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Assessment of Biosecurity Practices in Broiler Operations in South East and Kgatleng Districts, Botswana

KEYWORDS: Biosecurity, broiler operations, mortality, waste disposal.

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ABSTRACT *This study was carried out to assess biosecurity practices in 20 broiler operations in South East (5) and Kgatleng Districts (15). Data were collected using a structured questionnaire and through direct observation. Data were analyzed using Statistical Package for Social Scientists software, version 16.0. All farms (100%) were fenced and had gates closed most of the time to control unwanted visitors. Furthermore, 75% of the farms had footbaths, indicating that the risk of infection was high in farms that did not use footbaths. Furthermore, 25% of the respondents borrowed equipment from other farms or lent equipment to other farms. All farms cleaned and disinfected poultry houses at the end of the production cycle. In order to break the life cycle of disease causing microorganisms, 75% of the respondents rested poultry houses for 14 days, 15% for 21 days and 10% for 7 days. Fifty percent of farms carried out Newcastle disease and Gumboro vaccinations, whereas the remainder did not. Ninety percent of farms disposed of poultry manure by giving it to arable farmers. Mortality was disposed of by burning (40%); taken to dumping sites or landfills (35%); burial in pits located on farm premises (15%) and by feeding it to dogs after cooking (10%). The current results point to the inadequacy of biosecurity on broiler farms.*

Introduction
Biosecurity is the implementation of measures that reduce the risk of the introduction and spread of disease agents; it requires the adoption of a set of attitudes and behaviours by people to reduce risk in all activities involving domestic, captive exotic and wild birds and their products (Food and Agriculture Organization of the United Nations [FAO], 2008). In the opinion of Nyaga (2007), biosecurity principles include simple procedures and practices which when applied prevent entry of disease agents into a farm or the exit of the disease agent from infected premises. Biosecurity includes controlling movement of stock, persons, equipment and products into the clean farm and out of infected premises; and finally it involves methods that enable the farm to remain in a state of sustained cleanliness, referred to as sanitation. According to Australian Government Department of Agriculture, Fisheries and Forestry (2009), the objectives of biosecurity are to prevent the introduction of infectious disease agents to poultry, to prevent the spread of disease agents from an infected area to an uninfected area and to minimise the incidence and spread of microorganisms of public health significance.

No studies have been performed to assess biosecurity practices in broiler farms in Botswana. Therefore, a study was carried out to assess biosecurity practices applied in selected broiler operations in South East and Kgatleng districts by identifying areas of risks common to most broiler enterprises.

Materials and Methods
Description of the study areas
The study was carried out in South East and Kgatleng districts, Botswana. South East district lies at the altitude of 1014 m above sea level and is located between 24^0 S and 25^0 E latitude and longitude. Kgatleng district is located between 24^0 S and 26^0 E latitude and longitude, respectively.

Sample design
A list of commercial broiler operations was obtained from the Department of Animal Production, Ministry of Agriculture. From the list, 20 broiler operations (South East District = 5; Kgatleng District = 15) were randomly selected. The selection was based on the number of broiler operations within South East and Kgatleng districts and the scale of production (i.e., large, medium or small-scale). According to Moreki (2011), the commercial poultry sector in Botswana can be categorized into small-scale (operations that keep up to 20 000 birds), medium-scale (20 001 to 50 000 birds) and large-scale (>50 000 birds).

Data collection
Data were collected through direct observation and interviews with farmers using a structured questionnaire (Wei & Aengwanich, 2012). Questions about existing biosecurity measures, farm infrastructure, farm management, poultry health and productivity, as well as, farmer's knowledge of biosecurity and their opinions about the ease of implementing biosecurity measures were asked. The responses were recorded in the questionnaire with clarifications made where possible. Questions pertaining to biosecurity were grouped into three principles of biosecurity as defined by FAO (2008), namely traffic control, sanitation and isolation.

Data analysis
Data were loaded in Microsoft Excel and descriptive statistics were computed and analysed using Statistical Package for Social Scientists (SPSS), version 16 for windows.

Results and Discussion
Demographic characteristics
Demographic characteristics of the respondents are given in Table 1. Sixty-five percent of the respondents were males and 35% females. Previous study on the assessment of poultry production system in Ilesha West Local Government Area of Osun State in Nigeria by Adedeji, Amao, Alabi & Opebiyi (2014) also found that the majority (84.21%) of the respondents were males. All the respondents (100%) in this study had attended school (Table 1). Forty-five percent of the respondents had secondary school education followed by tertiary education (40%) and primary education (15%). Education can influence farmers' adoption of technology. In Nigeria, Ajetomobi, Ajagbe & Adewoye (2010) mentioned that the high level of education among respondents is expected to equip

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them to respond to challenges, lucrative opportunities, innovations and technology for high productivity. Furthermore, 45% of the respondents were aged 31-40 years followed by 20-30 years (35%), 41-50 years (15%) and >50 years (5%), indicating that the majority of the respondents were adults. In this study, 60% of the respondents were single and the remainder married (Table 1).

