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The economic impact of some important viral diseases affecting the poultry industry in Abuja, Nigeria

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Abstract

Viral diseases are major causes of severe economic losses in poultry worldwide. Information on the economic impact of these diseases in poultry in Abuja is scanty. This study assesses the economic impact from losses incurred due to the outbreaks of Newcastle disease, (ND), Infectious bursal disease (IBD) and Avian influenza (AI) in some selected poultry farms in Abuja from 2006 to 2015 as well as personnel perception and knowledge on the economic impact of the diseases. A six (6) poultry farms with history of outbreaks were sampled for the study from 3 Area Councils (Gwagwalada, Kuje and Municipal) in Abuja. Also, a total of 60 structured questionnaires were administered to personnel in the poultry industry. Economic losses were categorized into number and monetary value of birds lost, drop in production and loss of jobs. Data from farm records were collected, computed and analyzed using a two-way ANOVA. Results indicated that ND, AI and IBD made up of 58%, 7.6% and 33% respectively from the recorded outbreaks. Also, there was a significant difference ($P<0.05$) in the cumulative outbreaks, monetary value of birds lost and layoff of workers amongst the selected farms. However, other economic variables showed no significant difference. In monetary terms, outbreaks of ND resulted in the highest cumulative losses (₦13 million) whilst AI caused more losses when evaluated per outbreak (₦2 million). Most respondents in the questionnaire survey were involved in commercial (22%) and household production (21.6%). Awareness level of respondents on outbreaks of AI was highest and lowest for ND. Also, poultry production is a massive area of employment while biosecurity in farms need to be improved. Therefore, preventive measures are vital as these viral diseases could hinder expected revenue in poultry farms and the need for further studies to elucidate the economic losses from recurring outbreaks.

Keywords: Avian influenza, Economic loss, Infectious bursal disease, Newcastle disease, Poultry

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Introduction

Globally, there has been a constant increase in poultry production especially in developing nations where 75% of the expansion is taking place (FAO, 2013). In the Federal Capital Territory (FCT), the chicken has been the most extensively exploited in commercial poultry production and this remains a vital region where investment in poultry farming is immensely serving as source of income to entrepreneurs and subsistence role in backyard practice (Mbodi, 2014). Infectious diseases of viral origin such as avian influenza (AI), Newcastle disease (ND), infectious bursal disease (IBD) (Gumboro disease) and Marek's disease are identified as major constraints in the development of the poultry industry in Nigeria thereby causing huge economic losses to farmers (Abraham-Oyiguh *et al*.,2014; Wakawa *et al*., 2014; Balami *et al*., 2015; Mshelia *et al*., 2016). These economic losses range from

degradation of birds' value from mortality and culling to job losses and management cost (Kumar *et al*., 2008). However, there is paucity of information on such economic losses in the FCT. Therefore, this work is to assess the contribution of the occurrence of the diseases to such economic loss in selected poultry farms in the area through a retrospective study. An evaluation of the knowledge and awareness of the diseases studied was also conducted amongst selected personnel in the poultry industry.

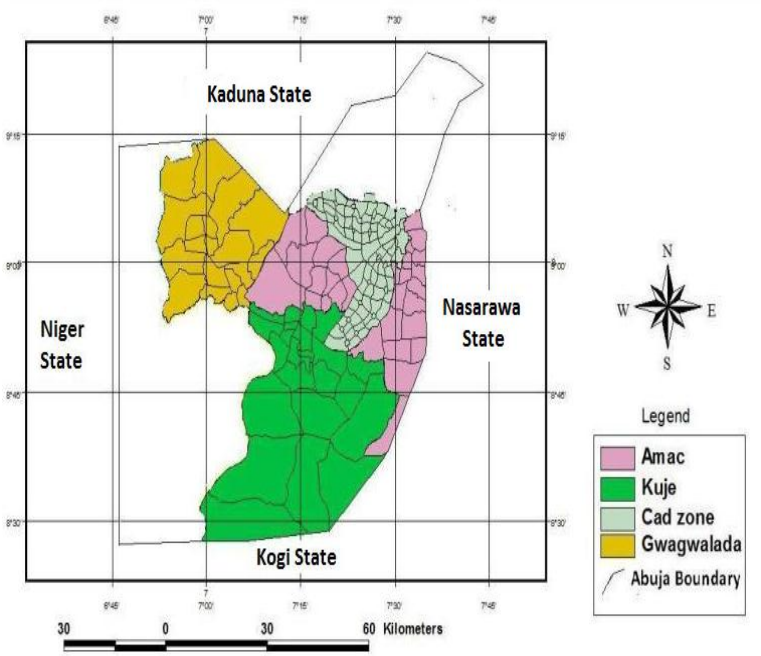


Figure 1: Map of Abuja showing the 3 study sites: Gwagwalada, Kuje and Municipal (Amac). Adapted from Department of Geography and Environmental Management, University of Abuja, FCT, Nigeria 2010

