

Biosecurity, Farm Structure and Antibiotic Use in Poultry Production Systems in Côte d'Ivoire

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Abstract: This cross-sectional study assessed biosecurity, poultry farm structure, and antibiotic use practices in Côte d'Ivoire between February and July 2024, based on a questionnaire survey administered to poultry farmers and descriptive and analytical statistical analyses. The results show a strong concentration of farms in urban and peri-urban areas, particularly in Abidjan, reflecting an intensification of poultry production oriented toward urban markets. Production systems are dominated by broiler farming (over 70%), followed by layer farming (approximately 28%). Most farms are medium-sized and managed by the owners themselves, with generally intermediate to low levels of education and technical knowledge. The biosecurity assessment reveals an overall inadequate level. Indeed, 58.8% of farms have low biosecurity and 26.1% have no structured biosecurity measures. Preventive measures remain poorly implemented, particularly footbaths (8.4%), fencing (30.2%), and farm isolation (42.9%), thereby increasing the risk of pathogen transmission and spread. Antibiotic use is high and often poorly regulated. About 62.5% of farmers report systematic antibiotic use, while 99.5% do not perform any laboratory diagnosis before treatment. Practices are largely empirical, with treatment durations generally ranging from 3 to 5 days. The main antibiotic classes used are tetracyclines (33%) and aminoglycosides (30%), followed by trimethoprim and fluoroquinolones. These findings highlight the need to strengthen biosecurity, technical support, and the rational use of antimicrobials within a One Health approach.

Keywords: Poultry Farming, Biosecurity, Antibiotics, Antimicrobial Resistance, Poultry Production Systems, Cote D'ivoire.

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I. INTRODUCTION

Poultry farming is a key sector for food security in sub-Saharan Africa, but its rapid growth, especially in urban and peri-urban areas, leads to high density in farms and an increase in health risks. [1]. This development promotes the spread of pathogens and makes managing farm health particularly critical. In this context, biosecurity is a key aspect of preventing diseases in poultry farming. It aims to limit the introduction and spread of infectious agents. However, several studies in Africa have shown that overall biosecurity levels remain low due to shortcomings in infrastructure, hygiene, and sanitary isolation. [2] ; [3]. These structural weaknesses increase the vulnerability of farms and make it easier for diseases to spread. At the same time, the use of antibiotics in poultry production is widespread and often unregulated. In many systems, they are used based on guesswork, without a prior veterinary diagnosis. ([4] ; [5]. This inappropriate use strongly contributes to the rise of

antimicrobial resistance, which has become a major threat to animal and public health ([2]. Studies have also shown a close relationship between low levels of biosecurity and high use of antimicrobials, with farmers using antibiotics to make up for poor health measures. ([6] ; [1]. This situation highlights the importance of an integrated approach linking livestock system structure, biosecurity, and antibiotic use. In Côte d'Ivoire, studies combining these three aspects are still limited. This study therefore aims to look at biosecurity, farm structure, and antibiotic use practices in poultry systems, in order to identify the main shortcomings and help improve health management and fight antimicrobial resistance.

II. METHODOLOGY

➤ Type of Study

This study is cross-sectional, with a descriptive and analytical aim. It is based on an integrated approach combining epidemiological and microbiological

investigations. It consisted of (1) a survey by questionnaire among poultry farmers, (2) the collection of biological samples, notably droppings and environmental samples, and finally (3) the lab analysis of the antibiotic sensitivity profiles of the bacteria that were isolated.

➤ Framework and Study Period

The study was carried out between February and July 2024 in several areas with high poultry activity in Ivory Coast. The main study areas included the Abidjan district as well as the Agnibilékrou region (Indénié-Djuablin). Other regions were also included, such as La Mé, Agnéby-Tiassa, Grands-Ponts, Iffou, and Sud-Comoé. These areas were chosen because of their significant contribution to national poultry production and their growth dynamics, marked by the development of intensive and semi-intensive farms.

➤ Study Population and Data Collection

The study population was made up of poultry farms selected through a reasoned sampling method, taking into account the accessibility of the farms and their level of activity. Data were collected using a structured questionnaire administered face-to-face with the farmers. The questionnaire covered several aspects, including the farmers' sociodemographic characteristics, the structural and functional features of the farms (type of farming, size, production system), the biosecurity practices in place, and the health management methods, including the use of antibiotics (types, frequency, reasons, and methods of administration).

