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Characteristics of Poultry Farms and Use of Antibiotics in Peri-Urban Farms in Burkina Faso

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A B S T R A C T

This study aimed to characterize farming practices and the use of antibiotics in the process of peri-urban poultry farming in Burkina Faso. Surveys were carried out on poultry farms with a questionnaire sent to 121 breeders in Ouagadougou and its surrounding areas. The results showed that poultry farming is dominated by males (79.3%) with a low level of education. Most poultry farmers make very little use of the services of an animal health specialist. Almost half (50.4%) of poultry farmers used a combination of modern treatment and decoction obtained from local plants. Self-medication was estimated at 73.6% while 38% of the drugs used came from unauthorized street sales. Poultry farmers (36%) said they didn't respect the recommended doses. Unhygienized poultry manure is discarded in nature or sold for use in fields or gardens. These practices present risks of spreading multi-resistant bacteria. This study provides an overview of husbandry practices and antibiotic use in peri-urban livestock in Burkina Faso. Good breeding practices and rational use of antibiotics in poultry farming will limit the misuse of antibiotics but also the proliferation of antibiotic resistance.

Introduction

Poultry farming is increasingly an important socio-economic activity around the world (Jabeen *et al.,* 2020; Attia *et al.,* 2022). It contributes to meeting animal protein needs. These needs are increasing in line with global demographics (Abd El-Hack *et al.,* 2022; Lee, 2021). Faced with the strong demographic growth of cities in recent years, the development of livestock farming requiring little space appears to be a solution to reduce the protein deficit and food insecurity of populations, but also to provide additional income to households (Pinde *et al.,* 2020) in increasingly restricted peri-urban spaces. In Burkina Faso, poultry is one of the main sources of protein (Bazié *et al.,* 2022; Assefa *et al.,* 2023) and poultry farming is an important socio-economic activity (Hedman *et al.,* 2020; Manyelo *et al.,* 2020) practiced by more and more people (Mak *et al.,*

2022). This influx of people without basic experience in poultry farming presents several challenges including the control and prevention of emerging and re-emerging zoonotic diseases, and antimicrobial resistance in bacteria. Dominated in the past by traditional family farming where poultry were left freely in the environment, poultry farming has seen the emergence of new players and new practices that are very (Nahimana *et al.,* 2020) little in line with good farming practices. These actors present an apparent diversity (Godfrey Alinaitwe, 2023). In addition, poultry carries many germs such as *Salmonella spp, Escherichia coli, Campylobacter spp* which can be sources of disease (Kagambèga *et al.,* 2018; Kagambèga *et al.,* 2021). To maintain poultry in good health and ensure optimal growth of poultry, the uncontrolled and abusive use of antibiotics as a preventive, therapeutic or growth promoter is very common (Sidibé *et al.,* 2019; Om and McLaws, 2016). This could induce antibiotic resistance through the selection and proliferation of resistant pathogenic bacteria (Kousar *et al.,* 2021; Rafiq *et al.,* 2022) in poultry farms and constitute a serious public health problem. The main objective of this study is to characterize peri-urban poultry farming practices in Burkina Faso and to highlight the risks of spreading resistant bacteria causing zoonoses in the environment.

Materials and Methods

Period and fields of study

The study was conducted from May to September 2020 and concerned the cities of three provinces of Burkina Faso: Sanmentenga, Oubritenga and Kadiogo (figure 1).

Poultry Farm Survey

The study was approved by the ethics committee of Burkina Faso, under reference number 2009-39. Informed consent was obtained from each participant before the interview. Therefore, all participants provided consent to participate in the study.

A total of 121 farms was surveyed. Data on the level of education of farmers, their knowledge of good husbandry practices, and the risk assessment of antibiotic resistance in bacteria were collected by face-to-face interview using a questionnaire. The inclusion criteria were all poultry farms older than one month with more than five birds. These surveys were preceded by pre-exploratory surveys to select poultry farms. The non-probabilistic “snowball” method was used (Johnston and Sabin, 2010). In this method, the first poultry farmers interviewed make it possible to obtain information on the location of the other poultry farmers. The latter, in turn, become informants after being interrogated. In addition, observations of farming practices and the farming environment were made.

Data Processing

The questionnaire was developed using Sphinx plus 2 version 5.0 software. All qualitative and quantitative data were analyzed with Sphinx plus 2 Version 5.0 and Excel 2010.

Results and Discussion

Cultured species

Most of the farms surveyed were mixed farms where several species of poultry lived side by side (figure 2). The exploration of poultry farms indicated that the species reared were mainly chickens in 96.7% of farms, guinea fowl in 31.4% and pigeons in 33.1% of cases. These animals cohabited with chickens in 50.4% of farms.

