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Analysis of microbiological and antibiotic resistance risks in poultry farming practices and sanitary management in the prefectures of Avé and Zio, Togo

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ABSTRACT

Objective: This study examined poultry husbandry practices and hygiene management on poultry farms in Togo.

Methodology and results: A cross-sectional survey was conducted among poultry farms in Avé and Zio prefectures, focusing on knowledge of good agricultural practices, risk of disease transmission, and antibiotic use. A total of 38 poultry farms and 76 samples (poultry faeces and eggs) were included in the study. Farmers' educational profile and marital status significantly influence their poultry farming practices. Most farmers received training on good agricultural practices, with the Poultry Sector Support Program organizing the training. Farmers showed good knowledge and a positive attitude towards poultry farming. However, concerns about disease transmission and antibiotic resistance have been raised. The prevalence of coccidiosis and *E. coli* strains, inadequate prevention and control measures, and inappropriate antibiotic practices were observed.

Conclusion and application of results: The results highlight the importance of ongoing training, biosecurity measures, and responsible use of antibiotics in poultry farming to reduce risks and promote sustainable practices. The Avé and Zio prefecture's poultry farmers must receive training in two areas: (1) the proper use of antibiotics (correct antibiotic for the disease, following the route of administration recommended by the manufacturer, respect the waiting period after administration, respect for the target species, always consult a veterinary doctor); and (2) the management of coccidiosis (detection of clinical signs, quarantining of sick animals.) on poultry farms.

Keywords: Poultry farming, attitudes, practices, microbiological risk, antibiotic resistance risk, biosafety, Togo.

INTRODUCTION

Poultry farming is a fast-growing industry worldwide (Mottet and Tempio, 2017). It is the rearing of poultry for meat or egg production which plays a crucial role in the agricultural sector and economy of many countries, including Togo. However, poor management of poultry farms can lead to various challenges, including spreading diseases to humans and developing antibiotic resistance (Banshi, 2010). In recent years, there has been growing concern about the potential risks associated with poultry farming practices, particularly regarding public health and food safety (Ahmed *et al.*, 2021). Poultry farms can serve as reservoirs for zoonotic pathogens, which can be transmitted to humans through various routes, including direct contact or ingestion (erysipeloid)(Rostamian *et al.*, 2022), inhalation of airborne particles (Tuberculosis (TB)(Sarkar, 2024), and consumption of contaminated poultry products (Campylobacteriosis) (El-Adawy and Hafez, 2024). In addition, the improper use of antibiotics in poultry farming can lead to the development of antibiotic-resistant microbes, which is extremely dangerous for human health (Antunes *et al.*, 2016). To address these challenges, it is essential to assess the current practices and management strategies employed on poultry farms. Understanding the knowledge, attitudes, and practices of poultry farmers is essential to identifying areas for improvement and implementing targeted interventions (Ornelas-Eusebio *et al.*, 2020; Kiambi *et al.*, 2021). Furthermore, assessing the risks of disease transmission and antibiotic resistance can help to develop appropriate preventive measures and promote responsible antibiotic use in poultry farming (Dhakal and Gompo, 2021; Sawadogo *et al.*, 2023).

While several studies have examined poultry farming practices and management in various regions, there is limited research on this topic specifically in the Avé and Zio prefectures of Togo. Consequently, this study aims to fill this knowledge gap by conducting a comprehensive assessment of poultry practices, knowledge, attitudes, and sanitary management on poultry farms in these prefectures. By evaluating the current situation, this study seeks to provide valuable insights into the strengths and weaknesses of poultry practices in Togo and to inform strategies for improving poultry farm management, reducing disease transmission risks, and promoting sustainable and responsible farming practices.

MATERIAL AND METHODS

Study Area: The research was carried out in prefectures of Avé and Zio, Togo, West African (see figure 1). These regions were selected based on their significant poultry farming activities and their relevance to the objectives of the study.

Sampling: A random sampling method was employed to select a sample of 38 poultry farms for the study. The selection of farms took into account criteria such as farm size, type of poultry activity, and the availability of farmers.

