APPRAISAL OF BIO-SECURITY MEASURES AMONG POULTRY FARMERS IN NASSARAWA STATE, NIGERIA.

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ABSTRACT
The study assessed the bio-security measure employed by poultry farmers in Nasarawa State, Nigeria, the objectives of the research were to examine socio-economic characteristics of the poultry farmers; identify the sources of information on bio-security measures used by farmers; examine the types of bio-security measures adopted by the poultry farmers; determine the factors influencing bio-security measures adopted by the poultry farmers and; examine the constraints associated with the adoption of bio-security measure by the poultry farmers in the study area. Data was collected from randomly selected 60 poultry farmers using well-structured questionnaire and interview schedule. Data were analysed using descriptive statistics and multiple regressions. The result shows that mean age, farming experience and flock size was 35 years, 7years and 6363 birds respectively. Almost all (93.33%) of the respondents had tertiary level of education. The majority (73.33%) of the farmers sourced bio-security information from veterinary officer and co-poultry farmers (58.33%). Major bio-security measures used by farmers include, isolation and quarantine of new birds (WM=3.90), disinfecting vehicles and all equipment before entry into the farm (WM=3.83) and avoiding contaminated feed and stagnant water (WM=3.87). The regression analysis revealed that the factors influencing bio-security measures adopted by the poultry farmers include Age, Farming experience, educational level, cooperative membership and system of poultry farming with an R^2 of 0.3140. The result shows that farmers carry out bio-security measure but have limited knowledge and resources for effective operation. The government, NGOs, and extension agent/workers should educate farmers on the importance and use of bio-security measures and effort should be made to bring down the cost of disinfectants for optimum production.

INTRODUCTION
Bio-security refers to practice designed to prevent the spread of disease onto farms. It is accomplished by maintaining the facility in such a way that there is minimal traffic of biological organisms (viruses, bacteria, rodent, etc.) across its borders. Bio-security are acts of adopting preventive measure designed to reduce the risk of transmission of infectious diseases in crop and livestock, quarantined pests, invasive alien species, and living modified organisms (Koblentz, 2010). Strict bio-security measures, in addition to vaccinations, are strategic prevention and control policies adopted to control some contagious poultry diseases as vaccination alone is not enough to control them under field conditions (Abdu, 2007). To avert human health risks and economic losses, bio-security measures are inevitable in farms. This can be achieved through isolation, limiting number of visitors coming into the farm and/or sanitation measures in addition to good husbandry practices such as adequate feeding, housing and stocking to avoid overcrowding, good ventilation, proper disposal of wastes, cleaning and disinfection of poultry premises help to keep out infections and their spread (Ameji, 2012).

Poor or absent of bio-security practices in farms results in high levels of baseline mortality due to predators (e.g. rodents, snakes, small carnivores) or infectious diseases (e.g. Newcastle Disease (ND), Salmonellosis, Gumboro disease or fowl typhoid) (Ameji, 2012). Initially vaccination was one of the methods in controlling poultry diseases. However, there have been high incidences of vaccination failure partly because of the poor storage due to epileptic nature of electricity supply in Nigeria. Therefore, the only alternative measure to control diseases in poultry farms to enhance production and reduce high mortality rate is through administration of an effective bio-security programs.

The importance of bio-security measures adopted by poultry farmers in order to curb the incidences of diseases attack, reduce mortality rate and enhance maximum production cannot be overemphasized. Focus on bio-security measures used by poultry farmers and the factors influencing the use of such practices is crucial to know the roles of the bio-security measures in improving the growth of poultry sector to meet up with the challenges of the under-supply gap in the economy. It is against this backdrop, the research appraises the bio-security measure employed by poultry farmers in Nassarawa State, Nigeria. The specific objectives of the study are to: examine socio-economic characteristics of the poultry farmers; identify the sources of information on bio-security measures used by farmers; examine the types of bio-security measures adopted by the poultry farmers; determine the factors influencing bio-security measures adopted by the poultry farmers and; examine the constraints associated with the adoption of bio-security measure by the poultry farmers in the study area.

