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DETERMINANTS OF THE LEVEL OF RISK MANAGEMENT AMONG POULTRY EGG FARMERS IN SOUTH-WEST NIGERIA

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Abstract

This study was conducted among 343 poultry farmers to assess the level of risk management in South-western, Nigeria using Ogun State, Osun State, and Oyo State as focal study areas. Multi-stage sampling procedure was employed while descriptive statistics, fuzzy logic, and ordered probit were used to analyse the study data. Majority (98.0%) of the poultry farmers had access to credit while only 2.0% of the farmers insured their poultry farms. Biosecurity, medications, and mitigation were identified as the elements of poultry risk management with 72.60%, 20.5%, and 6.9% respectively in their relative contributions. Majority (73.5%) of the poultry farmers operated at a low level of risk management in the study area. Ogun State had the highest (95.5%) of the poultry egg farmers that were on the low level of risk management while Osun State had the least (66.9%) among the three states. The study also revealed that the factors determining the level of risk management include years of education ($p \leq 0.05$ household size ($p \leq 0.01$), years of experience in poultry farming ($p \leq 0.01$), and mortality rate ($p \leq 0.01$). The study recommended that policy focus of government in Nigeria should be geared towards improvement in the service delivery in which extension agents should improve on information dissemination and enlightening on biosecurity practices to the poultry farmers as a crucial aspect of risk management in poultry farming. Poultry farmers should also be encouraged to utilise livestock insurance policy to safeguard them from future risks.

Keywords: Poultry, Risk management, Fuzzy logic, Ordered probit

Introduction

The significant of risks faced by the agricultural enterprises cannot be over emphasized on its tremendous effect on agricultural production and rural welfare which has placed attention on the risk and uplifted the management of risk to a place of national and global priority with regards to interventions to improve the agricultural sector in the entire regions of the world. Consequently, it is an imperative to develop innovative intervention and policies for manage agricultural risk (Singh and Hlophe, 2017). Production risks associated with production losses. Common causes of production risk in agriculture include climate variations, predators, theft, pests, and diseases. Production risks exist because agribusiness enterprise is affected by

many uncontrollable events that are often related to weather such as unlimited rain or drought, pests and diseases, random physical hazards, and technological failure of the production process (Maluleke and Mokwena, 2017).

Poultry is an important sub-sector of the Nigerian livestock industry as it provides significant proportion of the needed animal protein to the entire populace as well as creating employment for a considerable percentage of the population. Eggs are the primary source of animal protein in which larger population of countries of the world rely on it as their main income source. As a sub-sector of agriculture, the poultry industry is essential for production of eggs which are affordable and rich in protein (Dili, *et al.,* 2022). Despite the enormous contribution of the poultry industry to the national economy, poultry farmers are usually faced with a lot of risks such as drought, flood, fire outbreaks, theft, damage, and several other unplanned events. These risks pose a serious threat to the growth and development of the poultry industry in Nigeria Poultry production risks includes disease outbreak weather-related perils, pests, or predators. It also includes uncertainties such as price or market risk, financial or income risks, personal or human risk (Obike, *et al.*, 2017).

Risk management involves the intensive use of risk management practices which is subjected to determination of severity of risk and development of appropriate strategies to ameliorate the risks until the overall level of risk is reduced to the minimal level (Agboola, *et al.,* 2021). Risk management has for ages been restricted to the use of market insurance to protect individuals and companies from various losses related to accidents and uncertainty. Risk and uncertainty have always existed in all business ventures. However, with the concept of globalization of businesses, risk is now playing a dominant role in the management of organizations. Risk management practices are often considered as appropriate tools to mitigate against these uncertainties which can affect production resources meant for the production activity, resulting in a controversial impact on the overall farm productivity (Victor and Merlin, 2021).

In poultry production which is like other type of agricultural enterprise in which decision is made under risks and uncertainties that are complex inherent. Risk in modern poultry production is certain and is a major concern among poultry farmers that have reliable information to predict accurately things such as input prices, outputs and their prevailing market prices, government policies and climate instability. Risk management in poultry production is crucial and pertinent for the sustainability of the poultry business and its profitability as failure to manage risks effectively can have catastrophic effects on production, farmers' income, market stability, and potential food security (Adeyonu *et*. *al*., 2021).