➤ Evaluation of Biosecurity Practices

The biosecurity level of the farms was assessed using a standardized scoring grid called the 'Biosecurity scoring system.' This grid allows for an overall score between 0 and 200. The score is based on several aspects, including access control, hygiene measures, disinfection practices, biological waste management, and the organization of flows within the

farm. Based on this score, the farms were classified into four categories:

- Category 1 : No biosecurity (0–50) ;
- Category 2 : Low biosecurity (51–100) ;
- Category 3 : Moderate biosecurity (101–150) ; and
- Category 4 : Good biosecurity (151–200).

➤ Statistical Analysis

Data were entered and analyzed using Jamovi software (version 2.6.44). Only descriptive statistical analyses were conducted. Categorical variables were summarized using frequencies and percentages, while quantitative variables were described using means and standard deviations. The results are presented in tables and graphical forms to facilitate interpretation of the data.

III. RESULTS

➤ Geographical Distribution of Farms

Table 1 shows the distribution of surveyed poultry farms according to the regions and study locations. The results show a strong concentration of farms in the Abidjan district, which alone accounts for 38% of the total sample (n = 166), with a fairly even representation between Bingerville (28%), Yopougon (28%), and Abobo (20%). This concentration confirms Abidjan's role as the main poultry production hub in Côte d'Ivoire, linked to the high urban demand for poultry products. Outside of Abidjan, the La Mé region is the second most important area (18%), dominated by the town of Alépé (76% of the zone). The other regions show smaller proportions, especially Sud-Comoé (13%), Agnéby-Tiassa (10%), Grands-Ponts (7%), Iffou (5%), and Indénié-Djuablin (11%). Overall, the distribution highlights a geographic pattern focused around peri-urban and urban areas, where market and supply conditions are more favorable for intensive poultry farming.

Table 1 Geographical Distribution of Farms

Region / District	Locality	Number (n)	% on the area	% of total
Abidjan	Abobo	33	20 %	8 %
	Anyama	14	8 %	3 %
	Bingerville	47	28 %	11 %
	Port-Bouët	26	16 %	6 %
	Yopougon	46	28 %	11 %
Total Abidjan		166	100 %	38 %
Sud-Comoé	Grand-Bassam	42	75 %	10 %
	Adiaké	8	14 %	2 %
	Bonoua	6	11 %	1 %
Total Sud-Comoé		56	100 %	13 %
La Mé	Adzopé	19	24 %	4 %
	Alépé	59	76 %	14 %
Total La Mé		78	100 %	18 %
Agnéby-Tiassa	Agboville	8	19 %	2 %
	Azaguié	34	81 %	8 %
Total Agnéby-Tiassa		42	100 %	10 %
Grands-Ponts	Dabou	16	55 %	4 %
	Jacqueville	13	45 %	3 %
Total Grands-Ponts		29	100 %	7 %
Iffou	Daoukro	20	100 %	5 %

Indénié-Djuablin	Agnibilékrou	46	100 %	11 %
TOTAL		437		100 %

➤ Features of Farms and Farmers

The results in Table 2 show a clear predominance of broiler chicken farming (69.8%), followed by layer farming (28.1%), while mixed systems remain marginal (2.1%). This production structure reflects the sector's focus on short cycles, which are generally linked to more intensive farming practices and higher health pressures. Regarding farm management, most farms are run directly by the owners (65.9%), which can limit the implementation of strict

biosafety standards due to a lack of professionalization in some cases. The education level of farmers is still fairly moderate, with a large proportion having a secondary education (41.2%), while 12.1% have no formal education at all. Additionally, most farms are medium-sized (63.4%), which suggests a sector dominated by semi-intensive units. Knowledge of poultry farming is mostly basic (51%), which could negatively affect the adoption of advanced biosecurity and health management practices.

Table 2 Characteristics of Farms and Farmers

Variables	Numbers (n)	Percentage (%)
Type of farming		
Broilers	305	69,8 %
Layers	123	28,1 %
Mixed farming	9	2,1 %
Farm management		
Owner	288	65,9 %
Technician	63	14,4 %
Poultry Farmer	82	18,8 %
Manager	4	0,9 %
Education level		
Secondary	180	41,2 %
Higher	107	24,5 %
Primary	97	22,2 %
No level	53	12,1 %
Farm size		
Medium	277	63,4 %
Small	140	32,0 %
Large	20	4,6 %
Knowledge in poultry farming		
Basic	223	51,0 %
Intermediate	178	40,7 %
Advanced	36	8,2 %