METHODOLOGY

Nassarawa State is one of the 36 States in Nigeria, it is located in the North central part of the country and the State was created in 1996, the capital of Nassarawa is Lafia. The State lies between latitude 7° 45' and 9° 25N of the equator and between longitude 7° and 9° 37' E of the Greenwich meridian. It shares boundary with Kaduna state in the North, Plateau State in the East, Taraba and Benue states in the south while Kogi and the Federal Capital Territory flanks it in the West. The state has a total land area of 26,875.59 square kilometers and a population of about 1,826,883, according to the 2006 population Census estimate with a density of about 67 persons per square kilometer. The major source of income in Nassarawa State is Agriculture; they are notable in the farming of yam, maize potatoes, grains, and other cash crops. The State also has large deposits of solid minerals such has bauxite, emerald, uranium, tantalite, silica, sapphire, gemstone, topaz, mica, columbite, iron and lot more.

In order to achieve the study objectives, primary data were collected using three stage sampling technique. The first stage involved purposive selecting of two (2) Local Governments Areas (Karu and Keffi) (this was done because of the predominance of the poultry farmers in the area) out of the thirteen Local Governments Areas in the state. The second stage involves the selection of two (2) villages from each Local Governments Area using a simple random sampling technique. This gave a total of two villages from each selected Local Governments Area. In the third stage, 15 farmers were randomly selected from each village, thus, the total sample size of 60 respondents were used for the study. Descriptive statistics such as frequency counts and percentages were used to achieve objectives I, II, and IV while, Objective III was achieved using Ordinary Least Square regression. The algebraic specification of the ordinary least square regression model is given as: $Y_i = (\beta_1 x_1) + e$, ---------1

Where: $Y = \alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8 +\beta_9X_9 +\beta_{10}+ U$---------2

Where y = Bio-security measures(perception score)
α = constant term
β1 – β8 = Represents coefficients
X1 = Age (Years)
X2 = Sex (male = 1, female = 0)
X3 = Farming experience (Years)
X4 = Educational level (Years)
X5 = Membership of social organization (group member = 1, Not member = 0)
X6 = Household size (no of persons eating from the same pot)
X7 = Flock size (no birds in the farm)
X8 = System of poultry farming (deep litter = 1, battery cage= 2, both = 3)
X9 = Farm income (Naira)
X10 = Source of credit (Naira)
U = Error term

RESULT AND DISCUSSION

Socioeconomic characteristics of the respondent

The results in Table 1 show that majority (94.99%) of the respondents were between the age of 20 and 50 years, with a mean age of 35 years. By implication, the poultry farmers in the study area are still in their active and productive age. Poultry farming is labour intensive and requires young farmers to cope with the robust bio-security practices including disease management. This is in line with the findings of Eze *et al.* (2017) who stated that young farmers are more willing to venture into poultry farming than the older ones as a result of the high labour requirements needed to manage the poultry birds. Similarly, majority (85%) of were male. This is as a result of the strenuous nature of farm work especially poultry farming which demands much physical energy. This finding agree with the work of Maikasuwa and Jabo (2011) and Uzokwe and Bakare (2013), who reported that the majority of poultry farmers in their studies where male and may be because poultry farming is labour intensive and so scare women out of the venture.

Furthermore, the poultry farmers in the study were literate with majority (93.33%) having tertiary education. High level of education help farmers to embrace innovations and ideas relating to bio-security practices. Eze *et al.* (2017) reported that poultry farming is taken up by people who are highly educated as such could follow prescriptions written on poultry drugs, vaccines and feeds. Equally, the farmers are quite experienced in poultry farming with an average of 7 years of experience. Thus, implying that farmers are well equipped with the experience to understand the complexity involved in production and disease management of poultry birds. This compares favourably with the findings of Ibekwe *et al.* (2015) who indicated that the length of farming experience can potentially provide an opportunity for farmers to manage their poultry farm. The average household of the poultry farmers was five (5), implying a large household size. Farmers with large household size tend to utilize bio-security measures in an effort to reduce disease and gain more sales, since most of them channel their income to family consumption. Large household size may be an advantage in the use of family labour for poultry management but brings about intense competition for limited household resources and food resources (Ibekwe *et al.*, 2015).