Features of poultry farming

The characteristics of the poultry farmers were presented in Table 1. The age of the poultry farmers ranged from 19 to 69 years, with an average age of 39 years. This activity was dominated by men. The practice of poultry farming was essentially guided by personal consumption and sale. Most of the poultry farms were close to homes and the feces were released into the nearby environment. 86% of poultry farmers had a professional activity other than breeding. Poultry farmers' experience varied but most were less than 5 years old. However, there were poultry farmers with more than 10 years of experience. None of the poultry farmers interviewed belonged to a formal poultry association. The majority of the housing was traditional chicken coops with a daytime outdoor outlet. However, more or less modern intensive farms and improved traditional systems have been observed.

Animal feed and biosecurity aspects

Surveys of feed provided to poultry (figure 3) indicated that 12% of feed came from the farmer's own production.

However, 37% used food suppliers from well-known companies. 77.7% of farms had veterinary monitoring, however, 77.1% of farms did not have the capacity to prevent wild birds from having access to the water and food provided to poultry. The assessment of poultry farmers' knowledge of good breeding practices and biosecurity showed acceptable ventilation for the majority but with an absence of sanitary airlocks and personal protective equipment (PPE). Almost half of the farmers did not respect the waiting period.

Poultry health care and antibiotic use

The data in Table 2 indicates the main poultry farming system in the livestock areas. Cleaning frequency varied from daily to semi-annually, with or without disinfectant. It was found that 23% of farms performed no cleaning and 62.5% performed standard cleaning with water and detergent and the rest had cleaning coupled with disinfection. Then, 14.2% of farms used wood chips and replaced them when there was a lot of manure. The disinfectants used were bleach and veterinary disinfectants. Some farmers (2.5%) reported using the ash as a disinfectant. In addition, self-medication is estimated at 66.9% with 38% of drugs consumed from the unauthorized sale of "the street medical". Poultry farmers (60.3%) declared respecting the recommended doses. Farms with chickens were likely to be cleaned and disinfected, while farms with pigeons had never been cleaned. The cold and dry season has been the time when poultry fell frequently ill according to 74.4% of breeders. New Castle disease was the most common disease at this time of year with 66.1% of flocks affected. The bacterial diseases most recorded by poultry farmers during the four weeks preceding our visits were coryza (46.3%) and typhoid (39.7%).

Use of antibiotics and herbal decoctions in poultry farms

The main health treatments for poultry have been reported in Table 3. Self-medication was widely practiced in the poultry farms surveyed for the treatment of diseases. Animal health workers (livestock technicians or veterinarians) could not access less than half of the farms. The survey showed that 2% had not administered any modern medicine to poultry. The main route of drug administration was orally and more than half of the farmers surveyed used a combination of modern treatments and decoctions obtained from local plants. The main decoctions used for the care of poultry had been made from the bark or roots of *Khaya senegalensis* and the bark of *Balanites aegyptiaca.* A significant use of antibiotics was noted during the four weeks preceding our visits. For the treatment of poultry diseases, the most used antibiotics were amoxicillin, erythromycin, streptomycin, oxytetracycline with or without colistin and a combination of tylosin and doxycycline. The most commonly used antibiotics were amoxicillin in 58.6% of farms, oxytetracycline with colistin in (31.0%), oxytetracycline hydrochloride (17.2%) and a combination of tylosin and doxycycline (derived from tetracycline) in 13.8%.

Faced with poultry diseases on the farm, the behavior of breeders has been summarized in Figure 5. Some breeders have entrusted veterinary care to veterinary or breeding agents, others, on the other hand, have preferred drugs bought on the street while another group preferred the exchange of products between breeders. Among the products administered, some came from veterinary pharmacies or human pharmacies, but also from itinerant sales for self-medication. Depending on the effects of the disease on poultry, farmers could continue to refer to good practices, always consulting the specialist animal health worker if the effects of the products were positive on the animals. If the effects of the products did not lead to a cure, the poultry farmers could either refer to good practices or persist in bad practices (use of street medicine and self-medication).

The duration of treatment varied depending on the pathological condition of the poultry. The antibiotics used had diverse origins, and their use was very common with dosages varying from one breeder to another. The main antibiotics used in livestock farming were identified and their composition, action, group, and indications were noted. These antibiotics were purchased in veterinary pharmacies, human pharmacies, or from street vendors. Farmers pointed out that antibiotics were most often used for preventive purposes, for curative purposes as stimulants and, depending on the circumstances, they were used as anti-stress agents. Regarding the effectiveness of drugs, some poultry farmers relatively reported that certain molecules were no longer effective, while others observed no change in the effectiveness of these molecules. In the event of mortality, 81% used a landfill or disposed of the carcasses directly into the environment. However, 30% of the farms surveyed declared having consumed poultry that died of disease. Unsanitized poultry droppings were either thrown into the wild or sold for use in fields or vegetable gardens.

