

*Full Length Research Paper*

# Assessment of biosecurity initiatives on broiler farms in Khartoum, Sudan

Tegla Mena Williams, Mohamoud Mboya\* and H. O. Chadha

Department of Preventive Medicine and Public Health, Faculty of Veterinary Medicine, University of Khartoum, Khartoum, Sudan.

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This study was designed to evaluate the present biosecurity measures in broiler farms in Khartoum and to compare between the biosecurity practices followed in closed system and open system farms. The primary information that included numbers of broiler poultry in each farms, locations in the state and type of farms were obtained from Ministry of Agriculture and Animal Resources, Khartoum. Multi-stage cluster sampling method was used; collection of information was done at different levels (sites, farms and persons). A total of 45 broiler farms (13 closed and 32 open systems) were chosen from Khartoum, Khartoum North and Omdurman. Data were collected by using structured questionnaire. The respondents were farm owners, farm managers, veterinarians and workers. The results showed that the closed system had a higher level of biosecurity than the open system. 100% of the closed system practiced all in all out system when compared with 81.3% of the open system farms. The open system farms had less secure boundaries; 28.1% of the farms did not have fence when compared with 100% of the closed system farms. Only 2.2% of the farms had washing by disinfectants at the gates. The distance among the pens in each farm which was more than 100 m was 33.3%. Among the 45 farms, 87.5% disinfected the equipment before each production cycle. It was found that 88.9% of the farms collected dead chickens once daily. The results, also, showed that 57% of the farms did not use disinfectants in their foot dips of each pen and 84.4% had no warning signs for entrance of unauthorized people. Among these farms, 17.8% had control plan for vermin, 68.9% of the farms isolated the sick birds, and 26.7% were found to keep different species of birds other than poultry and 15.5% used to treat drinking water for poultry. It is concluded that the majority of the farms in were far from application of biosecurity measures.

**Key words:** Biosecurity, measures, broiler farms, Khartoum, Sudan.

## INTRODUCTION

Biosecurity is the implementation of measures that reduce the risk of introduction and spread of disease agents. Biosecurity requires the adoption of a set of attitudes and behaviors by people to reduce risk in all

activities involving domestic, captive exotic and wild birds and their products. Farm's performance is directly linked to good biosecurity measures. Poultry farms can be categorized into four farms according to classification

\*Corresponding author. E-mail: [mboya.mmm@yahoo.com](mailto:mboya.mmm@yahoo.com).

system stated by the FAO (2004). Sectors 3 and 4 have lower levels of biosecurity than farms belonging to sectors 1 and 2. Therefore, poultry farms in sectors 3 and 4 have a higher potential risk for acquiring and transmitting diseases, including Highly Pathogenic Avian Influenza (HPAI). Biosecurity practices were designed to minimize the transmission of infectious diseases between and within farms.

The principal elements of biosecurity are segregation, cleaning and disinfection. Biosecurity practices cover a broad range of measures. These have been divided into three categories (Shane, 1997): conceptual, including the choice of location of farms; structural, covering the physical facilities to protect against entry of wild birds; operational, covering the work procedures that farm staff and visitors adopt.

Poultry health management is the emerging issue along with bio-security measure. Livestock and birds are within the major causes of zoonotic diseases transmission chain. Food from livestock sources need to be free from disease causing agents to safe guard public health (Sharma, 2010). In spite of the importance of biosecurity and contact structures in disease transmission, there is little information available in the literature on the biosecurity status of poultry farms (Nespeca et al., 1997).

Due to the expanding poultry production in the Sudan and scarcity of information about the biosecurity practice on poultry farms, it is considered necessary to carry out the proposed research work. Therefore, the aim of the study was to evaluate the present measures of biosecurity on broiler farms in Khartoum and make comparison between closed system and open system biosecurity practices.

## MATERIALS AND METHODS

### Study area

The study was conducted in Khartoum because it has the largest poultry population in the country. Khartoum is the capital of Sudan, composed of seven localities and estimated population of approximately 7,152,102. It extended between latitudes 15.08 and 16.45 North and longitudes 31.36 and 34.25 East. The state has an area of 22,122 km<sup>2</sup> and shares borders with Northern, River Nile, White Nile, Gazira, North Kordofan, Gedaref and Kassala. The study area covered the following locality of Khartoum: Khartoum, Khartoum North and Omdurman.

### Data collection

The primary information and numbers of broiler poultry farms were obtained from Ministry of Agriculture and Animal Resources, Khartoum.