With regards to cooperative membership, majority (73.30%) belong to cooperative as it helps farmers to satisfy their innate need of solving their problems through collective efforts (Ameji, 2012). Hence, a good avenue to enlighten farmers on recent trends as it deals with bio-security measures in their farms. Finally, majority (70%) of the respondents keep 1000 – 5000 birds in their farms and the mean flock size

was 6363 birds in the study area. This shows that poultry farmers in the study area are medium scale farmers who own considerable number of birds and are at the risk of disease outbreaks if there are no bio-security measures in place. This agrees with the findings of Eze *et al.* (2017) who stated that the higher the level of asset ownership potentially the greater the bio-security risk.

Table1: socioeconomic characteristics of the respondent

Variable	Frequency	Percentage	Mean
Age (Years)			
Below 25	1	1.67	35
25-50	57	94.99	
51and above	2	3.34	
Sex			
Male	51	85.00	
Female	9	15.00	
Educational level			
Secondary education	4	6.67	
Tertiary education	56	93.33	
Farming experience			
1-5	33	55.00	7
6-10	19	31.67	
Above 10	8	13.33	
Household size			
1-5 people	40	66.67	5
6-10 people	20	33.33	
Cooperative membership			
Yes	44	73.30	
No	16	26.70	
NOs of birds			
<1000	1	1.67	6363
1000 – 5000	42	70.00	
5001 and above	17	28.34	

Source: field Survey, 2018.

Sources of Information on bio-security measures

The result in Table 2 shows that majority (73.33%) of the Poultry farmers in the study area had a strong network connecting with veterinary offices, while slightly above half (58.33%) poultry farmers source their information's from co-poultry farmers.

Table 2: Sources of information on bio-security measures in the study area (n= 60)

Information sources	Frequency*	Percentage
Co-poultry farmers	35	58.33
Veterinary officer	44	73.33
Textbook/internet	19	31.67
Radio	9	15.00
Newspapers	16	26.67
Leaflets/extension agent	10	16.67
Magazine	11	18.33
Pamphlets	7	11.67
Television	25	41.67
Posters	3	5.00
Films	1	1.67
Market of poultry product	18	30.00
Friends and neighbor	12	20.00
Audio/cassettes	1	1.67

Source: Field survey, 2018.*Multiple responses.

This implies that the information from veterinary officers and co-farmers have significant influence on the use of bio-security measures and the ability of the poultry farmers to control diseases related to poultry production in the study area. Good and effective sources of information will help to improve the effective use of bio-security measures. This finding agrees with Eze *et al*. (2017) who reported that information in the hands of the farmer's means empowerment through control over their resources

and decision-making processes. Focus on human resources for increased knowledge and information sharing about agricultural production through appropriate communication methodologies, channels and tools could lead to effective and efficient delivery system of essential information and technology services that will facilitates the clients' critical role in decision-making towards improved agricultural production, processing, trading, and marketing (Vidanapathirana, 2012).

Isolation practices employed by the respondents

The result on Table 3 shows that the major isolation practices employed by the poultry farmers were; isolation and quarantine of new birds (WM=3.90), separating different species of birds (WM=3.88) and isolation of sick birds from healthy birds (WM=3.85). Poultry farmers are therefore able to isolate and quarantine sick birds, recognize disease signs and report such to veterinarians for urgent attention. The adoption of good isolation practices may help to improve the condition of birds which may lead to increased production. This can be buttressed with the suggestion of Mccrea and Bradley (2008) who noted that procedures should be developed for emergency action if a bird in the flock falls ill, is injured, or is found dead. They further reiterated that sick or injured birds should immediately be placed in a quarantine area.