➤ Biosecurity Level of Farms

Table 3 and Figure 1 show an overall low level of biosecurity on the farms studied. Indeed, 58.8% of the farms have a low level of biosecurity, while 26.1% have no structured biosecurity measures at all. Only 15.1% of the farms reach an acceptable level, and no category of good biosecurity is in the majority. The analysis of specific indicators shows significant shortcomings in health prevention measures. Less than 10% of farms have a footbath

(8.4%), and only 30.2% have a fence, showing limited control over access to the farms. Also, more than half of the farms aren't isolated (57.1%), which increases the risk of cross-contamination between farms. The fact that most farms are single-group operations (68%) reflects a simple production setup, but one that might be less flexible for health management. Overall, these results highlight a structural weakness in biosecurity measures, which could promote the spread of pathogens.

Table 3 Biosecurity Status of Farms

Variables	Number (n)	Proportion (%)
Biosecurity level		
Weak	257	58,8 %
Absent	114	26,1 %
Acceptable	66	15,1 %
Isolated farm		
Yes	188	42,9 %
No	250	57,1 %
Presence of a footbath		
Yes	37	8,4 %

No	401	91,6 %
Presence of a fence		
Yes	132	30,2 %
No	305	69,8 %
Type of flock		
Unique	298	68,0 %
Multiple	140	32,0 %

➤ *Level of Biosecurity Practices on Poultry Farms in Côte d'Ivoire*

Figure 1 shows that most farms have a low level of biosecurity (58%), followed by farms without structured biosecurity measures (26%). A smaller proportion falls into the acceptable category (15%). For specific indicators, the presence of footbaths is very low (8%). Most farms do not

have footbaths (92%). Similarly, fences are present in a minority of farms (30%), while about 70% do not have them. Regarding isolation status, about 42% of farms are isolated, while 58% are not. Finally, the production system is mainly dominated by single-batch farms (68%), whereas multi-batch systems account for about 32% of farms.

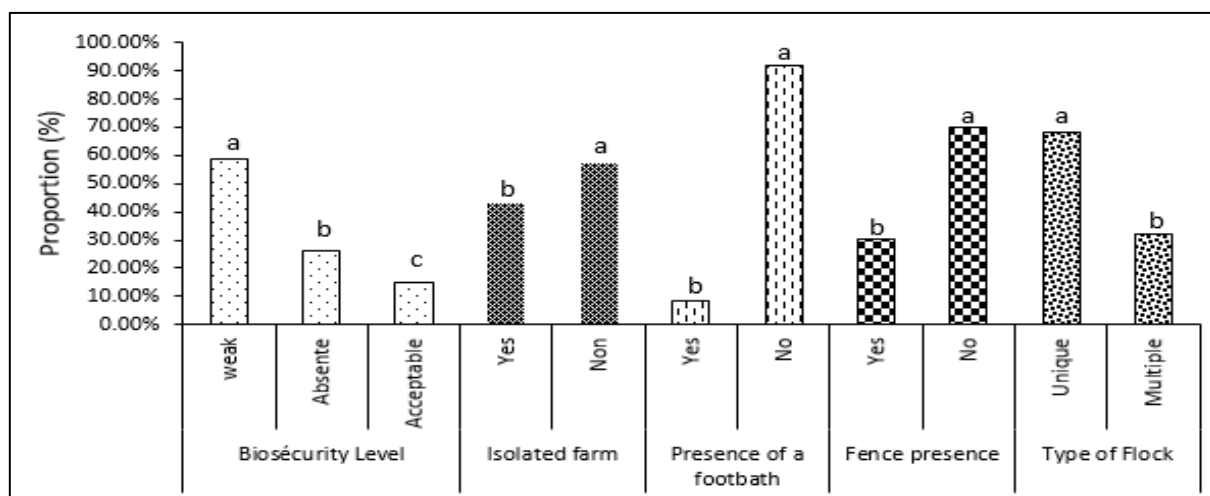


Fig 1 Biosecurity Status of Poultry Farms in Côte d'Ivoire

➤ *Antibiotic Usage Profile*

Table 4 highlights a significant and often unmonitored use of antibiotics in the farms studied. Over 60% of farmers report regularly using antibiotics, showing a strong reliance on these drugs for managing the health of their operations. Additionally, 39.9% of farms report an ongoing antibiotic treatment at the time of the survey, indicating continuous or repeated use. It's especially concerning that 99.5% of farms do not carry out any lab tests before administering antibiotics,

revealing a largely empirical practice not based on microbiological diagnosis.. Regarding the length of treatments, most protocols last between 3 and 5 days, with 3 to 4 days being the most common. This consistency suggests an empirical standardization of practices, regardless of scientific recommendations or veterinary prescriptions. Overall, these results reflect uncontrolled use of antibiotics, closely linked to poor health practices and a lack of technical guidance.