Materials and Methods

Description of study site

The study was carried out in Abuja, Nigeria's capital city located in the center of the country which lies between latitude 8 25'N and 9 20' and longitude 6 39' (Musa, 2014). The FCT is divided into six Area Councils: Abaji, Bwari, Gwagwalada, Municipal, Kwali and Kuje (Figure 1). The FCT falls within the savannah zone vegetation of the West African Sub region with a total annual rainfall in the city averaging 1100 mm (Abomeh, 2013; Ariyo *et al*., 2014).

Study design and sampling method

Between February and October, 2015, two farms (small and large scale) each were selected from 3 (Kuje, Gwagwalada and Municipal) (Figure 2) out of the 6 Local Government Areas (LGAs) in Abuja making a total number of six farms within the study area to obtain information and data on the recorded outbreaks of the 3 diseases considered in the research as from 2006 to 2014 and the corresponding economic losses accrued in the condition of their outbreaks. The sampled farms were identified with the history of outbreak of the diseases and still exist at the time of the study through a questionnaire survey distributed to farms in various regions of Abuja.

The economic impact of the diseases was assessed by recording the mortality of birds (including culled birds) and their monetary value, preventive and treatment costs, drop in productive capacity, and loss of jobs. The farms were divided into small and large scale farms according to Obi *et al*. (2008) based on their productive capacities, number of workers, customer type and, level of biotechnology (Table 1).

Study model specification and methodology

The spreadsheet model of livestock disease analysis was employed in assessing the economic impact of outbreak of the diseases in the studied area as explained by Bennett (2003). Economic losses were categorized into 5 major parts and simplified as

Table 1: Characteristics of the sampled farms as at 2015

Farm location and type	Flock size	Birds sold/week	Bio-tech	Staff capacity	Customer type
GW	5000	400-500	medium	20	wholesalers
gw	2500	300	medium	8	retailers
KU	9000	600-800	medium	15	wholesalers
ku	3000	350	medium	10	retailers
MU	10000	800-900	medium	22	wholesalers
mu	2000	300-500	medium	9	retailers

Keys: lower case=small scale farm, upper case=large scale farm, GW= Gwagwalada, KU= kuje, MU= Municipal, Bio-tech= Biotechnology

shown below:

Mortality and morbidity (M.M): This is the total number of birds or chickens that died and culled due to the outbreak of the disease in the studied farms.

Monetary value of M.M (MV): This is the value of the M.M in money terms which is calculated for each year for a given outbreak. For simplicity, the calculation was done as follows:

MV = Price per bird × value of M.M

Price at which the bird is sold prior to the outbreak was noted and other products such as eggs, feeds etc. were not considered in the above. In exceptional cases where the disease outbreaks led to high M.M and significant loss in production, the setbacks on the subsequent flock size and production capacity of the farm were adjusted. The price at which birds were sold from 2006-2010= ₦1000, from 2010-2015= ₦1200. This is the average price/kg considered around the studied areas at the period stipulated above.

Drop in Production (DP): This represents the proportional loss in productivity below the expected turnover/revenue from the birds sold as at pre-outbreak periods.

DP (%) = (M.V/ E.T) X 100

Where E.T= expected turnover per year

E.T= number of birds sold/week X price X 52

For example

M.M = 500 (number of birds affected in an outbreak of Newcastle disease in A (large poultry farm in Gwagwalada) in the year 2008)

P= ₦1200 (Average price as at 2007-2011)

E.T= 450 × 1200 × 52 = ₦28,080,000

MV= 500 × 1200 = ₦600,000

DP= 600,000/28,080,000 × 100 = 2.1%

Total drop in production (TDP): This is the cumulated loss in productivity accrued per year considering all outputs (products) from the farms with the loss due to outbreak of disease inclusive (DP above) and the preventive/ treatment costs to annul the effects. This information was obtained from the farm records and observations were made of the effect of TDP on the production capacity in the following years.