Table 3: Isolation practices employed by the respondents in the study area (n= 60)

Isolation practices	WS	WM	Remark	Rank
Birds of different species kept separate from each other	233	3.88	Agreed	2nd
Keep birds away from pets and pathogens	230	3.83	Agreed	4th
New birds from market should be kept separate, quarantined before joining order flocks	234	3.90	Agreed	1st
Use wire netting to prevent wild birds, pets and other animals from having contact with birds on the farm	222	3.70	Agreed	7th
Sick birds should be isolated from the healthy ones	231	3.85	Agreed	3rd
Birds returning from shows and exhibitions should be isolated.	223	3.72	Agreed	6th
Birds should be kept according to their age groups	208	3.47	Agreed	9th
Prevent visitors from having contact with the birds	223	3.72	Agreed	6th
Poultry house should be far away from public roads and residential houses	218	3.63	Agreed	8th
Stock birds from only reliable sources	229	3.82	Agreed	5th
Isolation of sick birds from health ones are not practiced in the farm	102	1.70	Disagreed	10th

Source: Field Survey, 2018. *Multiple responses

Traffic control practice employed by the respondents

Traffic control practices involve limiting traffic within the farm and controlling the movement of people and equipment to prevent exposure to disease. Table 4 indicates that disinfecting vehicles and all equipment before entry into the farm (WM=3.83) is the major traffic control practice used by the farmers in the study area. Unrestricted movement of people and equipment into poultry houses can introduce very serious diseases (Shama, 2010). This study agrees with the findings of Alhaji and Odetokun (2011), who reported that restricting people's movement in the farms limits the risk of introducing infectious agents into flocks.

Table 4: Traffic control practice employed by the respondents in the study area (n= 60)

Traffic control practices	WS	WM	Remark	Rank
Closing farm gates to prevent easy entry of personnel	218	3.63	Agreed	4th
Use of fence to prevent people from entering the farm	213	3.55	Agreed	6th
Placing of bio-security rules and regulations at the farm entrances	211	3.52	Agreed	7th
Availability of visitor's car park in the farm	189	3.15	Agreed	14th
Disinfecting vehicles and all equipment before entry into the farm	230	3.83	Agreed	1st
Ensuring traffic flow from the youngest to the oldest bird house	197	3.28	Agreed	11th
Ensuring farm workers do not visit other farms during operation	217	3.62	Agreed	6th
Provision of visitors log book that states who enters the farm	191	3.18	Agreed	13th
Restriction of free ranging animals from entering the farm	218	3.63	Agreed	4th
Provision of footbath at the entrance of the poultry house	229	3.82	Agreed	2nd
Provision of protective clothing's and foot wears to visitors	209	3.48	Agreed	8th
Restriction of visits to the poultry unless absolutely essential	208	3.47	Agreed	9th
Disinfection of farm equipment before moving them to other unit	221	3.68	Agreed	3th
Ensuring authorized visitors bath upon entering the farm	200	3.33	Agreed	10th
Traffic control is practiced in the farm.	192	3.20	Agreed	12th

Source: Field survey, 2018. *Multiple responses

Sanitation practice employed by the respondents

The result in Table 5 shows that, the respondents had positive perception/agreement to all the statements bordering on the different sanitation practices with the major practice being avoiding contaminated feed and stagnant water (WM=3.87)**.**

Table 5: Sanitation measures employed by the respondents in the study area (n=60)

Sanitation practices	WS	WM	Remark	Rank
Washing of hands by personnel before and when leaving the farm	208	3.47	Agreed	10th
Disinfection and cloth change by visitors during farm visits	200	3.33	Agreed	11th
Cleaning and disinfecting all equipment used in the poultry house	226	3.77	Agreed	3rd
Avoiding contaminated feed and stagnant water	232	3.87	Agreed	1st
Ensuring specific clothing and foot wear for use in the farm	211	3.52	Agreed	9th
Keeping the poultry house and its environment clean regularly	231	3.85	Agreed	2nd
Ensuring good drainage system for easy cleaning of equipment	212	3.53	Agreed	8th
Engaging in proper waste management	221	3.68	Agreed	5th
Using recommended disinfectants to disinfect the farm premises	224	3.73	Agreed	4th
Equipment such as buckets are regularly cleaned	212	3.53	Agreed	8th
Keep composting area clean before and after use	218	3.63	Agreed	6th
Machinery such as vehicles, trucks, fork lift are cleaned regularly	214	3.57	Agreed	7th
Dirt bins are kept closed regularly except during litter removal	176	2.93	Agreed	13th
Use low pressure water to wash dirt, lice and tick off the birds	177	2.95	Agreed	12th
Footbath or foot dip are provided at the entrance of the farm	215	3.33	Agreed	11th