Table 4 Antibiotic Profile

Variables	Number (n)	Pourcentage (%)
Systematic use		
Yes	273	62,5 %
No	164	37,5 %
Antibiotic treatment in Processing		
Yes	174	39,9 %
No	262	60,1 %
Lab test		
Yes	2	0,5 %
No	435	99,5 %
Treatment duration (days)		
0–2 Days	10	2,2 %
3 Days	144	33,0 %
4 Days	149	34,1 %
5 Days	134	30,7 %

➤ Breakdown of the Families of Antibiotics Used

Figure 2 shows the distribution of the main families of antibiotics used in the surveyed poultry farms. The results show a predominance of tetracyclines (33%), followed by aminoglycosides (30%). Trimethoprim accounts for 15% of use, while fluoroquinolones make up 10% of cases.

Sulfonamides and macrolides each make up 4%. Aminopenicillins represent 3% of use, while furaltadone is the least used at 1%. Overall, the distribution highlights a strong concentration of use in a few dominant families, especially tetracyclines and aminoglycosides.

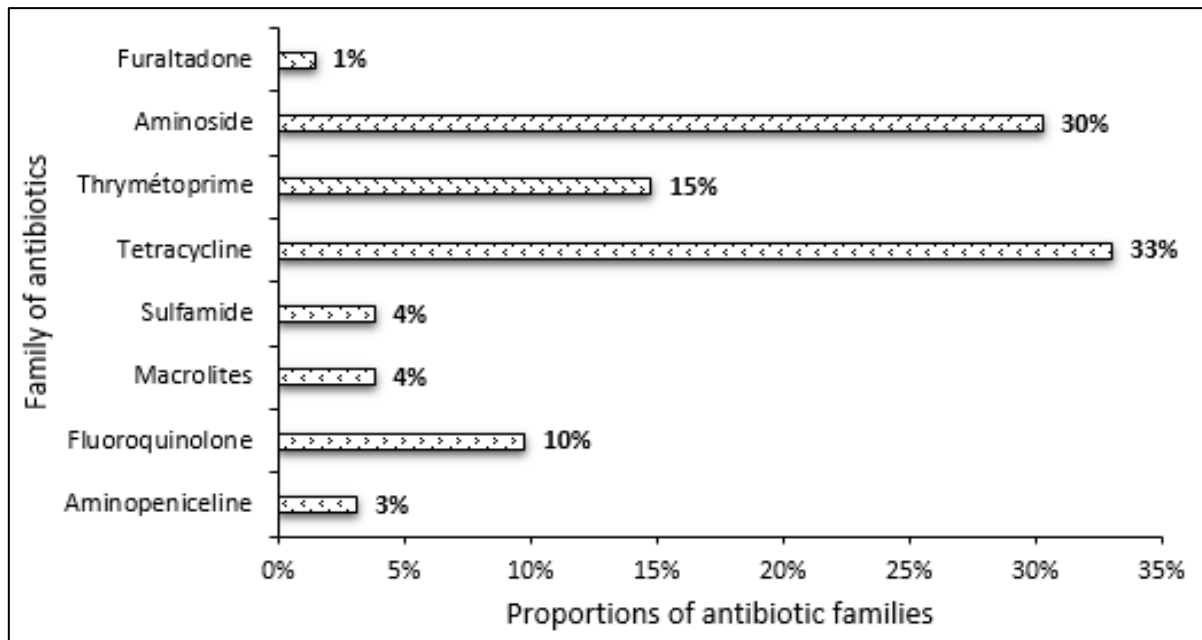


Fig 2 Percentage Distribution of Antibiotic Families Used in Poultry Farms in Côte d'Ivoire