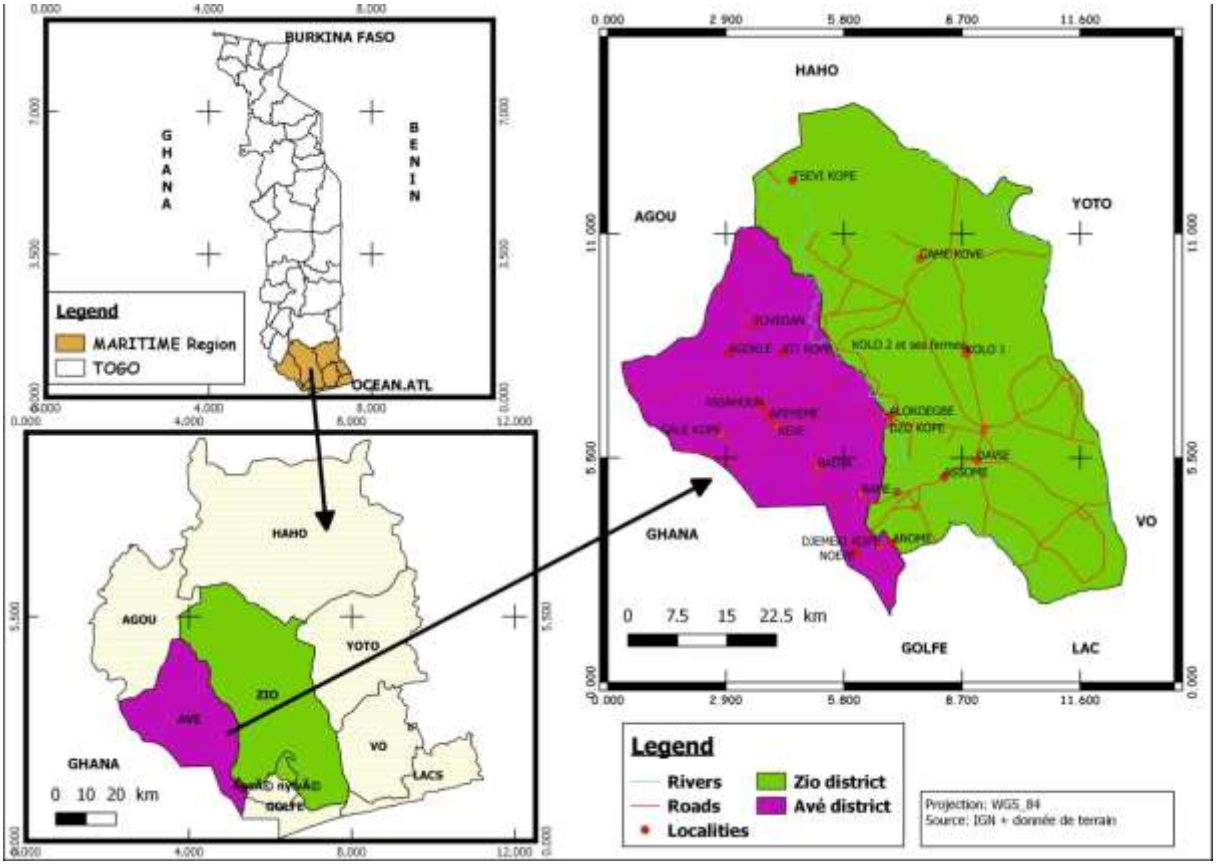

Figure 1: Geographical location of the study area

Selection of Poultry Farms: A random selection process was used to choose poultry farms in the Avé and Zio prefectures. Farms were chosen based on criteria including farm size, type of poultry activity (meat production, egg production, or both), and the willingness of farmers to participate in the study.