Source: Field survey, 2018. *Multiple responses

According to Mccrea and Bradley (2008) sanitation is of great importance in poultry houses in other to eliminate disease agents. Disinfectant footbaths may help to decrease the dose of organisms on boots. To maintain efficiency in production and also reduce the cost of production, the need to adopt different sanitation measures in the poultry farm is of paramount importance, this have serious implications in reducing the spread of contagious poultry diseases by people as well as being of public health importance regarding several poultry diseases. On the contrary, this result disagreed with the findings of Ameji *et al*. (2012) and Ambarawati *et al*. (2010) who reported that poultry farmers had poor sanitation practices with the majority of them not having footbath.

Factors influencing bio-security measures adopted by the respondents

Ordinary least squared regression analysis was used to determine the factors influencing bio-security measures adopted by the poultry farmers in the study area. The regression result presented in table 6 reveals that, regression coefficient of age, farming experience, level of education and cooperative membership were positively significant, indicating that an increase in value of these variables, holding others constant will lead to an increase in the adoption of bio-security measures. By implication, older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmer, thus indicating that the se of bio-security measures increases as age increases. This is in line with the findings of Eze *et al*. (2017) reported that, older farmers have higher accumulated capital, more contacts with extension workers, are better preferred by credit institutions and larger family size, all of which may enhance their adoption and use of technologies such as bio-security measures than younger farmers.

Table 6: Factors influencing bio-security measures adopted by the poultry farmers

Variables	Coefficient	Standard Error	T	P>|t|
Age	0.631874	0.3295455	1.92	0.061*
Gender	6.526055	6.368094	1.02	0.310
Farming experience	1.215686	0.4500879	2.70	0.009***
Educational level	2.652813	1.190583	2.23	0.030**
Cooperative member	2.652932	1.57655	1.68	0.099*
House hold size	0.1560859	0.3302683	0.47	0.639
Flock size	0.0000743	0.0002774	0.27	0.790
System of poultry farming	-0.0007251	0.0002452	-2.96	0.005***
Farm income	0.3096564	0.535947	0.58	0.566
Source of credit	0.0744715	0.0560137	1.33	0.190
Constant	208.1735	17.5403	11.87	0.000***
Number	60			
F	2.24			

Prob > F	0.0303**
R^2	0.3140
Adjusted R^2	0.1739

Source: Field survey, 2018.
Key: * implies significant level at 10%, ** implies significant level at 5% and * implies significant level at 1%**

Equally, as farmers' years of farming experience increases the probability of farmers having experience in disease management and other farm practices increases. This could be because farmers with more experience would be more efficient, have better knowledge of bio-security practices and are thus, expected to run a more efficient and profitable enterprise (Oluwatayo *et al.*, 2008). The findings of Eze *et al.* (2017) states that previous experience in farm business management enables farmers to set realistic time and cost targets, allocate, combine and utilize resources efficiently and identify production risks.

In relation to level of education, it is expected that high literacy level will help farmers analyze and understand the rationale of using bio-security measures. Namara *et al.* (2013) reported that education of the farmer is assumed to have a positive influence on farmers' decision to adopt new technology. Education of a farmer increases his ability to obtain; process and use information relevant to adoption of a new technology. This is because higher education influences farmers' attitudes and thoughts making them more open, rational and able to analyze the benefits of the new technology (Eze *et al.*, 2017).

Furthermore, the adoption of bio-security measures increases among farmers who are members of cooperative organizations than those who are not members. This could be because belonging to a cooperative organization enhances social capital, thus allowing trust, idea and information exchange from other farmers. This agrees with the findings of Uaiene *et al.* (2009) who suggested that social network effects are important for individual decisions, and that, in the particular context of agricultural innovations, farmers share information and learn from each other. Hence farmers who belong to social organizations will learn more about bio-security measures and therefore the likely hood to adopt them.