Table 1: Demographic characteristics of the respondents in the study area

Category	Frequency	Percentage
Gender		
Male	13	65
Female	7	35
Educational status		
Primary	3	15
Secondary	9	45
Tertiary	8	40
Age		
20-30 years	7	35
31-40 years	9	45
41-50 years	3	15
Over 50 years	1	5
Marital status		
Single	12	60
Married	8	40

Biosecurity practises on farms

Traffic control

Seventy percent of the respondents did not have warning signs and log books at their farms while 30% had signs instructing visitors to report at the gate before entering the farm. As shown in Table 2, 40% of the respondents allowed only poultry workers and input suppliers to enter farms; 35% allowed anyone into the farms; 15% allowed poultry workers, input suppliers and extension agents, whereas 10% allowed access to those people who made appointments only. Of those people allowed access to farms, 55% of the respondents indicated that they did not disinfect visitors and vehicles bringing one day old chicks, indicating that the risk of infection in those farms was high, whereas 45% of the respondents disinfected vehicles by spraying them.

The study by Rigby, Pettit, Baker & Bently (1980) showed that many transporters of live poultry do not clean their vehicles, cages and crates. The cages and vehicles are contaminated with feathers, manure and numerous disease causing organisms including salmonella. Moreover, these transport devices can transmit diseases from farm to farm; therefore it is vital to disinfect vehicles bringing in poultry. In the present study, 15 broiler operations (75%) had footbaths and used detergents such as virocid (80%), farm range (13%) and vet fluid (7%). Footbaths were used to reduce the risk of spreading diseases from farm to farm. Forty percent of the farms that had footbaths indicated that they replenished footbaths daily, 40% after 3 days, 13% after 7 days and 7% after the disinfectant had dried up (Table 2). Dupont Animal Health Solutions (2008) stated that footbaths should be replenished every 4-5 days or when visibly contaminated. Twenty-five percent of broiler farms in the present study did not have footbaths, indicating high risk of infection in these farms. According to Anderson (2010), poor or absence of disease control strategies such as footbaths and inadequate management like replenishing the footbaths after the disinfectant dries up are some of the factors that can increase disease outbreaks. All farms (100%) in this study were fenced and had gates closed all the time to keep away unwanted visitors. Cobb Avian 48 (2006) stated that each farm must have a perimeter fence to prevent unauthorized entry of people, vehicles and animals.

Table 2: Biosecurity practices associated with traffic control

Category	Frequency	Percentage
Permit in the farm premises		
Anyone	7	35
People with appointments only	2	10
Farm workers and suppliers	8	40
Farm and agriculture workers and suppliers	3	15
Meaures taken after farm visits		
Use footbath (people) or spray vehicles	9	45
No measures taken	11	55
Type of chemicals used in footbaths		
Virocid	12	80
Farm range	2	13
Vet fluid	1	7
Replinishing of the footbaths		
Daily	6	40
After 3 days	6	40
After 7 days	2	13
After the chemical dries up	1	7

Sanitation

Eighty-five percent of the respondents used protective clothing including coveralls, boots and head gears while the remainder said no protective clothing was used (Table 3). Furthermore, 85% of the respondents stated that they thoroughly cleaned and disinfected boots, indicating that biosecurity is upheld in the majority of farms. Fifty-nine percent of the respondents washed boots on daily basis, 23% once a week and 18% once a month. Additionally, 82% of the respondents said they changed coveralls in accordance with in-house procedures, 18% changed coveralls after a week. Twenty-five percent of the respondents said they borrowed from and/or lent equipment to other farms, which can spread infections between farms. Moreover, 60% of the respondents stated that the equipment were sanitized with an appropriate disinfectant before each use while the remainder did not sanitize the equipment, indicating a greater risk to bacteria and other microbes causing diseases (Table 3). The equipment may be a source of infection, hence the need for sanitation in order to minimize disease outbreaks. Ross Breeders (2009) stated that no equipment should be brought into the farm unless it has been cleaned and disinfected. Conan, Goutard, Sorn & Vong (2012) stated that it is mandatory to disinfect drinkers and feeders on daily basis. In this study, feeders were cleaned at the end of the production cycle in most farms (70%) while drinkers were cleaned daily when chicks were given water. Seventy-five percent of the respondents washed equipment with soap or disinfectant while 25% of the respondents washed equipment with water only probably due to either inadequacy of funds to purchase disinfectants or farmer's lack of knowledge of biosecurity.

