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Research Article

Data Analysis of Biosecurity Measures for Poultry Farms Registration in Khartoum State, Sudan

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Abstract

Data on biosecurity measures were gathered from Ministry of Agriculture and Animal Resources (MAAR), Khartoum State, Sudan with the objective to evaluate biosecurity status in poultry industry in Khartoum state. The data referred to one year work executed by the veterinary authorities during 2013 with the objective of measuring biosecurity level for registration purposes. The data were organized in twelve biosecurity variables prior analysis. The total number of farms visited was 59 of which 16, 33 and 10 were characterized as traditional, modern and semi modern production systems, respectively. The results showed that modern and semi modern farms are located at Khartoum and Bahri provinces and that the percent of broiler farms (69.5%) was found to be greater than that of layers farms (30.5%). Broiler industry is dominated by modern and semi modern systems. The survey results indicated that there was an overall low frequency of adoption of biosecurity measures ($P = 0.01$) by the poultry growers in semi modern and traditional systems. However, biosecurity measures were higher in modern production system although the compliance with biosecurity measures was not uniform among all farms in this system ($P = 0.01$). The results also found that poultry farmers have laid more consideration on those biosecurity measures targeting dead birds' disposal, veterinary supervision and vaccination variables.

Keywords: Biosecurity, Poultry Farms ,Infectious Diseases

Introduction

Biosecurity practices designed to minimize the transmission of infectious diseases between and within farms are an important component of modern flock health programs (Dorea *et al*, 2010). Biosecurity is simply described to consist of three fundamental principles: Segregation Cleaning and Disinfection (FAO, 2008). Poultry represents an important sector in animal production, with small commercial and backyard systems which are often extensive dominating the industry especially in the developing countries (Conan *et al*, 2012). Abdelqader *et al*. (2007 stated that poor disease control strategies and low or inadequate biosecurity measures result in high levels of baseline mortality due to infectious diseases.

The movement of farm personnel was positively associated with the probability of farm infection as highlighted by McQuiston *et al*. (2005) during the 2002 H7N2 avian influenza outbreak in Virginia. It was reported that biosecurity implementation requires training, awareness, resources and the perception of higher risk and loss of profit (Conan *et al*., 2012) and that the use of untreated poultry manure as fertilizer poses a serious risk of infection spread (Cristalli and Capua, 2007). Water and feed sources are recognized as a biosecurity hazard to poultry (Njue, 2009). In addition, association between untreated water source for poultry and outbreaks of HPAI A/H5N1was reported by Fasina *et al*. (2011) as farmers from

developing countries often use water from ponds or rivers for their birds.

With the increasing population and standard of living, the consumption of poultry products and the high demand for chicken meat and table eggs is becoming increasingly important in Khartoum state. However, the lack of adoption of biosecurity measures in the small commercial and backyard sector will certainly jeopardize biosecurity level in the modern poultry industry in Sudan (Mustafa, E. A. 2013). FAO and OIE recognize that improvement in biosecurity at all stages is an indispensable step for the prevention and control of HPAI, particularly in the long term (FAO, 2008). In September 2006, Sudan joined the list of nations seeing a resurgence of bird deaths due to H5N1. The disease had severe impacts on the country poultry industry and campaigns for awareness promotion and improvement of the biosecurity and restructuring of poultry production was launched. The serological survey of type A avian influenza antibody in chicken sera in Sudan which was carried out during 2003 to early 2006 revealed that the highest S/P ratio (1.299 for young and 6.711 for growing and adult) was detected in serum samples from Khartoum State and the presence of AI virus antibodies indicate previous exposure to the virus (Ali *et al*, 2007).

Materials and Methods

Description of the study area

The study was carried out in the three provinces of Khartoum state namely: Khartoum, Omdurman and Bahri.