However, the result further shows the regression coefficient of system of poultry farming had an inverse relationship with the adoption of bio-security measures. Therefore, indicating that the use of battery cage system, deep litter or the combination of both systems had a negative influence on the adoption of bio-security practices and might be attributed to the fact that, in the battery cage system, birds hardly come in contact with faeces and equipment. This practice may therefore reduce disease incidence in farms that use this system. Therefore, the farmer may not find it necessary to practice bio-security since he/she may seldom experience disease outbreak in the farm. This corroborates with the findings of Brandy (2012) who reported that using battery cage is important because it is easy to control diseases and parasites. This control can be done without using drugs, which is important to many consumers today who are concerned about drug residues in their food.

The F- value of 2.24 was significant at 5% level of probability indicating the goodness of fit of the overall model. The R^2 was 0.3140, indicating a relationship of 31.40% between the predictors and the predictions. In other words, about 31% of the likelihood of farmers adopting bio-security measures is explained by the independent variables.

Constraints associated with bio-security measures

The data in Table 7, shows that high cost of disinfectants (WM=2.27), limited government irresponsiveness to bio-security measures (WM=2.13), and lack of/or inadequate government policies to empower farmers on bio-security measures (WM=2.10) were the major constraint faced by farmers in the adoption of bio-security measures in the study area. Farmers are unable to afford more disinfectants to disinfect the surroundings of the poultry farms, individuals, vehicles etc. This finding corroborates with the research of Eze *et al.* (2017) who stated that government are lacking extension workers that will inform the farmers on bio-security measures leading to insufficient knowledge on bio-security measures.

Table 7: constraints associated with bio-security measures

Constraints	WS	WM	Remark	Rank
High cost of disinfectants	136	2.27	Agreed	1st
Unavailability of improved bio-security technologies	113	1.88	Disagreed	6th
Inadequate bio-security materials	117	1.95	Disagreed	4th
High cost of bio-security materials	116	1.93	Disagreed	5th
High cost of extension agency on bio-security	110	1.83	Disagreed	7th
Lack of security officers	94	1.57	Disagreed	15th
Lack of control of visitors	103	1.72	Disagreed	12th
Lack of fencing	113	1.88	Disagreed	6th
No visitation of extension agent	108	1.80	Disagreed	8th

Lack of/Inadequate extension programmes directed to meet the bio-security measure	117	1.95	Disagreed	4th
Poor access to bio-security measure	100	1.67	Disagreed	13th
Close distance of houses to poultry farms	107	1.78	Disagreed	9th
Poor agricultural extension service delivery of bio-security	113	1.88	Disagreed	6th
Poor access to or control of bio-security	104	1.73	Disagreed	11th
Poor information on early warning system	107	1.78	Disagreed	9th
Illiteracy of the bio-security measure	105	1.75	Disagreed	10th
Limited Government irresponsiveness to bio-security measure	126	2.10	Agreed	3rd
Lack of/or inadequate government policies to empower farmers on bio-security measure	128	2.13	Agreed	2nd

Source: field Survey, 2018.

CONCLUSIONS

The study has shown that age, farming experience, educational level, cooperative member and system of poultry farming, were found to have significant influence on bio-security measures used by farmers. The study also shows that farmer's use of bio-security measures was high. Also farmers face some Constraints such as high cost of disinfectant which Government or NGOs needs to look into.

RECOMMENDATIONS

Base on the outcome of this research, the followings are recommended:

i. Government should create an avenue to educate poultry farmers on the importance of strict bio-security measures in their farms.
ii. Government and NGOs should employ more extension workers to disseminate bio-security measures to the farmers during their visitation to poultry farms.
iii. Effort should be made by Government and non-Governmental organizations to subsidize the cost of disinfectants.
iv. Farmers should be educated more on poultry production so the will be able to know when and when not to disinfect there poultry farms.
v. Government, policy makers, extension agents, NGOs and related organizations should provide the farmers with subsidy/incentives that will help them build a strong financial base to help them upgrade their farms with sound bio-security measures for increased production.