The contribution of the disease outbreaks to the TDP were obtained per year signified as CTDP as shown below:

CTDP = (DP/TDP) × 100

V. Loss of Jobs**:** The final category involved the total number of employees that lost their jobs from incapacitation of farms due to the disease outbreak. Other causes job loss was not considered in this section.

All the aforementioned variables in the methodology were simplified into tables to generate information and data to be tested for statistical significance using a two-way ANOVA (analysis of variance).

Questionnaire survey: In order to assess the awareness and knowledge of personnel in the poultry industry on the diseases, 60 questionnaires were prepared and self-administered to personnel involved in poultry production in the studied areas (20 from each of the 3 LGAs) with the aim of obtaining relevant information on the level of sensitization of the public to the diseases, changes in demand and supply of poultry products in conditions of outbreaks and contribution of the poultry industry to the economy. Furthermore, information on current management plan to curtail and prevent outbreak of the diseases was included in the assessment. This information was drawn from responses to six statements as regards to the aforementioned areas and rated appropriately using likert scales.

Data analysis

Each of the categories of economic loss were recorded in database based on Microsoft excel for windows 2008. All the variables representing economic loss in the methodology were simplified into tables as cumulates to generate information and data to be tested for statistical significance using a two-way ANOVA (analysis of variance). A P value ≤ 0.05 was considered statistically significant in the evaluation of each simplified category of economic loss amongst the farms. The second analysis involved the direct report of the qualitative data of the information from the questionnaire while descriptive statistics was also utilized in the analysis of the data to generate frequencies and percentages.

Results

The analysis of the outbreak of the diseases (ND, AI and IBD) studied in the specific locations in Abuja recorded a total of 39 outbreaks from the six different poultry farms (Table 2). The corresponding proportions of ND, AI and IBD respectively were 58%, 7.6% and 33% respectively (Table 3). Also, the statistical analysis showed that there was a significant difference (P ≥ 0.05) in the recorded cumulative outbreaks of the diseases in the studied location. Amongst the small scale farms, ND was the most recurring disease and particularly in Kuje where it covers 78% of the total occurrence in this category while in the large scale farms ND represents 43% of the recorded outbreaks. The

Table 2: Outbreak of the diseases in the study location from 2006-2015

Location	Gwagwalada			Kuje			Municipal			
Year	**ND**	**AI**	**IBD**	**ND**	**AI**	**IBD**	**ND**	**AI**	**IBD**	**Total**
2006	1(2)	0(0)	1(0)	1(1)	1(1)	0(0)	0(1)	1(0)	0(0)	5(5)
2007	0(1)	0(0)	0(0)	0(1)	0(0)	0(0)	1(0)	0(0)	0(0)	1(2)
2008	0(0)	0(0)	0(0)	1(1)	0(0)	0(0)	0(0)	0(0)	0(1)	1(2)
2009	1(0)	0(0)	1(0)	0(1)	0(0)	0(0)	0(1)	0(0)	0(1)	2(3)
2010	0(1)	0(0)	1(0)	0(0)	0(0)	0(0)	1(0)	0(0)	0(0)	2(1)
2011	0(0)	0(0)	0(0)	0(0)	0(0)	1(0)	0(1)	0(0)	1(0)	2(1)
2012	0(0)	0(0)	1(1)	0(2)	0(0)	0(0)	0(0)	0(0)	0(0)	1(3)
2013	0(1)	0(0)	0(0)	1(0)	0(0)	1(0)	0(0)	0(0)	0(1)	2(2)
2014	1(0)	0(0)	0(1)	0(0)	0(0)	1(0)	0(0)	0(0)	0(0)	2(1)
2015	0(0)	0(0)	0(0)	0(1)	0(0)	0(0)	0(0)	0(0)	0(0)	0(1)
Total	3(5)	0(0)	4(2)	3(7)	1(1)	3(0)	2(3)	1(0)	1(3)	38

Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, n= number of farms (6), values in bracket = small scale farm, value outside bracket = large scale farm