Data were collected from commercial broiler farms from the different localities in Khartoum by using the Global Positioning System (GPS). For each location, the numbers of farms were determined. A total of 45 broiler farms were selected. 13 farms were visited, in Khartoum including 10 open system and 3 close system;

17 farms were visited in Khartoum North including 12 open system and 5 close system; and 15 farms in Omdurman including 10 open system and 5 farms close system.

## Methodology

A cross sectional survey was carried out from May 27th until June 14th, 2012. Data were collected by means of a questionnaire; respondents were farm owners, farm managers and veterinarians. The questionnaire was administered during face-to-face interview and contained the required data about biosecurity measures, farm design, farm management, poultry health as well as staff knowledge of biosecurity. Questions for biosecurity were grouped into the three components of biosecurity as defined by FAO (2004) which were traffic control, sanitation and isolation. A total of the biosecurity measures were calculated and expressed as frequencies and percentage.

## Data analysis

Data were analyzed by Descriptive Statistical Analysis

## RESULTS

Results showed that only 20% farms were far from the main road and 24.5% have distances less than 500 m to the nearest farms (Table 1). Results from the survey showed that open system tends to have less secure boundary than that of the close system. Only 2.2% farms had water washing in their gate, 22.2% farms did not have a fence and 93.3% farms did not have warning signs in front of the farms and sheds. Only 3 (6.7%) farms had warning signs for visitors and provide them with protective clothing and boots (Table 2). The results showed that the distance between houses more than 100 m in 15 (33.3%) farms and in 3 (73.3%) farms the pest control was done as a routine (Table 3). The results showed that closed system has a high level of biosecurity than the open system, 84.6% was using disinfectants in the foot bath in the front shed entrance and both systems do not share equipment between farms, 84.6% of the production personnel did wear protective clothing in the close system when compared with 9.4% in the open system and only 5 (11.1%) collected the dead birds twice daily, also open system does not have a barking area (Table 4).

Traffic onto the farm is an important factor that may enhance the disease risk. Traffic refers to the number of visitors and workers that move into and out of the farm. The result showed that closed system has a high level of biosecurity than open system 92.3% as compared to 56.3%. Only 5 (11.1%) farms provide visitors with clean clothing and boots if they entered the farm. The least number of biosecurity measures which present on the farms were related to traffic control. A total of 31 (68.9%) of the farms separated sick birds from healthy birds. The highest number of biosecurity measures which present on the farms was related to isolation (Table 5). A total of

**Table 1.** Location selected bird's farms and distance of farm to the nearest farms.

Item	Frequency	Percentage	Closed (%)	Open (%)
location of farm				
Near main road	36	80	61.5	87.5
Far from main road	9	20	38.5	12.5
Distance to nearest farm				
Less than 500 m	11	24.5	15.4	28.1
More than 500 m	34	75.5	84.6	71.9

**Table 2.** Level of biosecurity at farm gate.

Item	Frequency	Percentage	Closed (%)	Open (%)
<b>Presence of fence</b>				
Yes	35	77.8	100	71.9
No	10	22.2	0	28.1
<b>Presence of parking area</b>				
Yes	6	13.3	46.2	0
No	39	86.7	3.8	100
<b>Water washing in gate</b>				
Yes	1	2.2	7.7	0
No	44	97.8	92.3	100
<b>Warning signs</b>				
Yes	7	15.6	53.8	0
No	38	84.4	46.2	100
<b>Provide visitors with protective clothing and boots</b>				
Yes	3	6.7	23.1	0
No	42	93.35	76.9	100

39 (86.7%) farms practiced all in all out system and 33 (73.3%) of the farms controlled access of wild birds, rodents or insects into poultry sheds or had strict measures to keep other poultry and domestic animals away from their flock. The result showed that 15.5% from surveyed farms implemented water sanitation system (Table 6).

The results showed different sources of origin of chicken. Most obtained commercial farms 80% (Table 7). All of the farms in close system had appropriate vaccination program when compared with 4 (8.9) farms that had no vaccination program in the open system. In 16 (35.6%) of the respondent farms, the feed was manufactured within the farm itself. A total of 24 (53.3%) of the surveyed farms had veterinarian supervision and only 17.8% of respondent farms had training program to the farm staff on biosecurity practice (Table 8).

Among the target population in the study, 73.3% had no slaughter house in their farms. In 29 (64.4%) from

surveyed farms, the workers had no certificate declaration (Table 9). None of the farms had hatchery in the open system in target population, in contrast the closed system (38.5%) had hatcheries.