IV. DISCUSSION

This study made it possible to characterize biosecurity practices and the use of antimicrobials in Ivorian poultry farms. The results show that most farms are located in urban and peri-urban areas, reflecting a production setup focused on being close to consumer markets. This trend has also been seen in several sub-Saharan African countries, where the rapid growth of the poultry sector is closely tied to urbanization and increased demand for animal protein. [7]. Although this geographic concentration makes it easier to access inputs and commercial outlets, it can also increase the risk of spreading infectious diseases when biosecurity measures are insufficient. Assessing the level of biosecurity highlights a low adoption of preventive measures on the farms surveyed. Sanitary control facilities, devices limiting contact with the outside environment, and disinfection measures generally appear to be underdeveloped. These observations are in line with those of authors who have shown in their work in Nigeria that low implementation of biosecurity measures was associated with a higher spread of pathogens in poultry farms. [8]. Similarly, some authors point out that following biosecurity protocols is one of the most effective ways to prevent the introduction and spread of diseases in commercial poultry systems. [9]. According to these authors, biosecurity measures aren't just about the facilities—they also depend on the behavior of farmers and the daily management of the farms. The shortcomings observed might be linked to the farmers' level of technical training. In many African countries, the limited understanding of biosecurity principles remains a big obstacle

to putting them into practice. Studies carried out in several African countries have shown that farmers' knowledge of health risks directly affects their management practices and their use of antimicrobial treatments. [10]. The authors also point out that economic constraints, the lack of veterinary support, and insufficient agricultural advisory services often limit the adoption of recommended preventive measures. The low biosecurity observed on the farms studied seems to be linked to heavy use of antimicrobials. This situation is often seen in farming systems where antibiotics are used as a compensatory strategy due to shortcomings in preventive measures. Studies conducted in Cameroon have shown that prophylactic and metaphylactic treatments were widespread in poultry farms, mainly because of concerns about economic losses related to diseases. [6]. Similar findings have been reported in Senegal, where producers saw antibiotics as an essential tool to secure production in contexts characterized by high health pressure. [7]. The lack of systematic use of lab diagnostics before giving treatments is also a worrying issue. This practice reflects an empirical use of antimicrobials, relying more on farmers' experience than on the precise identification of the pathogens involved. Some authors have shown that this kind of management encourages inappropriate use of antibiotics and increases the risk of selecting resistant bacteria. ([10]. In intensive poultry systems, where mass treatments are commonly given to the entire flock, the effects of these practices can be particularly significant in terms of microbial selection pressure. The dominance of tetracyclines and other broad-spectrum antibiotics seen in this study aligns with trends reported in several low- or middle-income countries. These drugs are

often preferred because of their availability, relatively low cost, and broad range of activity. [6] ; [2]. However, their repeated use is a recognized factor in the development of bacterial resistance. According to some authors, animal production is now one of the main sectors consuming antimicrobials worldwide, which significantly contributes to the emergence and spread of resistant bacteria. [2]. The presence of molecules considered critical for human medicine deserves special attention. Some authors have shown that the use of critically important antimicrobials in animal production is a major global public health issue. [11]. Repeated exposure of bacteria to these molecules promotes the development of resistance mechanisms that could compromise the effectiveness of treatments used in humans. This concern is particularly important in developing countries where antimicrobial resistance monitoring systems are still limited. The results obtained also support the conclusions of the systematic review conducted by [5], which highlights a close relationship between the use of antimicrobials in livestock and the emergence of multi-resistant *Escherichia coli* strains in African animal productions. Likewise, some studies have shown that bacteria associated with poultry production are an important reservoir of resistance genes that can be transferred between microorganisms and spread into the environment [12]. These phenomena highlight the importance of considering antibiotic resistance as an issue at the intersection of animal health, human health, and the environment. From a One Health perspective, the results of this study point to the need to strengthen biosecurity programs on Ivorian poultry farms and to promote a more rational use of antimicrobials. As they point out [2], The fight against antibiotic resistance requires an integrated approach involving the animal health, human health, and environmental sectors. Improving farmer training, developing diagnostic capabilities, strengthening veterinary oversight, and setting up systems to monitor bacterial resistance seem to be key levers to enhance the health sustainability of the Ivorian poultry sector.

V. CONCLUSION

This study highlights poor biosecurity in poultry farms in Côte d'Ivoire, marked by shortcomings in isolation, hygiene, and access control. Antibiotic use is high, often based on trial and error and without prior diagnosis, showing farmers' strong reliance on these drugs. This situation increases the risk of selecting for and spreading antimicrobial resistance. There's a link between weak biosecurity measures and heavy antibiotic use. These findings underline the need to strengthen technical support, train farmers, and adopt a One Health approach for better, sustainable health management.

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