Cleaning and disinfection of poultry houses

Cleaning and disinfection plays an important role in the poultry industry and can significantly affect productivity and profitability of the farm (Bosman, 2003). In the present study, 90% of the respondents removed manure, washed the poultry house with water and detergent while 10% used only water to clean the poultry houses after manure had been removed. The high cost of disinfectants was the reason given by respondents that used water only to clean the poultry houses. The study by Mandero, Balcha, Sahle & Bekede (2012) in Ethiopia reported that almost the respondents used mere water for cleaning practices against only one respondent who claimed to use soap. The authors also reported that none of the respondents carried out disinfection as a sanitary measure. In Algeria, Alloui & Ayachi (2012) attributed the decline in production performances (mortality, feed conversion, and laying rate) in the poultry farms to failings in sanitary barriers during the production period. In this study, all the respondents said they rested the poultry houses at the end of the production cycle to break life cycle of disease. Seventy-five percent of respondents rested the poultry house for 14 days, 15% for 21 days and 10% for 7 days. According to Bosman (2003), the time required to reduce the microbiological load is around 10 days. Furthermore, Henrique (2012) stated that the poultry house is mainly rested for 14 days. Resting poultry houses for longer periods (e.g., 21 days) could have a negative effect on the productivity of broiler operations.

Table 3: Biosecurity practices associated with sanitation

Practices	Frequency	Percentage
Frequency of cleaning protective clothing		
Daily	10	59
After 3 days	4	23
After a month	3	18
Coverall washing		
After a week	3	18
In accordance with in-house procedures	14	82
Measures for borrowed or lent equipment		
Wash with detergent	3	60
Wash with water only	2	40
Frequency of equipment cleaning		
Daily	6	30
After the batch leaves	14	70

Types of bedding materials used

Five materials were used as bedding including sawdust (50%), wood shavings (35%), sunflower hulls (10%) and feeding bags (5%). Only one small-scale farmer used feed bags as bedding due to lack of finance. Prior to use of bedding materials, 60% of the respondents said they checked for contaminants such as parasites while the remainder did not check for contaminants. Eighty-five percent of the respondents said they changed litter (bedding material) at the end of the production while the remainder said they changed litter twice in a production cycle when the litter was wet. Sudarnika, Ridwan, Ilyas, Basri, Lukman, Sunartatie, Wibowo, Sugama, Hermans & Nell (2010) stated that wet litter promotes fungal development which poses risks to chicks.

Isolation

Ninety percent of the respondents raised day old chicks in separate poultry houses from the already existing poultry houses while the remainder raised mixed age groups. Inadequacy of funds was the reason outlined by respondents for raising chicks of different ages in the same house. Raising day old chicks and older chicks in the same poultry house presents a great risk to bio-security because the disease status of the day old chicks is unknown which can be passed to older chicks. In addition, if older chicks are suffering from an infection, it can be passed to day old chicks if they are housed in the same poultry house. According to Anderson (2010), day old chicks may have an infection or be susceptible to an infection that is already present in birds that appear normal (healthy carriers) in a farm. While all-in/all-out management system is not feasible for many breeding farms it is possible to maintain a separate pen or place to isolate and quarantine all new, in-coming stock from the resident population (Anderson, 2010).

Vaccinations

Eighty-five percent of the respondents said they knew the diseases that chicks were vaccinated for at the hatchery while the remainder said they did not know (Table 4). Most of the respondents that lacked knowledge on vaccinations carried out at the hatchery were small-scale farmers. Newcastle disease (35%), Gumboro (35%), and infectious bronchitis (15%) were the three diseases vaccinated for at the hatchery. Only 50% of farms carried out Newcastle disease (NCD) and Gumboro vaccinations, whereas the remainder did not carry out any vaccinations. Furthermore, 70% of the farms that vaccinated chickens against NCD and Gumboro administered the vaccines in drinking water and by spray, 20% used spray, whereas 10% administered vaccines in drinking water only (Table 4). Marangon & Busani (2006) noted that the widespread distribution of NCD had negative impact on the poultry producing sector. The use of poultry vaccines is aimed at avoiding or minimising the emergence of clinical diseases at farm level.