Data Collection: Data from poultry farms were gathered using structured questionnaires.The questionnaires were designed to assess various aspects, including farmer profiles, training in aviculture and good practices, knowledge, attitudes, and poultry farming practices, risks of disease transmission to humans, and the use of antibiotics. The surveys were delivered through face-to-face interviews with the farmers. Direct observations were conducted in the poultry farms to evaluate farming and sanitary management practices. Researchers observed the farm facilities, hygiene conditions, feeding methods, use of cleaning products and antimicrobials, as well as waste management practices.

Sample collection: Poultry meat, eggs, and stool were collected from representative samples of animals on each farm. Collection teams ensured diverse samples were obtained, covering different areas of each farm to ensure adequate representation. Eggs were collected from nests and hatcheries on each farm. Teams selected varied eggs from various parts of the poultry house to ensure a diverse set of samples.

Identification and Labelling: Each sample of stools and eggs was carefully identified and labelled with relevant information, such as the date, time, location of collection, and any other details necessary for traceability. Samples were transported securely to the laboratory under appropriate conditions to

avoid cross-contamination and ensure the preservation of the samples.

Microbiological Analyses: The microbiological analysis of samples of meat, stool, and hen eggs involved the identification of biological hazards according to international standards on food safety (Rees and Watson, 2001). At the Laboratory of Microbiology and Quality Control of Food Products (LAMICODA), the samples received were collected and processed with a stock solution, followed by a specific dilution (Table 1). Subsequently, 1 ml of this preparation was inoculated onto a specific culture medium and incubated at a defined temperature for a specific duration. The parasitological analysis focused solely on poultry stool to detect Coccidia and Giardia (ISO18744, 2016) in the solution made by 10 g of stool and 90ml of stock solution.

Table 1: Incubation condition

Target Organism	Sample Quantity (g)	Stock Solution	Dilution	Culture Medium	Incubation Temperature (°C)	Incubation Duration	Standard
E. coli	25	25g in 225mL	1/10	Brilliance E.coli agar	37	24 hours	(ISO16649-2, 2001)
S. aureus	25	25g in 225mL	1/10	Baird Parker	37	48 hours	(ISO6888-1, 2023)
Salmonella sp	25	25g in 225mL	1/10	Rappaport-Vassiliadis and Hektoen	37	24 hours	(ISO6579-1, 2017)
***Listeria* sp.**	25	25g in 225mL	1/10	PALCAM	30	24-48 hours	(ISO6579-1, 2017)

Detection of Veterinary Drug Residues by Premitest: Premi®Test is a microbial screening assay designed for the rapid detection of antibiotic residues, particularly in fresh poultry meat and eggs, providing results in under 4 hours. The test exhibits sensitivity towards various antibiotic groups, including β-lactams, cephalosporins, macrolides, tetracyclines, sulfonamides, aminoglycosides, quinolones, amphenicols, and polypeptides. The mechanism of Premi®Test involves inhibiting the growth of *Bacillus stearothermophilus*, a thermophilic bacterium highly responsive to a broad range of antibiotics and sulfur compounds. The assay incorporates a standardized quantity of bacteria embedded in an agar medium containing specific nutrients. In incubation at 64 °C, the bacteria grow. In the absence of inhibitory substances, the bacteria increase, leading to the production of acid. This enzymatic reaction is visually indicated by a color shift from purple to yellow. However, if antimicrobial compounds are present in concentrations exceeding the detection limit, the bacteria fail to germinate, resulting in no observable color change (Gaudin *et al.*, 2008).

Data Analysis: We analyzed the data we collected using appropriate statistical methods. The study used descriptive analyses to investigate the demographic attributes of poultry farmers, training rates, knowledge, attitudes, and practices related to poultry farming, along with the frequency of avian diseases. To assess whether there were any significant differences between the variables under study, statistical techniques like analysis of variance (ANOVA) were employed.

Ethics: To guarantee the participating poultry producers' permission and the privacy of the data gathered, ethical factors were taken into account. The researchers followed appropriate norms and ethical standards when conducting their research.

RESULTS

Profile of Poultry Farmers: Most poultry farmers (71%) in the study were married. Regarding education, 63% have a secondary level and 37% have a higher level. We have a high representation (97%) of the surveyed poultry farmers who had received poultry training and good farming practices (Figure2).