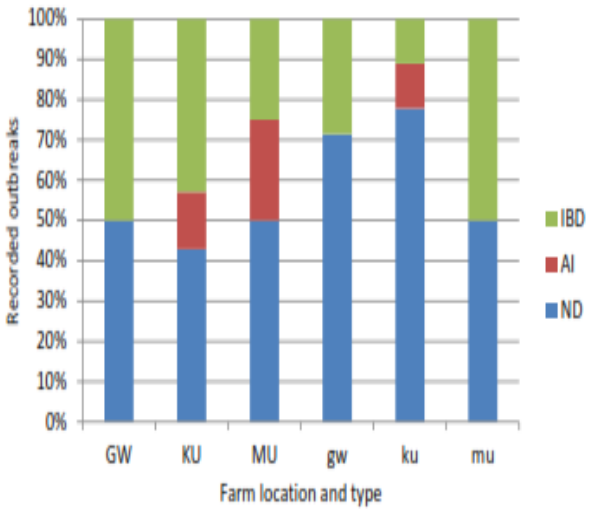
Table 3: Cumulative outbreaks from each location (n=39)

	Number of recorded outbreaks		
Location	**ND**	**AI**	**IBD**
GW	6	1	6
KU	7	1	3
MU	10	1	4
Total (%)	23(58.0)	3(7.6)	13(33.4)

Fcal = 39.17(2, 36), Fstat = 3.26, P < 0.05

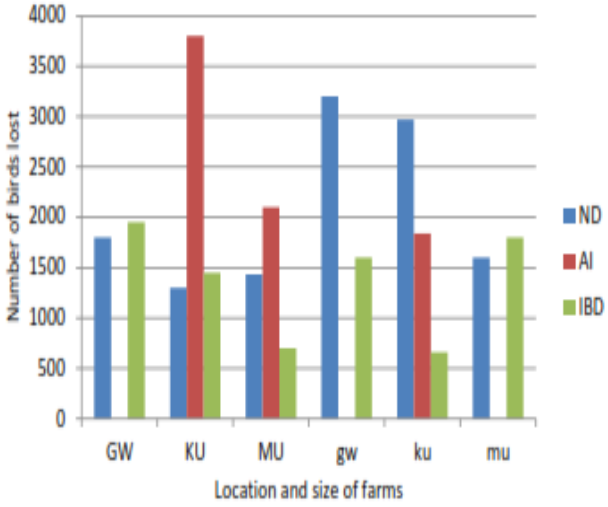
Note: degree of freedom (df) between and within groups is 2 and 36 respectively in all cases

Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, n= number of outbreaks



Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, Upper case= large scale farms, lower case = small scale farms

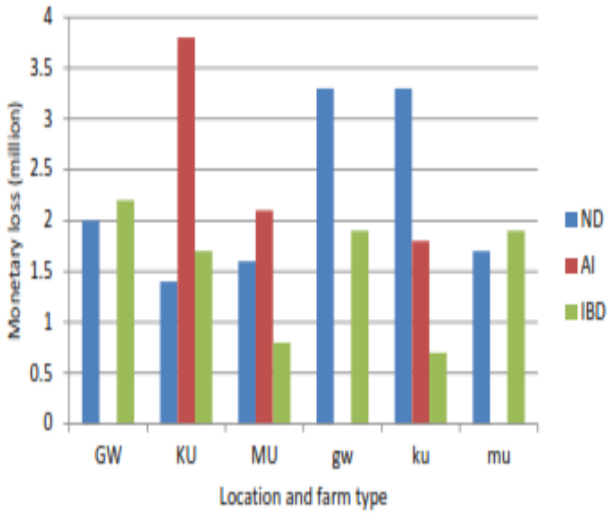
Figure 2: Cumulative data of outbreak of the diseases in the various farms (2006-2015)



Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, Upper case= large scale farms, lower case = small scale farms