## DISCUSSION

The present study has been conducted in Khartoum state targeting the following area Khartoum, Khartoum North, and Omdurman in the Sudan and was intended to examine biosecurity practice on broiler farms in close and open system. Global Positioning System (GPS) technology was used to determine location of farms and the distance between farms. The results showed that majority of the farms 35 (77.8) had a secure boundary fence that is able to stop people and animals entering the farm, most of the farms 39 (86%) practiced all in all out system and 19 (42.2%) farms used disinfectants in foot

**Table 3.** Level of biosecurity between the farm gate and the shed.

Item	Frequency	Percentage	Closed	Open
<b>Distance between houses</b>				
Less than 100 m	30	66.7	53.8	71.9
More than 100 m	15	33.3	46.2	28.1
<b>Pest control</b>				
As routine	33	73.3	92.3	56.6
After out break	12	26.7	7.7	43.4
<b>Litter and manure disposal</b>				
Burning	9	20	23.1	18.8
Use as fertilizer	5	11.1	7.7	12.5
Accumulate at back yard	7	15.6	7.7	9.3
Sale	24	53.3	61.5	59.4
<b>Structure of farm design</b>				
Well	29	64.4	100	50
Not well	16	35.6	0	50

**Table 4.** Level of biosecurity at the shed.

Item	Frequency	Percentage	Closed	Open
<b>Using of disinfectants in foot path</b>				
Have no foot path	26	57.8	15.4	75
Yes	19	42.2	84.6	25
Use water	0	0	0	0
<b>Decontamination of equipments</b>				
As routine	41	91.1	100	87.5
After out break	4	8.9	0	12.5
<b>Equipments share</b>				
Yes	0	0	0	0
No	45	100	100	100
<b>Collection of dead birds</b>				
Once daily	40	88.9	76.9	93.8
Twice daily	5	11.1	23.1	6.2
<b>Dead bird disposal method</b>				
Burning	43	95.5	100	93.8
Left thrown away	2	4.5	0	6.2
<b>Production personnel wearing protective clothing</b>				
Yes	14	31.1	84.6	9.4
No	31	68.9	15.4	90.6

path; this results were in agreement with Etih et al. (2010) who reported similar observation. According to Stephen

(2012), there was no set distance that will uniformly eliminate the risk of disease transfer. During this study, it

**Table 5.** Biosecurity measures related to isolation.

Item	Frequency	Percentage	Closed (%)	Open (%)
<b>Isolation of diseased birds</b>				
Yes	31	68.9	92.33	59.4
No	14	31.1	7.7	40.6
<b>Have different species</b>				
Yes	12	26.7	7.7	71.9
No	32	73.3	92.3	28.1
<b>Presence of quarantine area</b>				
Yes	7	15.6	46.2	3.1
No	38	84.4	53.8	96.9

**Table 6.** Water sanitation and water system cleaning.

Item	Frequency	Percentage	Closed (%)	Open (%)
<b>Cleaning of water system after</b>				
Two weeks	33	73.3	76.9	71.9
Three weeks	12	26.7	23.1	28.1
<b>Source of water treating</b>				
Yes	7	15.5	53.8	0
No	38	84.5	46.2	100

**Table 7.** Chicken origin.

Item	Frequency	Percentage	Closed (%)	Open (%)
<b>The origin of chicks</b>				
Commercial farms	36	80	61.5	100
Hatcheries within farms	5	11.1	38.5	0
Imported	4	8.9	8.9	0
<b>Disease affected your farm</b>				
IB	0	100	100	100
ND	0	100	100	100
Both	0	100	100	100
None	0	100	100	100

was found that the distance to the nearest farm was more than 500 m and found to be about 75.5% of the respondents of the surveyed farms.

Among the survey in two types of production systems, the results showed that the close system was more secure than the open system, this indicated that management regarding biosecurity is more than open system, also larger facilities are often assumed to implement more advanced biosecurity measures (FAO, 2003). The survey results indicated that majority of the

open system lacked the appropriate biosecurity practices such as boundary barriers, water sanitation, restrict visitors, the use of disinfectants in the footbaths, health record keeping and dead bird's disposal in a hygienic way; our results was in agreement with the findings reported by FAO (2003). FAO (2003) categorize that the open system farms have no appropriate biosecurity practices. This study when investigation proved the aforementioned parameters in the surveyed farms which followed an open system.