Data source

The source of the data used in this study was MAAR, Khartoum. The veterinary department is the competent authority responsible for poultry farms registration. Registration procedure is usually conducted using a checklist containing some biosecurity parameters through veterinarians belong to the authority using the single-visit approach described by Creswell (1998). The authors of this paper organized the data used in the registration for the year 2013 and grouped them into 12 parameters(Appendix 1) The data comprised 59 commercial poultry farms in the three provinces (41 broiler and 18 layer farmers); of which traditional, modern and semi modern management systems comprised 16, 33 and 10 farms, respectively. The modern and semi modern management systems are usually closed systems and the management is intensive, while the traditional system is usually opened and the management is semi intensive.

Analytical Techniques

The collected survey data were coded and analyzed using Statistical Packaging for the Social Sciences (SPSS/PC version 16.0 for windows). Data were analyzed by Descriptive Statistical Analysis. Chi-square was used with the hypothesis that the compliance with biosecurity measures is uniform among all poultry farms and that for registration purposes by the veterinary authority all biosecurity variables must score good.

Biosecurity Score Form (BSF)

For the purpose of this study a simple biosecurity score form was developed using selected biosecurity measures. The score form consisted of 12 indicators as shown in appendix 1: Each indicator contained scores ranging from 1 to 3 (1 being unacceptable biosecurity, 2 moderate and 3 being good) level. The BSF is calculated by summing the biosecurity indicator scores. This is similar to the approach of Dorea *et al* (2010) who developed a scoring system to measure farmer adoption of biosecurity in Georgia, USA. Depending upon the extent of adoption of biosecurity measures the poultry farms were categorized as follows: (1) Unacceptable biosecurity level; (2) Medium biosecurity level and (3) Good biosecurity level.

Only farmers comply with all the biosecurity variables i.e. "good biosecurity level" will be entitled for official registration, while those attaining medium and unacceptable biosecurity levels were considered non compliant and were asked to improve their farms situation after a grace period for correction, and a second inspection visit will be conducted for verification.

Results and Discussion

The data was collected from 59 commercial poultry farms in the three provinces of Khartoum state with the objective to evaluate biosecurity condition that will

]entitle them for official registration. The results showed that the concentration of modern and semi modern farms is in Khartoum and Bahri provinces (Table 1). This may be due to the fact that both provinces have well established infrastructure suitable for poultry industry i.e. paved roads, electricity, feed factories etc. Table 2 presents the type of poultry prevails in the three production systems. The percent of broiler farms (69.5%) was found to be greater than that of layers farms (30.5%) and that the broiler industry is dominated by modern and semi modern systems. This trend might be attributed to the high prices of red meat, increased population of Khartoum state and the expansion of modern restaurants and hotels during the last two decades.

There was a generally higher level of biosecurity reported by growers in the modern production system (Table 3). Whereas variables such as feed source, dead birds' disposal, farm fence, veterinary supervision and vaccination were complying with the biosecurity standards set by the veterinary authority, observed and expected water source, distance to residential area, distance to other farms, cleaning and disinfection, biosecurity plan, training and visitors access variables were significantly different (P = 0.01). Similar findings were also obtained by Ali *et al*. (2014) who evaluated biosecurity measures on broiler farms in Khartoum and stated that closed system has a high level of biosecurity measures than that found in open system.

The survey results indicated that there was an overall low frequency of adoption of biosecurity measures (P = 0.01) by the poultry growers in semi modern and traditional systems (Table 4 and Table 5). In these systems most of the biosecurity variables were not complying with registration requirements. A fence and a closed gate are the first line of defense against disease transmition (Mustafa, E. A. 2013). The results showed that farm fence was not available for most farms in both semi modern and traditional systems. Our results were in agreement with Ali *et al*. (2014) who reported similar observation on that 22.2% of farms in the open system in Khartoum State did not have a fence.