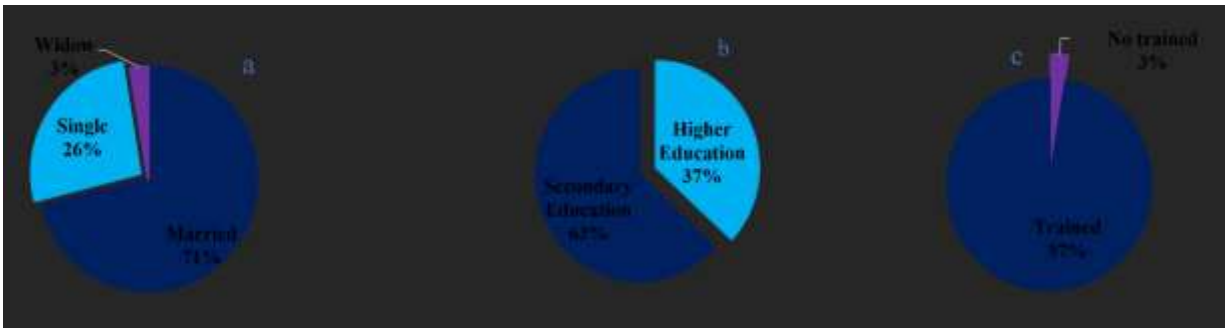

Figure 2: Aviculture profile and training. a represented marital status, b represented Education level and c represented the rate of farmers who take training in poultry farming.

Knowledge, Attitude, and Practice of Poultry Farming: The analysis of the questionnaire responses revealed that 86.84% of poultry farmers had good knowledge, and 97.37% had good attitudes towards poultry farming practices (Table 2). There was a statistically significant difference (p-value < 0.05) between the knowledge, attitude, and practice scores of the surveyed poultry farmers (Table 2).

Table 2: Knowledge, Attitude, and Practice of Poultry Farming

	Knowledge	**Practice**	**Attitude**
Good/Positive	86.84%	13.16%	97.37%
Bad / Negative	13.16%	86.84%	2.63%
p-value	0.000		

The correlation test shows that knowledge and attitude have a positive link (Table 3). On the other hand, it has been found that there is a negative association between attitude and practice as well as knowledge.

Table 3: Correlation between Knowledge, Attitude, and Practice of Poultry Farming

	Knowledge	**Practice**	**Attitude**
Knowledge	1		
Practice	-0,1885771	1	
Attitude	0,38303622	-0,3187402	1

Analysis of danger: pathogens and antibiotics residues detection: Table 4 provides information on the percentage of positive pathogen detection for various pathogens and antibiotics residues. It's shown that *Coccidi* and *E. coli* are present in all the stool sample and *Salmonella* sp. are absence in all the sample. High rate (65.79%) of antibiotics residues detection are shown in eggs sample.

Table 4: Pathogen and antibiotics residues detection

Pathogen	**Percentage of positive detection (%)**		
	Stools (n=38)	**Meat (n=38)**	**Eggs (n=38)**
Coccidias	100.00%	*Not applicable*	*Not applicable*
Giardia lamblia	10.53%	*Not applicable*	*Not applicable*
E. coli	100.00%	10.53%	0.00%
Listeria sp.	*Not applicable*	7.89%	0.00%
Staphylococcus aureus	0.00%	0.00%	0.00%
Salmonella sp	0.00%	0.00%	0.00%
Antibiotics residues	26.32%	21.05%	65.79%

Hygiene Practices and Sanitary Management: source of disease transmission: The probable modes of disease transmission to human were inhalation of airborne particles (97%), direct contact (85%), and inadequate prevention and control measures (80%). Environmental contamination, inadequate waste management, and lack of vaccination programs were identified as risk factors for disease transmission to human, with percentages of 97%, 95%, and 26%, respectively (Figure 3).