Available empirical studies on risk management and other management issues associated with poultry production are mostly descriptive analysis and ordinary least square regression model on risk perceptions and coping strategies, risk management strategies and its determinants on farm outputs, and other poultry management. In a study by Adeyonu *et al.* (2021), production risk, financial risk and human risk were perceived by farmers as most important risks in poultry production. Poultry farmers adopted disease prevention and financial management strategies as means to cope with the adverse effects of various risks. Their analysis further revealed that years of poultry keeping, value of poultry output and production risk are important determinants of disease prevention and financial management strategies adopted by the

poultry farmers. Factors that influence disease prevention strategy include years of schooling, household size and human risk, while sex and financial risk are the determinants of financial strategy.

Mbah (2018) investigated constraints to poultry management practices among smallholder farmers in Benue State, Nigeria. It was discovered that poultry management practices include proper sanitation (80%), cull sick birds (76.3%), brooding of chicks (73.8%) and use of disinfectants (70%). Results further indicate that constraints to poultry management include technical, labour, and input related factors. Obayelu *et al.* (2017) noted that 52.5%, 37.5% and 10% of the poultry farmers were risk averse, risk neutral and risk preferring, respectively. About 31.4% and 68.6% of the female and male farmers respectively were risk averse. Close to a fifth, a quarter and two-thirds of the risk averse, risk neutral and risk takers respectively contributed 21-30% of the decisions in the associations. The choice of being risk averse was affected by marital status, educational level, family size, percentage spent on poultry income and aggregate social capital. There was no reverse causality between risk attitude and social capital.

Obike *et al.* (2017) conducted research on risk management and determinants of farm output among small scale poultry farmers in Ekiti State, Nigeria. The results of the study showed that production, financial, marketing, technological and human risks were the major sources of risks encountered by the poultry farmers. Risk management practices among the farmers are enterprise diversification, marketing, and production strategies. The result of the multiple regression model revealed that age, household size, stock size, capital input, farming experience, location, cost of medication and cost of labour ($p<0.01$) were the major determinant of farm output among poultry farmers. However, none of these studies has considered the assessment of level risk management and determinant of exposure to production risks among the poultry farmers. Therefore, this study contributes to the literature on risk management in poultry production through the assessment of the level of risk management and analysis of its determinant factors in South-west, Nigeria. The specific objectives are to:

(i) identify elements of dimensions and attributes of risk management in poultry,
(ii) compute risk management index in poultry production,
(iii) estimate the level of risk management, and
(iv) analyse the determinants of risk management in poultry production.

Methodology

Area of Study:
The study was carried out in Southwest, Nigeria where the bulk of backyard and commercial poultry production system is based. Oyo, Osun, and Ogun States were selected as the study area. Osun State has 30 Local Government Areas with a projected population of 4.7 million by the year 2020 (NPC, 2006) and a land area of 14,875 km^2 on latitude 5^0N and 8^0N; between longitude 4^0E and 5^0E. Oyo State has 33 Local Government Areas with a projected population of 7.8 million by the year 2020 (NPC, 2006). The land area is 35,743 km^2 located within latitude 3^0N and 5^0N; between longitude 7^0E and 9.3^0E. Ogun State has twenty Local Government Areas bordered to the east by Ondo State and to the north by Oyo and Osun states. Its border with the Republic of Benin to the west makes it an access route to the expansive market of the

Economic Community of West Africa States (ECOWAS), and it is bordered to the south by Lagos State and by the Atlantic Ocean. The state covers about 16,762 square kilometer which is approximately 1.81 percent of Nigeria's landmass of about 923,768 and a projected population of 5.2 million by the year 2020 (NPC, 2006).

Source and Type of Data**:**
Primary data were obtained with the aid of structured questionnaire that captured socio-economic characteristics of small-scale poultry egg farmers and farm characteristics. These include the age of the poultry farmer, sex, level of education, layer rearing experience, household size, access to livestock insurance, sources of credit, stock size, and mortality rate. Also, information was sought on various risk management practices. This study adapted stock size classified by Arowolo, *et al.,* (2012). Farms having between 500 and 2000 birds were considered as small stock-size farms, those farms having more than 2, 000 birds were regarded as a medium while those having 10, 000 birds and above is classified as large stock size farms. This study captured small scale poultry egg farmers.