Poultry farming in West Africa is changing with the growth of cities (Peng *et al.,* 2014; Faihun *et al.,* 2017). The demand for animal proteins and in particular poultry products is growing, hence the urgent need to intensify production to meet needs. In addition, in the context of the restriction of poultry meat imports in Burkina Faso, poultry production becomes a promising activity that improves the income of 26-56 years (Desta, 2020), hence the enthusiasm of the populations observed by our study around this activity. In this country with low per capita income, poultry farming is still largely dominated by a traditional system with rudimentary means. The extensive system features chickens raised free-range or semi-free range (Desta, 2020). The straying of poultry could thus present a health risk factor (Bouzouaia, 2018). Indeed, the proximity of farms to the population (Gwan and Kimengsi, 2020) could lead to both animals and human contamination by pathogenic agents from poultry (Hedman *et al.,* 2020; Kagambèga *et al.,* 2021). Additionally, good animal husbandry practices in urban and peri-urban areas are difficult to adequately monitor (FAO, 2022). Mixed farming and the interface between wild and domestic poultry facilitate the sharing of infectious agents (Carter *et al.,* 2018). Thus, the fact that more than half of farms have other avian species on the farm in addition to chickens poses a risk of contamination of chickens and microbial proliferation as well as the accessibility of farms to wild birds (Nooruzzaman *et al.,* 2021; Ameji *et al.,* 2021) and other animals (Ayala *et al.,* 2020). The adoption of strict biosecurity measures could prevent the introduction of pathogens into farms (Delpont *et al.,* 2021; Tilli *et al.,* 2022). The presence of resistance genes in wild animals has been demonstrated (Wang *et al.,* 2017). Indeed, a high prevalence of extended-spectrum beta-lactamase (ESBL) was detected in scavenging vultures in Gambia (Woksepp *et al.,* 2023), and in France in the same species (Haenni *et al.,* 2023). This high prevalence of resistance genes has also been observed in other wild birds (Ben Yahia *et al.,* 2020). Thus the involvement of wild and migratory birds as vectors of resistance genes. Urban pigeons in Portugal have also been identified as sources of ESBL-producing *E. coli* (Freire *et al.,* 2022). Other livestock such as goats and sheep have been found to harbor antibiotic-resistant germs (Herawati *et al.,* 2023). The access of these animals (wild or livestock) to poultry farms could be a source of transmission of resistant germs to poultry. Adopting strict biosecurity measures could prevent the introduction of pathogens into livestock farms. This study also revealed that the level of education of poultry farmers did not influence compliance with good practices in the treatment of poultry, particularly dosages, waiting time, and expiry date, at the alpha threshold of 5%. However, there was a relationship between the level of education and the choice of where to purchase antibiotics. Thus, 2.1% of breeders without education and 0.7% with university training had already used amoxicillin purchased in human pharmacies to treat their poultry. While the first group felt they were not equipped to make medical decisions, those with a high level of education felt they had sufficient knowledge about medications (Mekuria *et al.,* 2021). The frequent use of modern drugs without the advice of animal health workers is also observed in other African countries such as Cameroon (Mouiche *et al.,* 2020). Self-medication with medications from the family medicine practice for use in avian health without professional advice presents a risk of inappropriate dosages, ineffectiveness or toxicity (Roess *et al.,* 2015). Unfortunately, 73.5% of the breeders interviewed in our study had used family medications for the purpose of avian treatment.

Self-medication can lead to a poor choice as to the medication to use (Zeb *et al.,* 2022), which could lead to the animal not being cured, but also to a risk of poisoning by these substances. Consumption of meat or eggs from this animal would also expose the consumer to risks of antibiotic resistance, (Hakeem and Lu, 2021; Gržinić *et al.,* 2023) toxicological, allergic, and technological problems (Ano Guy Serge *et al.,* 2021). The majority of poultry farmers are men due to social and cultural issues. Indeed, women have very little property rights and they generally accompany men in various activities (Nordhagen and Klemm, 2018; Leight *et al.,* 2022). In contrast, in some African countries, the keeping of chickens belonged almost exclusively to women (Manyelo *et al.,* 2020; Gemeda *et al.,* 2023). Hoffmann *et al.,* (2020) found that the poultry activity of smallholders involved greater participation of women, especially in cleaning tasks, while the sale of poultry is perceived as a male task. Disease prevention is based on health and medical measures (Ebegbulem, 2018).