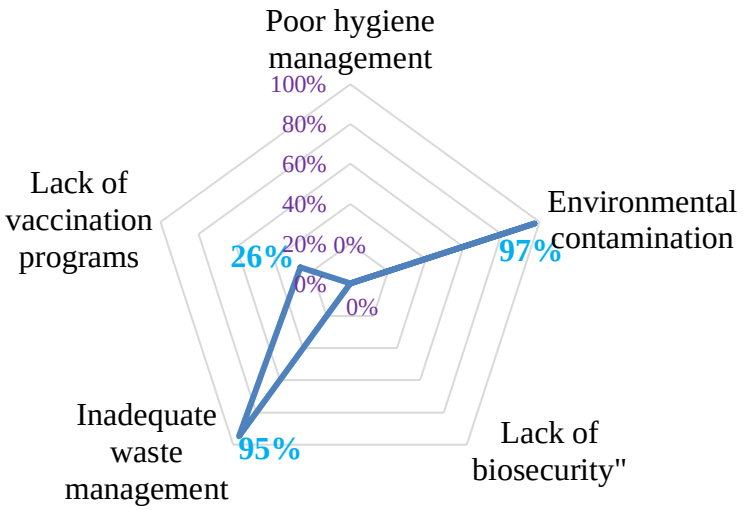

Figure 3: Risk Factors of Disease Transmission to Humans

Analysis of chemical contamination sources: Antibiotics Used Practices and Sanitary Management : Table 5, Table 6 and figure 4 represented the antibiotics practices used in farm and their risk. The study revealed varying practices regarding the use of antibiotics in poultry farms. Quinolones and anticoccidials were the most often prescribed antibiotics (Table 6). Overall, there was adherence to recommended dosages and treatment durations for prophylaxis, curative treatment, and zootechnical use (Table 5). However, inappropriate practices such as incorrect therapeutic dosing, failure to adhere to recommended withdrawal periods, lack of prescription by qualified veterinarians, lack of knowledge about maximum residue limits, and improper waste treatment were observed in some poultry farms (Figure 4).

Table 5: Dosage and Treatment Duration

	Prophylaxis	**Curative**	**Zootechnical Use**
Dose	5g per 10l of water (5/10)	According to recommendations	According to recommendation
Treatment Duration	3 to 5 days	3 to 5 days	3 to 5 days

Table 6: Disinfectants and Antimicrobials Used in Poultry Farms in Zio and Avé

Farm Maintenance Product		**Equipment Maintenance Product**		**Antimicrobials Used**		**Vitamins Used**	
Crésyl	59.26%	**Omo**	42.86%	**Aminoglycosides**	0.83%	**Amin'total**	42.11%
Virunet	16.67%	**Crésyl**	19.64%	**Cephalosporins**	1.67%	**stremix**	5.26%
SNP	1.85%	**Virunet**	3.57%	**Macrolides**	1.67%	**sequvit**	5.26%
Javel	7.41%	**Javel**	16.07%	**Penicillins**	3.33%	**aminogrow**	5.26%
D7	1.85%	**No product**	14.29%	**Quinolones**	29.17%	**Pantex**	5.26%
Bamboo leaves	1.85%	**D7**	1.79%	**Anticoccidian**	20.00%	**Introvit**	15.79%
No product	1.85%	**Detole**	1.79%	**Antiparasitic**	11.67%	**Multivitamin**	5.26%
Insecticide	7.41%			**Polymyxins**	19.17%	**boostiling**	5.26%
Ash hanging	1.85%			**Broad-spectrum**	11.67%	**aminovit**	10.53%
				Antiviral	0.83%		