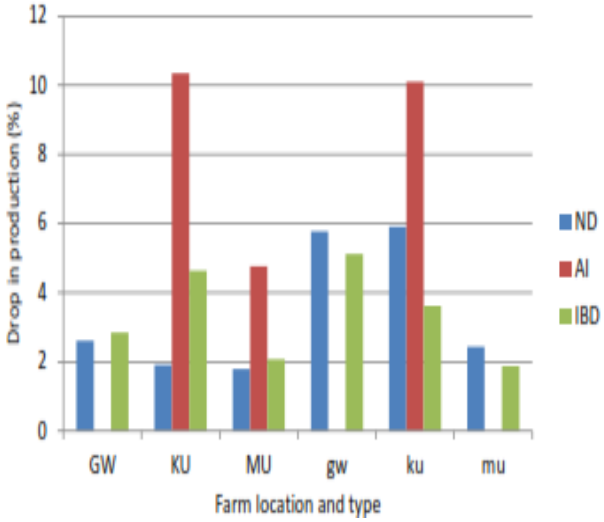
Figure 3: Distribution of mortality and morbidity of birds in the various locations (2006-2015)

occurrence of IBD was highest in the large scale and small scale farm in Gwagwalada and Municipal areas respectively representing 50% of the outbreaks (Figure 2). The analysis of the various aspects of economic loss due to the outbreak of the diseases showed that there was no significant difference (P< 0.05) in the total number of birds lost (mortality and morbidity) in the studied locations. Similarly, the same outcome was obtained when the birds lost in the small and large scale farms were compared. A total number of 28,144 birds were lost in the various locations in the past 10 years (2006-2015) from outbreak of the diseases with 43.7%, 27.5% and 28.8% being that attributed to ND, AI and IBD respectively (Table 4) (Figure 3). ND was the major cause of mortality and loss of birds, although the computed mortality rate per outbreak is highest for AI when compared to ND and IBD as indicated in the study where 2,580 birds or more could be lost in one outbreak of AI depending on the flock size (Table 5).



Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, Upper case= large scale farms, lower case = small scale farms

Figure 4: Monetary value of the birds lost (in ₦ million naira) from 2006-2015



Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, Upper case= large scale farms, lower case = small scale farms

Figure 5: Drop in production (%) caused by disease outbreaks in sampled locations (2006-2015)

Table 4: Economic loss incurred from outbreak of the diseases in various study site (2006-2015)

Economic category	Location	Variables			Fcal	Fstat	Sig
M.M		ND	AI	IBD			
	GW	500	0	3350	0.005	3.26	P> 0.05
	KU	4270	5640	2110			
	MU	3034	2100	2500			
	Total (%)	12304(43.7)	7740(23.5)	8100(28.8)			
M.V	GW	5.3	0	4.1	3.74	3.64	P< 0.05
	KU	4.7	5.6	2.4			
	MU	3.2	2.1	2.7			
	Total (%)	13.3(45.3)	7.7(25.6)	9.2(30.4)			
DP	GW	8.4	0	7.9	3.26	3.68	P> 0.05
	KU	7.8	20.6	8.3			
	MU	4.2	4.8	4.9			
	Total (%)	20.4(30.8)	25.2(37.6)	21.12(31.5)			

Note: degree of freedom (df) between and within groups is 2 and 36 respectively in all cases
Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, M.M= mortality and morbidity, M.V= monetary value, DP= drop in production, GW= Gwagwalada, KU= Kuje, MU= Municipal

Table 5: Economic loss per outbreak for each disease

Diseases	M.M	M.V(₦ million)	M.M/CO	M.V/CO(₦ million)
ND	12,304	13.3	535	0.6
AI	7740	7.7	2,580	2.6
IBD	8100	8.2	623	0.6

Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, M.M= mortality and morbidity, M.V= monetary value

Table 6: Workers lay off from each farm type

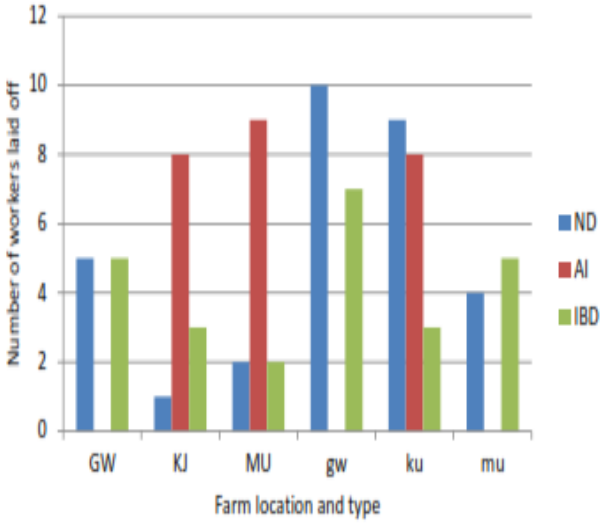
Economic category	Diseases	Variables	
		Large scale	Small scale
Job loss	ND	8(22.9)	23(50.0)
	AI	17(48.6)	8(17.4)
	IBD	10(28.6)	15(32.6)
	Total (%)	35(43.2)	46(56.8)