Cleaning contributes to health prophylaxis (Brou *et al.,* 2018); however, regular disinfection and a rigorous cleaning schedule can provide protection against microbial contamination (Sebho, 2016). In the event of mortality, the release of carcasses directly into nature for most breeders is a practice likely to be a source of air pollution and microbial propagation and contamination (Ismael *et al.,* 2021).

Table.1 Features of poultry farming

Characteristics (n = 121)	Number (%)
Gender	
Male	96 (79.3%)
Female	25 (20.7%)
level of studies	
Secondary	36 (29.8%)
Primary	33 (27.3%)
University	22 (18.2%)
None	30 (24.8%)
Other activity	
Yes	104 (86%)
No	17 (14%)
Farm manager	
Permanent workers	49 (40.5%)
The owners	73 (60.33%)
Type of breeding	
Traditional	82 (67.76%)
Semi-intensive	36 (39.75%)
Modern intensive	3 (2.47%)
Proximity to accommodation	
City	66 (54.5%)
Periphery	54 (44.6%)
Origin	
Given	7 (5.78%)
Imported	61 (50%)
Local market	53 (44%)
Mixed on the farm	
Mixed	65 (54%)
Unmixed	56 (46%)
Manufacturing destination	
Trade	113 (93.4%)
Personal consumption	93 (76.9%)
Other	1 (0.8%)
Nutrition	
Automatic	0 (0%)
Manual	121 (100%)
Semi-automatic	0 (0%)
Water supply	
Automatic	15 (12%)
Manual	104 (86%)
Semi-automatic	2 (2%)
Management of dead animals	
Dump or cesspool	94 (77.7%)
Consumption	31 (25.6%)
Waste or droppings	
management	86 (71.1%)
Use in a field	67 (55.4%)
Release into the environment	28 (23.1%)
Sale	
Management of dead carcasses	
Disposal in a landfill	83 (68.6%)
Dump	39 (32.2%)

Table.2 Poultry farming processes

Features	Number (%)
Level of knowledge of managers on avian zoonoses	
Acceptable	94 (78%)
No concept	39 (32%)
Know the dangers of misusing antibiotics	
Acceptable	18 (15%)
Some notions	33 (27.3%)
Good level	30 (24.8%)
Types of diseases observed	
New Castle	80 (66.1%)
Coryza	56 (46.3%)
Aujeszky	30 (24.8%)
Typhosis	48 (39.7%)
Gumboro	28 (23.1%)
Coccidiosis	41 (33.9%)
Mark	21 (17.4%)
MANAGEMENT OF SICK BIRDS	
Quarantines	
Chickens	117 (96.7%)
Pigeons	40 (33.1%)
Quails	4 (3.3%)
Guineafowls	38 (31.4%)
Turkeys	6 (5.0%)
Ducks	10 (8.3%)
geese	3 (2.5%)
Not quarantined (all types of poultry)	
Consumption	15 (12%)
Sold	65 (54%)
No action	4 (3%)
Response to an outbreak	
Report to a veterinarian	109 (90%)
Euthanasia	11 (9%)
no action	1 (0.82%)
Management of waste from animal care	
Environmental disposal	86 (71.1%)
Dumping in a landfill	67 (55.4%)
Sale	24 (19.8%)
Transformation	3 (2.5%)
CLEANING OF FARMS	
Type of cleaning	
With disinfectant	18 (14.5%)
With detergent	76 (62.5%)
No cleaning	28 (23%)
Types of disinfectant	
Bleach	11 (9.5%)
Veterinary disinfectant	5 (4%)
Ashes	3 (2.5%)
White vinegar	1 (0.82%)

Disinfection method	
Wash before application	85 (70%)
No-wash application	36 (30%)
Periodicity	
Half-yearly	73 (60%)
Variable	48 (40%)
After an epidemic	115 (95%)

Table.3 Poultry health care

Bird health care	Number (%)
TYPE OF CARE PROVIDED	
Treatment	
Pharmaceutical product	67 (55%)
Herbal decoction	54 (45%)
Administration of care	
Myself	89 (73.6%)
Veterinarian	37 (30.6%)
Livestock agent	24 (19.8%)
no action	9 (7.4%)
USE OF ANTIBIOTICS	
Name	
Amoxicillin	79 (65.3%)
Tylodox	10 (8.3%)
Tetracolivic	39 (32.2%)
Oxytetracycline	21 (17.4%)
Aliseryl	4 (3.3%)
Cotrimoxazole	9 (97.4%)
Source of supply	
Veterinary offices	68 (56.2%)
street drugs	62 (51.2%)
Pharmacy human 4	4 (3.3%)
Donations	5 (4.1%)
Observance of expiry dates	
Yes	81 (66.7%)
No	40 (33.3%)
Respect of dosages	
Yes	77 (64.0%)
No	44 (36.0%)