Table 4: Responses on vaccinations and route of vaccine administration

Practices	Frequency	Percentage
Vaccination at the hatchery		
Newcastle	7	35
Infectious bronchitis	3	15
Gumboro	7	35
No idea	3	15
Vaccinations at the farm		
Newcastle disease	5	25
Gumboro	5	25
No vaccinations done	10	50
Routes of vaccine administration		
In drinking water	1	10
Spray	2	20
In drinking water and spray	7	70

Poultry waste disposal

Poultry waste produced on broiler farms included litter (a mixture of manure, feathers and bedding material) and mortality**.**

Poultry litter

Ninety percent of farms disposed of poultry litter by giving it to arable farmers while 10% distributed it on their own crop fields around the poultry farms (Table 5). A recent study by Moreki & Keaikitse (2013) in Botswana showed that 80% of poultry operators around Gaborone disposed of manure and/litter by giving it away to other farmers, 16% used it as a fertilizer on their own fields, whereas 4% disposed of it at the landfills/dumping sites. Kaiser, Mallarino & Haq (2009) stated that most of the manure and litter produced by the poultry industry is currently applied to agricultural land. However, pollution and nuisance problems can occur when manure is applied under environmental conditions that do not favour agronomic utilisation of the manure-borne nutrients. Adewumi, Ogedengbe, Adepetu & Aina (2005) argued that the application of livestock manure to farmlands may lead to phosphorus build-up in soils because manure is often applied to meet the nitrogen needs of crops. The phosphorus to nitrogen ratio in manure is about twice that required by crops and excess phosphorus is released into the environment as run-off or can be independent of erosion. Excess phosphorus in run-off is associated with pollution of surface water and the overgrowth of algae populations (Adewumi et al., 2005).

According to Millner (2009), dust, odourous and bio-aerosols (e.g., microbes, endotoxins and mycotoxins suspended in air) generated at production, manure storage facilities and during land spreading of poultry litter constitute the most frequent source of complaints against animal-based industries. Uncontrolled decomposition of manure produces odorous gases, including amines, amides, sulphides, and disulphides, which can cause respiratory diseases in animals and humans (Schiffman & Williams, 2005).

Table 5: Waste disposal methods used in broiler operations in the study area

Category	Frequency	Percentage
Given to crop farmers	18	90
Distributed in the farmer's crop field	2	10
Disposal of farm mortality		
Burn	8	40
Dumping site/ landfills	7	35
Cooked for dogs	2	10
Buried	3	15

Mortality

As shown in Table 5, 40% of the respondents burnt mortality, 35% disposed of it at the dumping site or landfills and 15% disposed it of in burial pits which were constructed on the farm premises, whereas 10% was cooked for dogs. In a similar study, Moreki & Keaikitse (2013) reported the three methods of mortality disposal to be at landfills (52%), incineration (20%) and burning (20%). Moreki & Chiripasi (2011) reported that the predominant methods of poultry waste disposal in Botswana are direct disposal at the landfills, application as a fertilizer in gardens or farms and burning. According to Cai, Pancorbo, Merka, Sander & Barnhart (1994), burial of dead birds in a pit can lead to ground water contamination. Furthermore, burning may lead to atmospheric pollution in the event of catastrophic mortalities resulting from outbreaks of highly infectious diseases such as Newcastle disease and avian influenza (Anonymous, 2005). In addition, Meroz & Samberg (1995) stated that poultry carcasses must be disposed of by methods which prevent dissemination of any disease agents regardless of whether death was due to a serious clinical infection or routine mortality while also protecting the environment from pollution and maintaining a good public health image.

Control of rodents and other animals

Ninety percent of the respondents said they used baits while 10% used cats to control rodents. Berdoy, Webster & Macdonald (2000) stated that it is possible that mice and rats caught by cats are intermediate hosts for parasites such as Toxoplasma gondii. The cats in turn can become the definitive host for the parasites and excrements from infected cats can then pose a hazard to the health of farm animals and humans. According to Kapel (2000), rodents can transfer pathogens and parasites to poultry and their products, to farmers and (indirectly) to consumers of poultry products, thus causing food safety problems. All farms (100%) in the present study had strict measures to keep wild birds or domestic animals away from their flocks.

Recommendations

Based on the findings of this study, the following recommendations are made:

- Strict biosecurity measures such as provision of footbaths, disinfecting vehicles, chicken crates and equipment in addition to vaccinations must be carried out to prevent and control poultry diseases on broiler farms.
- The practice of exchange of equipment between farms should be discouraged as it encourages spread of infection between farms.
- Poultry litter should be disposed of in a safe manner to prevent dissemination of infectious agents while also protecting the environment from pollution and maintaining a good public health image.

Conclusion

Based on the findings of this study, it is concluded that biosecurity in broiler operations in South East and Kgatleng districts was inadequate. A significant proportion of farms did not use footbaths and disinfectants following cleaning. These results point to the inadequacy of the extension service. It is therefore important that farms should adopt good husbandry practices such as adequate housing, current stocking densities, good ventilation, proper disposal of wastes, cleaning and disinfection of poultry premises and vaccinations in order to keep out infections.

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