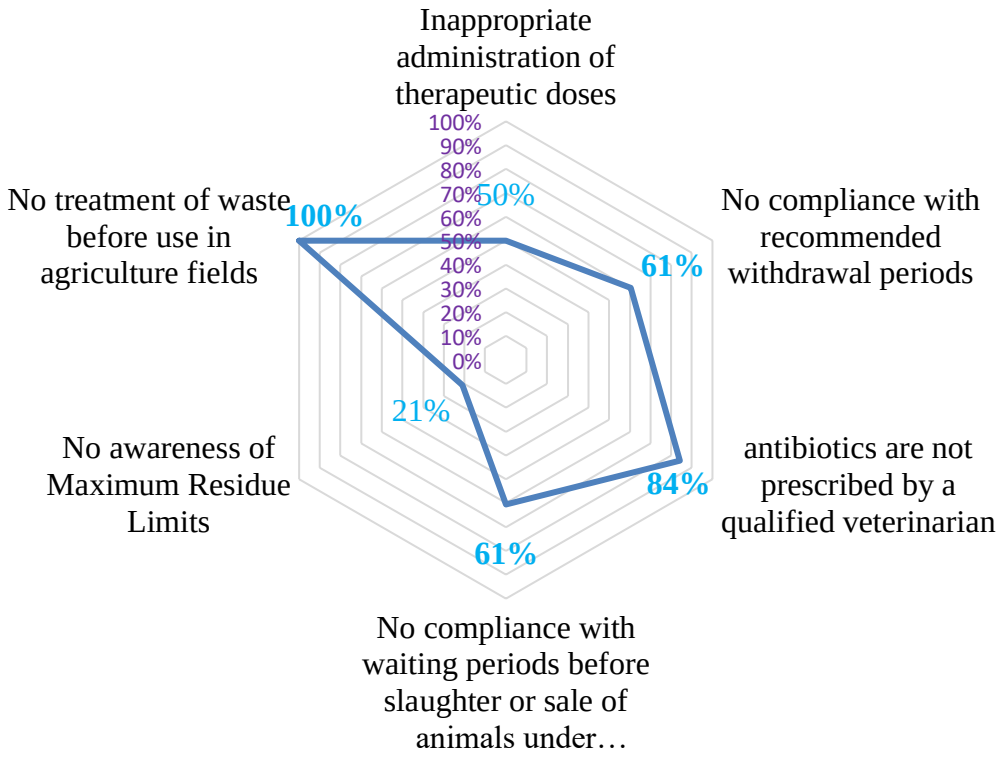

Figure 4: Risks Associated with the Use of Antimicrobials on Farm

DISCUSSION

The profile of poultry farmers is characterized by a high representation of married with a secondary level of education, indicating that poultry farming is a common livelihood activity in the study area. This demographic is also prevalent in commercial poultry farming, where psychological characteristics such as innovativeness and scientific orientation are important (Raju *et al.*, 2005). Regarding knowledge and awareness, livestock farmers in the same region have a medium level of family education status and a low overall knowledge level about animal husbandry practices (Amitendu *et al.*, 2014). In terms of perceptions and interventions, farmers in Ethiopia perceive poultry farming as a supplementary income source and believe that additional inputs may not lead to higher income (Wondmeneh *et al.*, 2016). Lastly, the training needs of poultry farmers in India include culling and selection of birds, feeding and watering management, and marketing (Kandpal and Kumar, 2022). These findings underscore the importance of understanding the demographic characteristics of poultry farmers to tailor interventions and support programs to meet their specific needs. The positive impact of training in aviculture and good farming practices on poultry farmers is evident in several studies. In this study, the results indicate a high percentage of surveyed poultry farmers who have received training in poultry farming and good practices. This suggests that poultry farmers have access to professional training, which can contribute to improving the knowledge and skills necessary to mitigate microbiological risks and antibiotic resistance. Singer and Hofacre (2006) found that vocational training led to increased knowledge and skills in feeding, health care, and management. Similarly, Noor and Dola (2011) reported that training programs improved farmers' capabilities and performance, leading to increased work quality, product output, cost and time savings, income, and networking. These findings are supported by Turkson and Okike (2016), who identified significant differences in practices, incentives, and capacities among poultry chain actors, suggesting that training can enhance these aspects. Furthermore, Alders *et al.* (2014) highlighted the importance of culturally sensitive dialogue in developing prevention and control options for avian influenza, underscoring the need for effective training in this area. These studies collectively underscore the crucial role of training in equipping poultry farmers with the knowledge and skills necessary for effective and sustainable production. The findings indicate that a majority of poultry farmers demonstrated good knowledge and attitudes without practice. This suggests a positive awareness of the importance of implementing good practices and management strategies. However, the existence of a significant difference between knowledge, attitude, and practice scores suggests that there is room for improvement in translating positive knowledge and attitudes into consistent farming practices. The studies by Young *et al.* (2010); Ithika *et al.* (2013); Salina *et al.* (2021) and Bunkar and Bangarwa (2021) collectively highlight the positive knowledge and attitudes of poultry farmers toward good farming practices. However, there is a gap in translating this knowledge and attitude into consistent practices, as indicated by the significant difference between the three factors (Young *et al.*, 2010). This gap is influenced by factors such as farm size, information-seeking behavior, and resourcefulness (Ithika *et al.*, 2013). Ongoing training, mentoring, and extension services are recommended to bridge this gap (Young *et al.*, 2010). The importance of knowledge, attitude, and practice in livestock traceability is also emphasized, with a need for structured education and training programs (Salina *et*