Figure.1 Sampling area

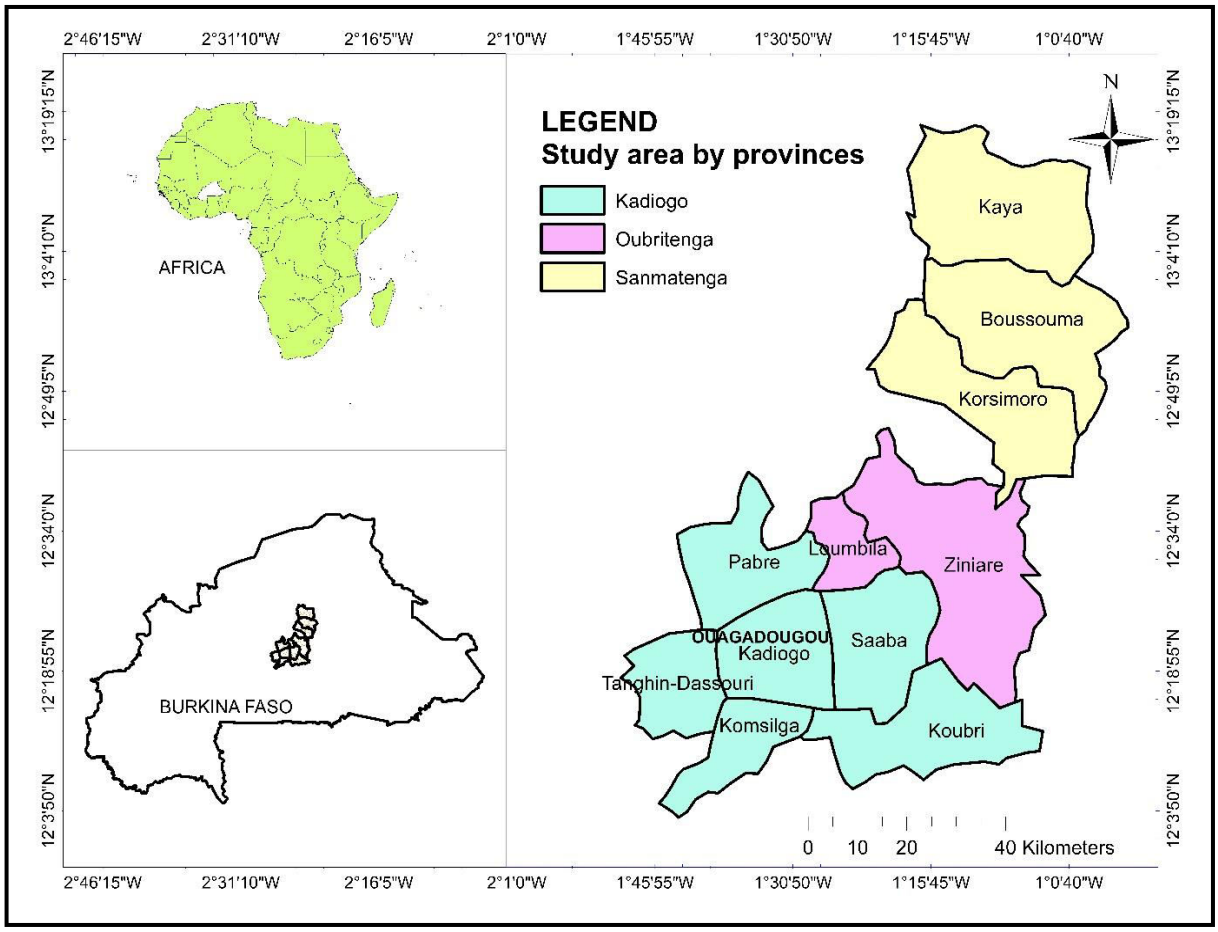


Figure.2 Percentage of species in peri-urban poultry

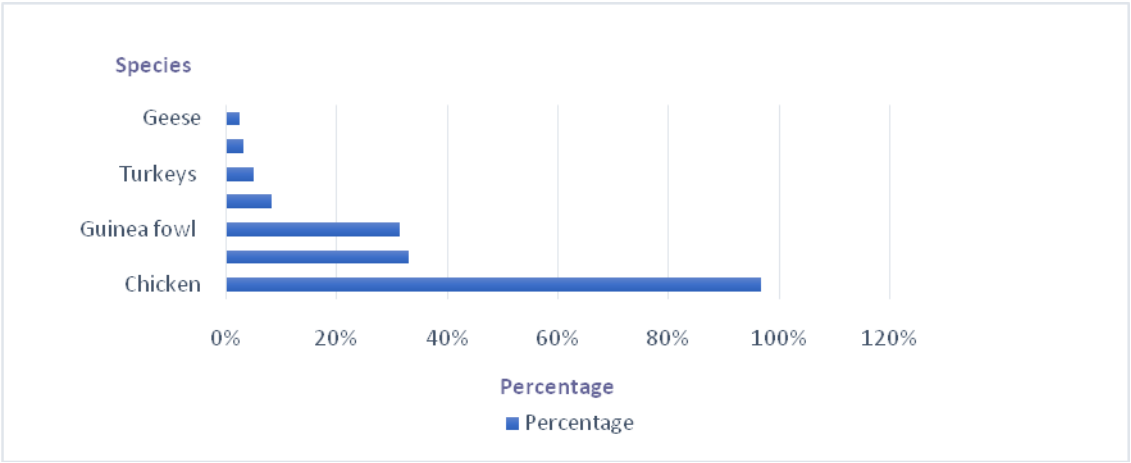


Figure.3 Origin and composition of poultry feed

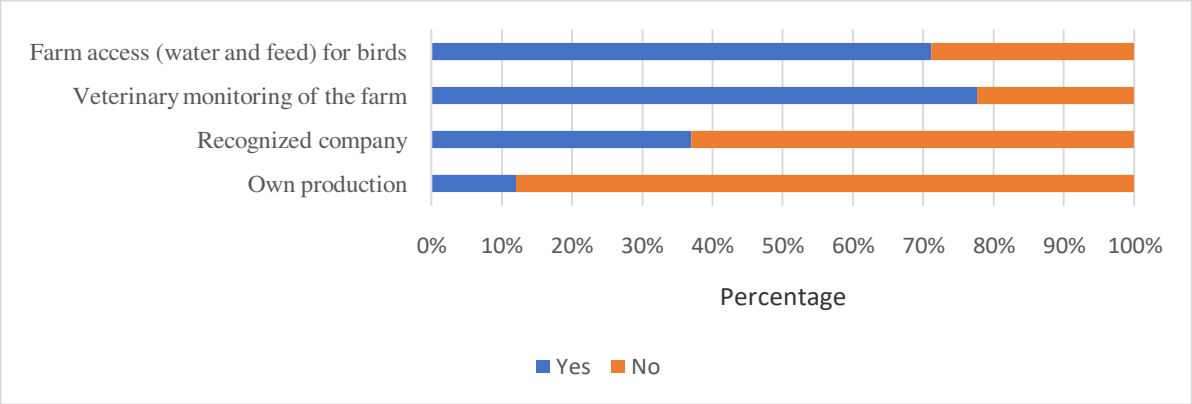


Figure.4 Knowledge of good practices and biosecurity in livestock farming

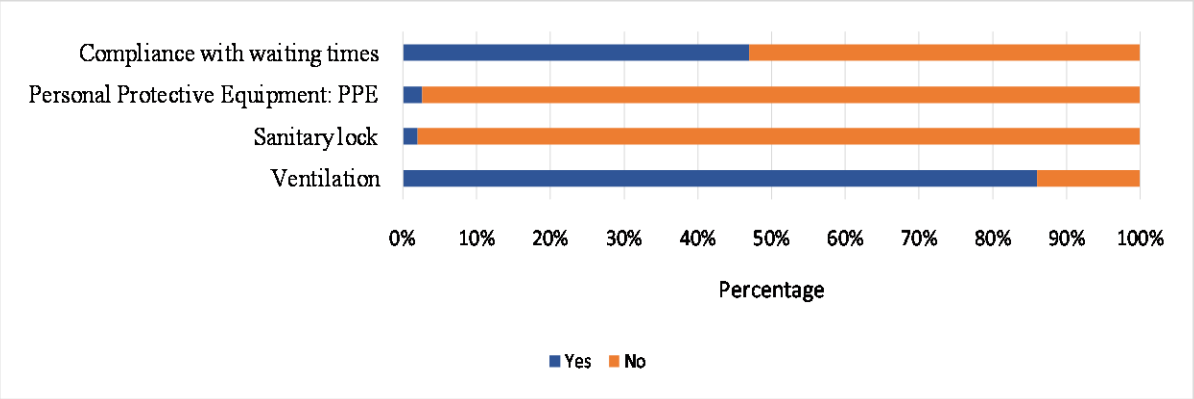
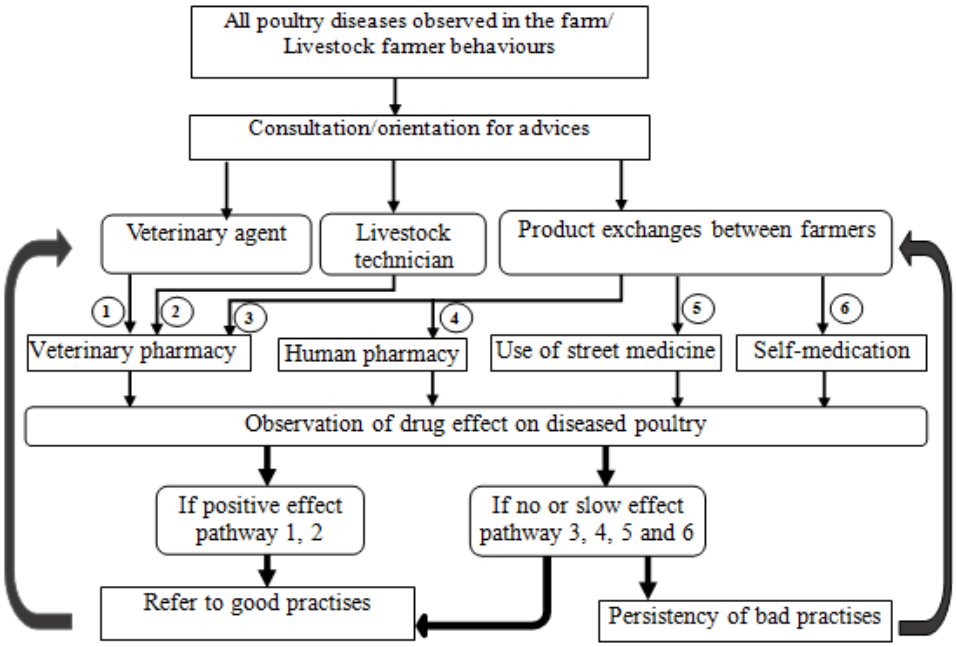


Figure.5 Health component practices in poultry farming 1, 2, 3, 4, 5 = care pathway



Unsanitized poultry droppings released into nature or sold for agricultural purposes, in particular, to produce compost (Bomisso *et al.,* 2019; Gnimassoun *et al.,* 2020) but also directly used as fertilizer (Pinde *et al.,* 2020) without treatment, could cause diseases or spread pathogens in the environment (Elmberg *et al.,* 2017; Kagambèga *et al.,* 2018). Less than half of the farms were monitored by an animal health agent. Furthermore, their interventions were mainly medical prescriptions with very little advice on biosecurity. Lack of knowledge and compliance with biosecurity guidelines could have a considerable impact on the conduct of poultry farming and the spread of pathogens (Manishimwe *et al.,* 2017).