Fcal = 4.25 (2, 36), Fstat= 3.28, P < 0.05

In contrast, the analysis of the monetary value of birds lost revealed a significant difference (P< 0.05) from the recorded outbreaks. Accordingly, ND has caused the highest loss in monetary terms amounting to about 13.25 million Naira (Table 4) (Figure 4) over the years in the studied farms with an average of 4% drop in production. In addition, the monetary loss due to ND was also highest in the small scale farms and predominantly in Kuje area of Abuja (Figure 5) (Table 6). In the area of job loss, there was a significant difference (P< 0.05) between the large and small scale farms. A total number of 81 employees have been laid-off in the 6 studied farms as 51% and 43% of the workers laid off were in the small scale farms and large scale farms respectively (Table 6) (Figure 6).

The socio-demographic features of the respondents are presented in Table 7. A total number of 58 personnel in the poultry industry responded to the questionnaire out of 60 yielding a response rate of 96.7%. In respect to sex, the participants were composed of 37 (67%) males and 21(37%) females. Also, 89% of the respondents were between the age of 21-40 years. The highest qualification of the respondents were BSc holders (74%) while HND and MSc holders were 10% respectively and only 3% had PhD. Furthermore, respondents were mostly commercial and household farmers (21.6% each) while 30.7% and 28.2% areas of specialization were animal health and agriculture respectively.

The assessment of level of sensitization indicated that about 75% of the respondents are aware of the diseases studied and their contribution to economic loss in the poultry production. AI was the most widely publicized among the 3 diseases (ND, AI and IBD) amongst the respondents. This was also signaled in the affirmation (proportion of agree and strongly agree) of the zoonotic importance of AI among the respondents (60%) in contrast to ND which was 16% (Table 9).The respondents' awareness and notification on outbreak of the diseases were 21%, 44%, 34% for ND, AI and IBD respectively. Most of the respondents (44%) have been sensitized on outbreak of AI but surprisingly the most prevalent amongst the viral diseases in the



Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, Upper case= large scale farms, lower case = small scale farms

Figure 6: Number of workers lay off due to disease outbreaks in sampled locations (2006-2015)

Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease, GW= Gwagwalada, KU= Kuje, MU= Municipal, Upper case= large scale farms, lower case = small scale farms

Table 7: Socio-demographic characteristics of respondents

Feature	Alternative	frequency	%
Sex	Male	37	63
	female	21	37
Age	Under 20	3	6
	21-40	52	89
	41-60	3	6
	Above 60	0	0
Category	Commercial farmer	13	22
	Household farmer	13	22
	Middlemen	3	5
	Employee	12	14
	Consumers	10	19
	Others	7	20
Educational qualification	OND	2	3
	HND	6	10
	BSc	42	74
	MSc	6	10
	PhD	2	3
Area of specialization	Agriculture	17	28
	Animal health	18	31
	Business management	6	13
	Engineering	2	3
	others	14	26
Year of Experience	1-5 years	8	14
	6-10 years	16	28
	11-15 years	9	16
	15-20 years	18	31
	Above 20	7	12

studied area which is ND was the least notified among the respondents (Table 8). In Table 9, the result revealed the affirmation of some of the specific statements by respondents which include the employment opportunities inherent in the poultry industry (74.1%) and the negative impact of outbreak of the diseases on the demand and supply of poultry products (58.6%). High proportion of respondents (87.9%) also stated that vaccination against ND and IBD is a common practice amongst commercial poultry farms in Abuja but 44.6% affirmed that farms lack adequate biosecurity measures

Discussion

In this study, ND was the most reported disease among the viral diseases studied in the selected farms followed by IBD and AI. This is not surprising as it might be attributed to the endemicity of ND in several parts of Nigeria (Salihu *et al*., 2012; Wakawa *et al*., 2014) as well as Abuja (Abraham-Oyiguh *et al*., 2014;

Table 8: Distribution of respondents on awareness of the diseases and notification of outbreaks

Feature	Alternatives	frequency	%
Awareness of the disease	ND	21	35.8
	AI	19	33.9
	IBD	17	30.2
Notification of outbreaks	ND	13	21.0
	AI	25	44.0
	IBD	19	34.0