REFERENCES

Abdu, P. A, (2007). Manual of Important Poultry Diseases in Nigeria (2nd edition), *MacChin Multimedia Designers, Samaru-Zaria,* Pp 1 – 100

Alhaji, N. B., Odetokun, I. A. (2011). Assessment of bio-security measures against Highly Pathogenic Avian Influenza risks in small-scale commercial farms and free-range poultry flocks in the North central Nigeria. *Transbound Emerg Dis,* 58(2):157–161.

Ambarawati, I. G., Bugie, K. & Ian P. (2010). Farmer investment into bio-security on broiler and layer farms; In Bali, Melbourne Australia, pp: 12.

Ameji, N. O. (2012). Knowledge of poultry diseases, bio-security and husbandry practices among stakeholders in poultry production in Kogi State, Nigeria. *Sokoto Journal of Veterinary Sciences,* 10(2):26-31.

Ameji, N. O., Abdu, P. A., Sa'idu, L. & Isa-Ochepa, M. (2012). Knowledge of poultry diseases, bio-security and husbandry practices among stakeholders in poultry production in Kogi State, Nigeria. *Sokoto Journal of Veterinary Sciences,* 10 (2):26-31.

Ameji, O. N., Abdu, P. A., Sa'idu, L. & Isa-Ochepa, M. (2012), Knowledge of poultry diseases, bio-security and husbandry practices among Stakeholders in poultry production in Kogi State, Nigeria, *Sokoto Journal of Veterinary Sciences,* 10(2):26-31

Brandy, R. (2012). The future of confinement housing for egg-laying hens. Farm animal welfare news. BCSPCA Farm Sense.

Eze, C. O., Chah, J. M, Uddin, I. O, Anugwa, I. J, & Igbokwe, E. M. (2017). Bio-Security Measures Employed by Poultry Farmers in Enugu State Nigeria, *Journal of Agricultural Extension,* 21(3): 89-104

Ibekwe, U. C., Chikezie, C., Ibeagwa, O. B., & Onyeoziri, M. N. (2015). Broilers Production among Small Scale Producers in Imo State, Nigeria: A Profit Function Analysis. *International Journal of Research in Agriculture and Forestry*. 2 (1): 40-45.

Koblentz, D., (2010). "Bio-security Reconsidered: Calibrating Biological Threats and Responses," *International Security, 34(4):96-132*.

Maikasuwa, M. A. & Jabo, M. S. M. (2011). Profitability of Backyard Poultry Farming in Sokoto Metropolis, Sokoto State, North-West, Nigeria. *Nigerian Journal of Basic and Applied Science* 19 (1): 111-115 ISSN 0794-5698. Available online at

http://www.ajol.info/index.php/njbas/index.

Mccrea, B. A. & Bradley F. A. (2008). Bio-security for poultry at community farms, *University of California Division of Agriculture and Natural Resources Publication* 8280. ANR CS Web site, http://anrcatalog.ucdavis.edu

Namara, E., Weligamage, P., Barker, R. (2013). Prospects for adopting system of rice intensification in Sri Lanka: A socioeconomic assessment, Research Report 75. Colombo, Sri Lanka: International Water Management Institute.

Oluwatayo, I. B., Sekumade, A. B., Adesoji, S. A. (2008). Resource use efficiency of maize Farmers in rural Nigeria, Evidence from Ekiti State, *World Journal of Agricultural Science*, 4(1):91-99.

Sharma, B. (2010). Poultry production management and bio-security measures, *Journal of Food Agriculture and Environmental*, 1:122.

Uaiene, R., Arndt, C., & Masters, W. (2009). Determinants of Agricultural Technology Adoption in Mozambique. Discussion papers No. 67E

Vidanapathirana, N. P. (2012). Agricultural information systems and their applications for climate variability on poultry production in Ose Local Government Area of Ondo State, Nigeria: Socioeconomic characteristics and perceptions of farmers. *Inter J. Agric. Biosecurity*, 2(1): 39-44.