However, the level of education could be one of the obstacles to the application of biosecurity measures. Our study shows that the level of education does not affect compliance with safety instructions in the farms surveyed. Small farms could not afford the cost of biosecurity requirements (disinfectant, footbaths, etc.) and they did not benefit from technical and health advice from a specialist livestock agent or veterinarian (Delpont *et al.,* 2021; Eriksson *et al.,* 2018). Likewise, biosecurity on traditional farms was absent (Gragnon *et al.,* 2020). On these farms, poultry can rub shoulders with family members and peck at household food. Poor biosecurity practices at the level of family farms in households and in certain poorly maintained commercial farms, as well as limited access to veterinary services and medicines, would favor the persistence and spread of certain poultry diseases as shown by several studies (Umunna *et al.,* 2022; Ismael *et al.,* 2021). The poor health status of most intensive poultry farms leads to poor health of the poultry. This encourages poultry farmers to use antibiotics in an uncontrolled manner (Cuong *et al.,* 2018; Emes *et al.,* 2023; Manyi-Loh *et al.,* 2018) including the use of traditional plant extracts, due to the cost of modern drugs.

Poultry farmers had some knowledge of certain diseases and their clinical signs. However, this knowledge had an empirical basis. Thus, confusion could be made on the basis of common symptoms caused by different pathogens which could lead to the use of inappropriate drugs. Drug abuse based on their knowledge and perceptions of diseases and drugs is a serious problem in poultry farming (VougatNgom *et al.,* 2017; Moffo *et al.,* 2020; Enahoro *et al.,* 2021). This highlights the lack of knowledge and awareness among poultry farmers in the conduct of their activity. Lack of financial resources was the first factor cited for the use of street drugs (Yao *et al.,* 2018). However, various quality issues have been raised, ranging from lower or higher concentrations of active ingredients than stated on the labels to toxicity (Bengaly *et al.,* 2018; Jaime *et al.,* 2022). Our results show that tetracyclines are the most prescribed.

