the findings of Turkson and Okike [19], who stated that poultry birds freely mingling with wild birds amplified the risks of being infected by infectious pathogens.

All the farmers stated that they did not get visitors all the time so there was no need to take records of those who visited the farm. The visitors' logbook was not something they were conversant with.

Conclusion

In conclusion, the survey shows that poultry farm managers in the Ashanti Region of Ghana have moderate to high knowledge on the concept of biosecurity. All the three areas of biosecurity: isolation, traffic control and sanitation, were practiced by the farmers in the region. Isolation is practiced fully as a biosecurity measure, but sanitation and traffic control are partially practiced by the farmers due to lack of appreciation for these measures and resources. This presents a danger to the overall health of birds in the region and eventually to the consumers of the end products from these birds.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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