Keys: ND= Newcastle disease, AI= Avian influenza, IBD= Infectious bursal disease

Table 9: Economic impact of diseases outbreaks and their public health significance

S/N	Statement	SA-A (%)	UD (%)	DS-D (%)	∑fx	M
1.	Poultry industry is an area of massive employment	43(74.1)	10(17.3)	5(8.6)	231	3.9
2.	High consumption of chickens among the public	56(96.5%)	1(1.7)	1(1.7)	265	4.6
3.	Demand for poultry products is unaffected by outbreaks	20(34.5)	6(10.3)	34(58.6)	158	2.7
4.	Presence of adequate biosecurity measures in poultry farms	27(46.5)	5(8.6)	26(44.8)	178	3.1
5.	Vaccination against viral disease is common practice	51(87.9)	5(8.6)	2(3.4)	242	4.2
6.	AI is transmissible to man	40(68.9)	6(10.3)	12(20.7)	211	3.6
7.	ND is transmissible to man	9(15.5)	10(17.3)	39(67.2)	132	2.3

Keys: SA= strongly agree, A=agree, UD= undecided, D= disagree, SD= strongly disagree, ∑fx= summation, M= mean,
Rating of scores: SA= 5, A=4, UD=3, D=2, SD=1
Mean value ≥ 3 indicates the assertion of the statement

Ameh *et al*., 2016). In addition, most of the studied farms were located in close proximity to rural and backyard poultry, meanwhile such association is reported to enhance the transmission of ND virus to unvaccinated flocks (Abraham-Oyiguh *et al*., 2014), Accordingly, the finding of this study was similar to that of Wakawa *et al.* (2014) carried out in the Veterinary Teaching hospital, Zaria as ND was the highest reported cases in both cases. However, the reported occurrence of ND in this study and Wakawa *et al*. (2014) was different which was 28% and 58% respectively, the difference might be related to the comparatively lower number of sampled farms in this study as well as the number of viral diseases reported. The lowest recorded case (7.6%) in the sampled farms which was AI is in accordance to the disease being non-endemic in Abuja and Nigeria at large (Monne *et al*., 2015). In addition, the difference in endemicity might be responsible for the significant difference in the cumulative outbreaks among the farms. In Nigeria, Studies entailing the economic impact of poultry viral diseases have reported a probable substantial fall in chicken production and revenue of farmers (You & Diao, 2007). In this study, although there was no significant difference in the total flock size lost to the various reported diseases, the 4 sampled farms in Gwagwalada and Municipal area of Abuja lost ₦5.3 and ₦3.2 million respectively due to ND outbreaks for the studied period resulting from mortality and culling of birds. ND has been reported to cause heavy morbidity and mortality (Saidu *et al*., 2008). Although, the cumulative loss in monetary terms was highest for ND occurrence, AI represented the most crucial when the mortality rate and monetary losses were considered per outbreak depending on farm productive capacity. In previous studies, outbreaks of AI in commercial farms in Nigeria were reported with high mortality (You & Diao, 2007) as well as the spread to other parts of the country (Monne *et al*., 2008). Furthermore, the economic loss in money terms is similar to the survey results following the outbreak of AI in Abuja in 2006 where estimated farmers lost millions of naira (Ibrahim *et al*., 2010) as well as reports of great reduction in the income of both smallholders and commercial poultry farmers following outbreak of AI (Muteia *et al*., 2011).The highest economic loss due to IBD outbreak was reported in the 2 sampled farms in Gwagwalada which was about ₦5 million. Although, there was no means to evaluate the level of biosecurity retrospectively, the current poor state of biosecurity and absence of a well-defined vaccination schedule in the 2 studied farms in Gwagwalada and 1 in Kuje (small scale) based on the questionnaire survey could be contributory. Teshome *et al*. (2015) reinstated that an optimum biosecurity program remains vital to reduce the spread of IBD in poultry flocks. In Nigeria, IBD has also been reported to be an important cause of economic losses in the poultry industry (Musa *et al.,* 2012) as well as reported outbreaks in vaccinated and unvaccinated birds (Musa *et al*., 2010) .