Data Collection and Sampling Procedure:
A multi-stage sampling procedure was employed in selecting the poultry farmers in the study area. The first stage was the purposive selection of Ogun, Osun, and Oyo States from the six states in Southwest, Nigeria; based on the prominent poultry production in the Southwest, Nigeria (FDLPCS, 2007). The second stage involved the purposive selection of five (5) Local Government Areas (LGAs) from Ogun State and four (4) Local Governments from Osun State and six (6) local Governments from Oyo State. The size of the local governments chosen from each state was based on available records of registered members of the Poultry Association of Nigeria (PAN) in which Oyo State has the highest number of poultry farmers.

The purposive selection of the local governments in each state was based on those with the highest number of registered members of the Poultry Association of Nigeria (PAN) using purposive sampling technique. Local governments selected in Ogun State include Abeokuta North, Egbado North, Odeda, Remo North, and Sagamu. In Osun State, Iwo, Ejigbo, Irepodun, and Ilesa West were selected. Egbeda, Lagelu, Atiba, Oyo East, Ona Ara, and Oyo West local governments were selected in Oyo State. The third stage was the random selection of one hundred and twenty (120), one hundred (100) and one hundred and forty (140) poultry egg farmers selected from Ogun, Osun, and Oyo States respectively proportionate to the size of registered members of the Poultry Association of Nigeria (PAN) in each state. Also, the number of farmers selected in each selected Local Governments Area is proportionate to the size of registered members of the Poultry Association of Nigeria (PAN) in each LGAs. In all, three hundred and sixty (360) poultry farmers were sampled. However, due to incomplete responses, only three hundred and forty-three (343) copies of questionnaires were used for the analysis. According to Bzugu *et al*., (2019) the proportionality factor used in the selection of poultry egg farmers is stated as:

State	Proportionality factor
Oyo	$N_i = \frac{n_i}{N} \times 140$
Osun	$N_i = \frac{n_i}{N} \times 100$
Ogun	$N_i = \frac{n_i}{N} \times 120$

Where:

N_i = the number of poultry egg farmers selected from local government *i* in each state (for Ogun State *i* =1 to 5, *i* =1 to 4 for Osun State, and *i* =1 to 6 for Osun State)

n_i = the number of poultry egg farmers in local government *i*

N = total number of poultry egg farmers in all the selected local governments in each state.

Analytical techniques:

The study employed analytical tools based on the stated objectives. They include descriptive statistics, fuzzy logic model, and Ordered Probit Model

Fuzzy Logic Model:

Fuzzy logic model was adopted to estimate the risk management level index based on poultry farmers' decisions in the application of various risk management strategies in their poultry farm. The term fuzzy was proposed by Zadeh, 1965, and adapted by Omomule, *et al.* (2020). To determine the level of risk management, let X be a set of poultry egg farms (i=1, 2, 3… n) and P, a fuzzy subset of X. In the fuzzy approach $F_p(x)$, the membership function of the level of biosecurity of poultry farm i is defined as in Equation 2 thus:

x_{ij} = 1 if farm i is of high-level risk management (1)

$0 \leq x_{ij} \leq 1$; if farm i reveals a partial degree of level of risk management.

First stage (Estimation of Membership Function): The determination of the individual membership function $F_P(x_i)$ depends on the type of variable. The variables that define indicators of biosecurity index are either dichotomous or categorical.

Dichotomous Variables in the poultry farm: Following Costa (2002), the degree of membership to the fuzzy set P of the a_i^{th} chicken egg farm (i=1, 2… n) for the j^{th} attribute (j=1….m), is stated in Equation 2:

$$F_p = (a_i)j = X_j(a_i) = x_{ij} \quad (2)$$

$X_j(a_i)$ is the m order of attributes that will result in a state of risk management if totally or partially owned by the a_i^{th} farm.

Categorical Variable**:** Ordinal or categorical discrete variables are those that present several modalities (more than two values). The lowest modality is denoted as $C_{inf,j}$ and the highest modality as $C_{sup,j}$, then, following Cerioli and Zani (1990); Costa (2002); Dagum and Costa (2004), the membership function of the

a_i^{th} farm is expressed in Equation 3:

$$F_p(a_i) = 1 \text{ if } 0 < C_{ij} \leq C_{inf,j}$$
$$F_P(a_i) = \frac{C_{sup,j} - C_{ij}}{C_{sup,j} - C_{inf,j}} \text{if} C_{inf,j} < C_{ij} < C_{sup,j} \quad (3)$$
$$F_p(a_i) = 0 \text{ if } C_{ij} \geq C_{sup,j}$$