Table 1: Total number of poultry farms in the different production systems

Location	Production system				Total
	%	Traditional	Modern	Semi modern	
Khartoum province	Count	1	13	2	16
	% of Total	1.7%	22.0%	3.4%	27.1%
Bahri province	Count	10	17	6	33
	% of Total	16.9%	28.8%	10.2%	55.9%
Omdurman province	Count	5	3	2	10
	% of Total	8.5%	5.1%	3.4%	16.9%
	Count	16	33	10	59
Total	% of Total	27.1%	55.9%	16.9%	100.0%

Table 2: Poultry types in the different Production systems

Poultry type	%		Poultry production system			Total
			Traditional	Modern	Semi modern	
	Broiler	Count	9	25	7	41
		% of Total	15.3%	42.4%	11.9%	69.5%
	Layer	Count	7	8	3	18
		% of Total	11.9%	13.6%	5.1%	30.5%
Total		Count	16	33	10	59
		% of Total	27.1%	55.9%	16.9%	100.0%

Table 3: Comparison between observed and expected values for modern poultry management variables

Variables	Expected	Observed values											
		Water source	Feed source	Dead birds disposal	Farm fence	Distance to residential area	Distance to other farms	Cleaning and disinfection	Veterinary supervision	Vaccination	Bio security plan	Training	Visitors access
Good	(10.02) 100.00	(0.71) 0.00	(9.87) 96.97	(10.02) 100.00	(9.72) 93.94	(1.88) 3.03	(0.71) 0.00	(7.00) 48.49	(9.87) 96.97	(10.2) 100.00	(3.96) 15.15	(3.55) 12.12	(5.55) 30.30
Moderate	(0.71) 0.00	(10.02) 100.00	(0.71) 0.00	(0.71) 0.00	(1.88) 3.03	(3.96) 15.15	(3.96) 15.15	(7.00) 48.49	(1.88) 3.03	(0.71) 0.00	(9.07) 81.82	(7.82) 60.61	(7.82) 60.71
Unacceptable	(0.71) 0.00	(0.71) 0.00	(1.88) 3.03	(0.71) 0.00	(1.88) 3.03	(9.07) 81.82	(9.24) 84.85	(1.88) 3.03	(0.71) 0.00	(0.71) 0.00	(1.88) 3.03	(5.26) 27.27	(3.10) 9.09
d.f		2	2	2	2	2	2	2	2	2	2	2	2
chi-square value		130.73	1.93	0.00	3.87	119.93	126.01	58.49	1.93	0.00	104.04	104.54	81.24
Sig.		**	Ns	Ns	Ns	**	**	**	Ns	Ns	**	**	**

Transforming values from percentage to degrees (using square root) are in parenthesis. ns: not significant. **: significant at 0.01 level of probability.

Table 4: Comparison between observed and expected values for semi modern poultry management variables

Variables	Expected	Observed values											
		Water source	Feed source	Dead birds disposal	Farm fence	Distance to residential area	Distance to other farms	Cleaning and disinfection	Veterinary supervision	Vaccination	Bio security plan	Training	Visitors access
Good	(10.02) 100.00	(4.53) 20.00	(7.78) 60.00	(10.02) 100.00	(7.78) 60.00	(0.71) 0.00	(5.52) 30.00	(6.36) 40.00	(10.02) 100.00	(8.40) 70.00	(0.71) 0.00	(0.71) 0.00	(0.71) 0.00
Moderate	(0.71) 0.00	(8.40) 70.00	(0.71) 0.00	(0.71) 0.00	(7.11) 30.00	(7.11) 50.00	(5.52) 30.00	(7.11) 50.00	(0.71) 0.00	(5.52) 30.00	(9.51) 90.00	(0.71) 0.00	(7.78) 60.00
Unacceptable	(0.71) 0.00	(3.24) 10.00	(6.36) 40.00	(0.71) 0.00	(3.24) 10.00	(7.11) 50.00	(6.36) 40.00	(3.24) 10.00	(0.71) 0.00	(0.71) 0.00	(3.24) 10.00	(10.02) 100.00	(6.36) 40.00
d.f		2	2	2	2	2	2	2	2	2	2	2	2
chi-square value		95.30	45.46	0.00	67.21	124.03	79.57	68.05	0.00	32.85	126.74	130.72	124.01
Sig.		**	**	Ns	**	**	**	**	Ns	**	**	**	**

Table 5: Comparison between observed and expected values for traditional poultry management variables