This resistance could affect the effectiveness of the treatment of diseases in humans because it is currently recognized that the transfer of multiresistant bacteria directly from animals to humans and the spread of resistance genes are a real threat (Landecker, 2016).

The emergence and increasing development of bacterial resistance to antibiotics constitute a public health problem (Nikiema *et al.,* 2021). In addition, infection is very often associated with the consumption of meat and meat products, especially poultry (Ehouman *et al.,* 2021; Awawdeh *et al.,* 2022). Chickens play a major role as vectors of transmission of human salmonellosis, colibacillosis, and campylobacteriosis requiring special biosecurity attention (Ungemach *et al.,* 2006; Elmi *et al.,* 2021). Good practices combined with appropriate biosecurity can reduce the use of antimicrobial drugs (Rafiq *et al.,* 2022).

Self-medication for prophylaxis or growth promotion is a major source of increased antimicrobial resistance in humans (Rather *et al.,* 2017). Our results show that tetracyclines are the most prescribed. This antibiotic is also designated as the most consumed in Tanzania (Azabo *et al.,* 2021) with a percentage of 44%. Self-medication could lead to the use of banned drugs in poultry (Samandoulougou *et al.,* 2016) farms. Several data have demonstrated the relationship between the use of antimicrobials and the emergence of resistant bacterial strains in animals and their spread to humans, particularly via the food chain (Nikiema *et al.,* 2021; Aslam *et al.,* 2022).

According to Moffo *et al.,* (2020) the use of antibiotics in the livestock system is gradually gaining importance, which constitutes a major epidemiological risk vis-à-vis emerging and re-emerging diseases. An upsurge in resistance of *E. coli* strains to Tetracycline (16.79%) and 12.5% for *Salmonella spp* strains was observed (Bodering *et al.,* 2017). Most antibiotics are given prophylactically in drinking water or incorporated into food (Lawal *et al.,* 2015; Carrique-Mas *et al.,* 2015). This method, while allowing rapid delivery of antibiotics to poultry, makes it difficult to control doses, which can lead to underdosing or overdosing.

Poultry farmers had no knowledge of the problems related to improper disposal of livestock and slaughterhouse wastes into the environment and their use as organic fertilizer in agricultural land, aquaculture and the spread of resistance genes to colistin in the environment (Schroeder *et al.,* 2017). The presence of the resistance gene has been reported in livestock wastewater (Bako *et al.,* 2017; Drali *et al.,* 2018; Touati *et al.,* 2020; Snyman *et al.,* 2021).

Periods of high consumption such as festivals or ceremonies lead to the sale of processed poultry without respecting a waiting period before slaughtering the poultry for human consumption. Several studies have found antibiotic residues in poultry meat (Patel *et al.,* 2018). Thus, antibiotic residues in livestock products indicate non-compliance with waiting times reflecting poor livestock practices in Burkina Faso (Bagre *et al.,* 2015; Ano Guy Serge *et al.,* 2021).

The potential risks associated with the presence of these residues in foods of animal origin are carcinogenic, allergic, and toxic but also selection of bacteria resistant to antibiotics (Shahid *et al.,* 2021; Arsène *et al.,* 2022). Non-prudent use of antibiotics was also observed in Tanzania in 70% of farms that had drug residues in poultry. Reducing the unnecessary prescription and consumption of antibiotics in the veterinary sector could contribute, in a "One Health" approach, to preventing resistance in humans and animals (Roger and Ducrot, 2017; Velazquez-Meza *et al.,* 2022). This "One Health" concept is widely recognized as the cornerstone of the strategy to curb the development of antimicrobial resistance (AMR) worldwide (CDC, 2022).

In Burkina Faso, poultry farming provides income for many people with little education. However, the lack of good animal husbandry practices leads to problems such as the overuse of antibiotics and the emergence of pathogens resistant to these antibiotics. This resistance can be dangerous for human populations because of the high consumption of these poultry. Thus, raising awareness and effective supervision of breeders will be able to popularize good practices for sustainable, healthy, and profitable breeding.

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Author Contribution

SKD, KA and BN designed the study. SKD and CKAM designed the questionnaire. SKD, BSC and SA identified the farms of the poultry farmers and carried out the preliminary survey. SKD, NMEM, SNF and SA collected data from poultry farms. Data was analyzed by SKD and NMEM. KA and BN critically reviewed the manuscript. All authors have read and approved the publication.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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