The outbreak of the viral diseases contributed to drop in production in the various farms as the average loss for the study period for ND, AI and IBD were 3.4%, 4.2%, and 3.52% respectively. Data distribution in this category as well as the contribution of the diseases to the total drop in production amongst the farms was not significantly different ($P > 0.05$). In contrast, finding herein is different from that of Uzochukwu *et al*. (2008) who reported that there have been significant drop in production in poultry farms since the first case of AI. This might be due to different number and location of farms used for the study as well as the variables included to measure the economic impact of the outbreaks. These losses were only on the account of monetary value of dead and culled birds when computed as a proportion of the expected turnover over the years as other factors contributing to reduced production capacity were not included.

Another aspect of the economic loss implored in the study is the series of job loss resulting from the outbreaks of the diseases. In between large scale and small scale farms, the data distribution was statistically significant ($p \geq 0.05$) as the proportion was 43% and 57% respectively. A reason behind this could be the presence of highly skilled workers in the large scale farms that cannot be easily laid off due to their scarcity and importance to the industry which might be lacking in small scale and household farms (Muteia *et al*., 2011). Previously, similar findings related to increasing unemployment have been reported in the outbreak of AI in other parts of Nigeria (Obayelu *et al*., 2007).

The questionnaire survey results revealed different level of awareness and economic impact of the diseases amongst the respondents. Awareness level for ND, IBD and AI was 21%, 34% and 44% respectively. Whilst awareness to the outbreak of ND is the least among the diseases, this might be linked to low level of public sensitization since the disease is endemic in several parts of Nigeria (Salihu *et al*., 2012). In addition, the mild clinical manifestation of ND in man which may go unnoticed has been the reasons why veterinarians have not

made a strong public sensitization of its zoonotic tendencies. Newcastle disease has been reported to cause conjunctivitis in humans but generally mild and self-limiting (Ashraf & Shah, 2014). In contrast, a recent study reported high level of awareness amongst personnel in poultry production on the occurrence of ND and its adverse effect on chickens in Gwagwalada, Abuja (Ameh *et al*., 2016). The difference in awareness level might be the structure of the study design as ours entailed comparing the awareness for different viral diseases. In addition, the distribution and category of the respondents might contribute to the varying level of awareness. It can be deduced from the large percentage of the respondents (44%) on awareness to AI that recent outbreaks in some nearby states in northern part of Nigeria has enlighten the masses in the study region couple with the influence of media in publicizing the disease (Babalola & Babalola, 2011). This contributes to immense sensitization of the people which could hinder the poultry business if not inspected (Babalola & Babalola, 2011). Furthermore, studies have also shown the high tendency of mass media influencing both perception and behavior of consumers (McCarthy & Brennan, 2009). Respondents were indifferent to the efficacy of biosecurity measure in the poultry farms but observation showed that it is still below optimum and need to be improved. Vaccination against ND and IBD was considered a routine plan in most farms as affirmed by 80% of the respondents as this also concur with reports of the endemic state of ND in Abuja (Abraham-Oyiguh *et al*., 2014). A large section of the respondents (74%) affirmed that poultry industry is an area of great employment opportunities in Abuja. This perception might be linked to the categories of respondents which were mainly personnel in the poultry industry such as farmers, poultry workers and stakeholders. In addition, the demand and consumption of poultry products such as chicken and eggs for consumption are on the increase in the studied area. In this survey, about 59% of the respondents agree that outbreak of any of the viral disease affects the demand products of poultry origin. This is in accordance to Obayelu (2007) who revealed that confidence of both consumers and producers was affected by outbreaks of AI as demands for poultry products dropped substantially while farmers contemplated leaving the industry.

In conclusions, the viral diseases studied in this work: Avian influenza, Gumboro disease and Newcastle disease have been demonstrated to be important causes of economic loss in the poultry industry in Abuja. The most prevalent and recurring among the diseases is Newcastle disease (ND) representing 58% of the total outbreaks studied. Moreover, losses in monetary terms due to the outbreaks of these diseases might run into millions of naira depending on the productive capacity.

It is therefore recommended that more in depth studies on the economics of poultry production should be carried out to assess the impact of disease outbreaks on poultry trade and distribution of poultry products. Also, losses in other poultry products such as eggs and poultry feeds could be evaluated in future studies. Finally, research on the economic impact and dynamics of the diseases also needs to be fostered to generate current information and further enlighten the entrepreneurs in the agricultural sector on the gains and pains inherent in poultry production.

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