Variables	Expected	Observed values											
		Water source	Feed source	Dead birds disposal	Farm fence	Distance to residential area	Distance to other farms	Cleaning and disinfection	Veterinary supervision	Vaccination	Bio security plan	Training	Visitors access
Good	(10.02) 100.00	(4.39) 18.80	(3.61) 12.50	(9.04) 81.20	(5.63) 31.30	(6.65) 43.70	(5.63) 31.30	(4.39) 18.80	(9.38) 87.50	(9.71) 93.80	(0.71) 0.00	(0.71) 0.00	(0.71) 0.00
Moderate	(0.71) 0.00	(9.04) 81.20	(2.60) 6.30	(3.61) 12.50	(2.53) 56.20	(5.05) 25.00	(5.63) 31.30	(8.32) 86.70	(3.61) 12.5	(0.71) 0.00	(2.60) 6.30	(2.60) 6.30	(3.61) 12.50
Unacceptable	(0.71) 0.00	(0.71) 0.00	(9.04) 81.20	(2.60) 6.30	(3.61) 12.50	(5.63) 31.30	(6.16) 37.40	(3.61) 12.50	(0.71) 0.00	(2.60) 6.20	(9.71) 93.80	(9.71) 93.80	(9.38) 87.50
d.f		2	2	2	2	2	2	2	2	2	2	2	2
chi-square value		100.89	106.43	16.98	79.28	61.75	77.85	96.58	11.89	5.04	127.77	127.77	126.37
Sig.		**	**	**	**	**	**	**	**	ns	**	**	**

Transforming values from percentage to degrees (using square root) are in parenthesis.
ns: not significant.
**: significant at 0.01 level of probability.

All farms in the three production systems scored either moderate or unacceptable water source because water used in this study were mostly derived from wells and sources other than municipal treated water. This can be explained by the fact that the location of all farms are far from municipal services.

Other biosecurity measures of importance were also not practiced in the three production systems e,g. training, cleaning (including manure management) and disinfection. Similar findings were also obtained by Ali *et al*. (2014) who reported that training of farm staff on biosecurity in Khartoum State was only 38.5% in the closed system and 0% in the open system.

The results of this study showed that none of the three production systems succeeded in preventing human access and equipment among poultry facilities on all surveyed farms. Similar findings were reported by Dorea *et al*. (2010) who stated that visitors were not usually prevented access into premises or asked to wash car tires before entering the farm in Georgia, U. S. A. Free access of visitors and farm personnel was positively associated with H7N2 avian influenza outbreak (McQuiston *et al*., 2005). Bearing in mind the highly pathogenic AI outbreak occurred in Khartoum State & Central Sudan in September 2006 (Wegdan and Kheir, 2007) and that the highest S/P (6.711) detected in samples collected from Khartoum State (Ali *et al*, 2007), this will indicate the circulation of the AI virus and the continuous field challenge. Since that time on-farm biosecurity measures were not improved as suggested by the findings of this study. This might be attributed to low or insufficient awareness campaigns that emphasized the role of biosecurity in disease control and the irregular inspections of compliance provided by the veterinary authority.

Whereas 100% of growers in both modern and semi modern systems in this study followed sound means for on farm dead birds' disposal (incineration and burial), growers in the traditional system used over the fence bird disposal. On farm bird disposal practiced in this study was in agreement with the study of Vieira *et al*. (2009) who found that on-farm bird disposal was reported by 100% of the producers in their study area. Results from a similar study (Ali *et al*., 2014) showed that 6.2% of farms in the open system in Khartoum state left dead birds thrown away. Dorea *et al*. (2010) reported that the practice of disposing birds' off-farm may pose a higher risk of pathogen spread. Their statement was confirmed by Akey (2003) who reported daily transportation of dead birds to rendering facilities off farm as having the highest association with infected premises in the H7N2 avian influenza outbreak in Virginia.

It could be concluded that the commercial poultry sector in the study area is dominated by modern and semi modern farms and that the observed low frequency of biosecurity adoption by poultry growers may be attributed to the high biosecurity standards "good status" required by the official authority for registration. We recommend that training courses and extensive awareness campaigns on biosecurity issues need to be conducted to poultry growers on regular basis.

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