**Table 8.** Veterinarian supervision and training of staff on biosecurity and record keeping.

Item	Frequency	Percentage	Closed (%)	Open (%)
<b>Veterinarian Supervision</b>				
Yes	24	53.3	92.3	37.5
No	21	46.7	7.7	62.5
<b>Record keeping</b>				
Yes	30	66.7	100	53.1
No	15	33.3	0	46.9
<b>Training of staff on biosecurity</b>				
Yes	8	17.8	38.5	0
No	37	82.2	61.5	100

**Table 9.** Presence of slaughter house and drainage.

Item	Frequency	Percentage	Closed (%)	Open (%)
<b>Have slaughter house</b>				
Yes	12	26.7	61.5	0
No	33	73.3	38.5	100
<b>Slaughter house well drained</b>				
yes	10	22.2	61.5	0
No	45	77.8	38.5	100
<b>Worker assigned certificate declaration</b>				
Yes	16	35.6	76.9	18.8
No	29	64.4	23.1	81.2
<b>Workers have shower before handling poultry meat</b>				
Yes	3	6.7	23.1	0
NO	42	93.3	76.9	100

It was found that about 22.2% from the respondent's water sanitizing system is implemented. Peter and Tim (2009) stated that all water derived from dams, streams, drains and open storage units used for internal shed fogging or drinking water for birds must be sanitized. Sanitation of water helps in minimizing transmitting diseases. Most of the farms (82.2%) did not have control plan of vermin; this practice does not agree with Waston et al. (2008) who found the use of disinfectant and insecticides to control pathogens and insects may harbour avian pathogens. They stated that vermin should be used as a routine for farm biosecurity programs. Only 17.8% of the respondent farms had staff training of about the bio-security practice. It is important for all people with poultry farms to receive training/briefing before starting to work with poultry so that they have general understanding about all aspects of the process and as it

is their own task.

Workers who understand the purpose of a bio-security measure are more likely to adopt the practice as part of their daily routine. They are more likely to ensure that any visitors and service contractors act in accordance with the farm biosecurity practice. About 88.9% of the farms collected the mortality once daily. This was in agreement with Arzey and Littleton (2007) who reported that dead birds must be removed from the free range enterprise daily or twice daily if mortality is high. Dead birds must be in appropriate site either on or preferably off farm. In reference to isolation of sick birds, 68.9% of farmers separated sick birds from health birds and 95.5% of respondents used burring for disposable of dead birds and just two farms (4.4%) left dead birds thrown. Sudarnika et al. (2010) found that 24 farmers (96%) separated sick birds from healthy birds and burned or

buried them for disposable and just two farms (4.4%) left dead birds thrown away.

It was noticed that about 11.1% of the farmers reared different species in their farms; this practice is not in agreement with Cardona and Kuney (2002). They reported isolation of premises and species of poultry from sources of infection. This would include biosecurity practices by keeping different bird species separately, preventing exposure of birds to potential sources of disease, preventing introduction of new birds from live bird markets or neighbors into an old flock. A total of 91.1% of the respondents had a vaccination program according to FAO (2007) regulation. In an ideal situation, a vaccination regime is available for the layer and broiler flocks in each country and ever for the respective farms which plan a program depending upon the disease challenge in the country.

## Conclusion

In general, the biosecurity measures level among broiler farms in Khartoum can be classified into low in the open system when compared with medium in close system and were far away from international standards especially in the open system. Majority of the farms in this survey were the open system; this could partly interpret their low biosecurity status which gently reflected the general biosecurity of the surveyed farms whether closed or open.

## RECOMMENDATIONS

1. Comprehensive and well-designed study of the broiler farms should be carried out including the cost of biosecurity in broiler farms.
2. Overall, government policy needs to facilitate the improvement of biosecurity adoption among poultry farmers.
3. It is advised or recommended provision of an updated biosecurity training workshop for poultry growers and staff who work in poultry farms in order to cover and implement the program and to introduce new updated tools in the program.
4. To preserve records for as long as they are required, providing access to records is also recommended to locate farm composting areas, dead bird management facilities and litter storage areas away from boundaries and neighbors.
5. Hygiene must be improved, first by educating workers to adhere to personal hygiene and slaughter facilities, equipment and personnel garments should be cleaned and disinfected.
6. Standard protocols of biosecurity practice should be enhanced to reduced disease outbreaks.

## Conflict of Interests

The author(s) have not declared any conflict of interest.

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