al., 2021). Bunkar and Bangarwa (2021) underscore the pivotal role of poultry farming in India's livestock industry, further emphasizing the need for improved knowledge and practice. The identification of coccidias and *E. coli* as the high-prevalence microbial in this area underscores the need for effective prevention and control measures. Dalloul and Lillehoj (2006) highlight the economic impact of coccidiosis on the poultry industry and the need for novel control strategies. Pousga *et al.* (2018) emphasize the importance of biosecurity measures, such as vaccination, in controlling avian flu in developing countries. Elmberg *et al.* (2017) discusses the potential role of wild geese and swans in disease transmission, suggesting the need for the separation of poultry and livestock from these birds. Blake and Tomley (2014) review the challenges of coccidiosis and *E. coli* control in poultry and the development of cheaper vaccines. Together, these studies highlight the importance of biosecurity measures, environmental hygiene, and the respect of vaccination programs to reduce the risk of disease transmission from birds to humans. One major factor contributing to the emergence and spread of antibiotic resistance in chicken production is the usage of antibiotics (Agyare *et al.*, 2018). While some positive practices have been identified, such as compliance with recommended doses and treatment times, there are also worrying practices, including incorrect dosing and failure to observe withdrawal periods (Agyare *et al.*, 2018). These practices are influenced by a lack of knowledge about rational antibiotic use (Sawadogo *et al.*, 2023) and a failure to perceive the risks of antibiotic resistance (Ibrahim *et al.*, 2020). To mitigate these risks, education, training, and stricter enforcement of regulations are crucial (Agyare *et al.*, 2018; Ibrahim *et al.*, 2020; Sawadogo *et al.*, 2023).

CONCLUSION AND APPLICATION OF RESULTS

Overall, this study sheds light on the current status of poultry farming practices and management in Togo's Avé and Zio prefectures. The results highlight strengths, such as the high percentage of trained farmers with good knowledge and attitudes, as well as areas that require particular attention, including disease prevention and control measures and prudent antibiotic use. The findings provide a basis for targeted interventions and policy development to promote sustainable and responsible poultry farming practices. Ongoing research and monitoring efforts are needed to assess the long-term impact of interventions, evaluate the effectiveness of training programs, and address emerging challenges facing the poultry industry.

AUTHOR CONTRIBUTIONS

Conceptualization: *GAMBOGOU*; methodology: *GAMBOGOU, MENSAH and TASSA*; investigation: *GAMBOGOU, MENSAH and TASSA*; data curation: *GAMBOGOU, MENSAH and TASSA*; writing—original draft reparation: *GAMBOGOU*; writing—review and editing: *GAMBOGOU, TAALE, MENSAH, TASSA, LANWI, TCHIGUIRI and AMEYAPOH*; project administration: GAMBOGOU and AMEYAPOH.

All authors have read and agreed to the published version of the manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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