The risk management index (MI) of the a_i^{th} poultry farm, $F_P(a_i)$ (the degree of membership of the a_i^{th} farm to the fuzzy set P) is defined as the weighted average of x_{ij} as shown in equation:

$$F_p = \sum_{i=1}^{n}(a_i)n_i \,/\, \sum_{i=1}^{n} n_i \quad (4)$$

F_p is the Risk management index (MI) for the population of poultry egg farms studied is expressed as equation 5:

$$F_p = \sum_{i=1}^{n} F_{P(a_i)n_i} / \, n \quad (5)$$

Estimation of Weight**:** The degree of attainment of the selected risk management index (RMI) is expressed by equations 4 and 5. It is conceptualised as equation 6:

$$F_p = \sum_{j=1}^{m} x_{ij} w_j \,/\, \sum_{j=1}^{m} w_j \quad (6)$$

Where w_j is the weight given to the j^{th} attribute and $x_{ij}n_i$ is the average membership function of attributes in equation 7 as:

$$w_j = logn \sum_{i=1}^{n} x_{ij}n_i \geq 0 \quad (7)$$

Computation of Risk Management Index (RMI)
Equation (8) expresses the risk management index (RMI) of the j^{th} attribute for the entire population of *n* poultry farms. Equation 8 is expressed as:

$$F_p = \sum_{i=1}^{n}(a_i)n_i \,/\, \sum_{i=1}^{n} n_i = \sum_{i=1}^{n} F_{P(a_i)n_i} / \, n \quad (8)$$

Estimation of Level of Risk Management:
The level of risk management was estimated from the index generated in equation (8). The level of risk management was categorised following Lestari *et al.* (2011); Akintunde and Adeoti (2014) as (1) Low level (0 up to 0.33); (2) Moderate level (0.34-0.66) and (3) High level (0.67-1.0). Risk management practices attributes were selected following Lestari *et al.* (2011) as shown in Table 1.
Ordered Probit Model:

The ordered Probit Model was used to model relationships between a polytomous response variable which has an ordered structure and a set of regressor variables (Van Der Ark, 2001). It is a widely used approach to estimate models of ordered types. The ordered Probit Model is built around a latent regression in the same manner as the binomial Probit Model. The standard Ordered Probit Model is widely used and more acceptable compared to ordered Logit because the former follows a symmetric normal distribution while the latter follows a logistic distribution to analyzed discrete data and is built around a latent regression of the following form:

$$y^* = x'\beta + \varepsilon \quad (9)$$

Here x and β are standard variable and parameter matrices, and ε is a vector matrix of normally distributed error terms. Predicted grades (y^*) are unobserved.

The ordered Probit Model is an ordered dependent variable model in which the observed Y is a product of ranked categories. The Y was modelled by considering a latent variable Y_i^* which depends linearly on the explanatory variable X_i;

$$Y_i^* = X_i'\beta_i + \varepsilon_i \quad (10)$$

Where:
ε_i is a vector of random error terms,
The observed Y_i is determined from the latent variable thus,

$Y_i = 0$ *if* $Y_i \leq \theta_1$
$Y_i = 1$ *if* $\theta_1 < Y_i^* \leq \theta_2$
$Y_i = 2$ *if* $\theta_2 < Y_i \leq \theta_3$
$Y_i = n$ *if* $\theta_n < Y_i^*$

The probabilities of observing each value of Y are given by,

$$\Pr(Y_i = 0 | X_i, \beta, \theta) = F(\theta_i - X_i\beta) \quad (11)$$
$$\Pr(Y_i = 1 | X_i, \beta, \theta) = F(\theta_2 - X_i\beta) - F(\theta_1 - X_i'\beta)$$
$$\Pr(Y_i = 2 | X_i, \beta, \theta) = F(\theta_3 - X_i'\beta) - F(\theta_2 - X_i'\beta)$$
$$\Pr(Y_i = n | X_i, \beta, \theta) = 1 - F(\theta_n - X_i'\beta)$$

Where F is the cumulative distribution function of ε
The threshold values θ are estimated along with the coefficients β by maximizing the log-likelihood function.
The independent variables are itemized below:
Poultry farmers' socio-economic and demographic characteristics:
X_1 = Age of farmers (years)
X_2 = Years of education (years)
X_3 = Household size (number of persons)
X_4 = Labour (man-days)
X_5=Poultry rearing experience (years)
X_6 = Access to Extension services (dummy = 1 if yes, 0 otherwise)

X_7= Access to Credit (dummy = 1 if yes, 0 otherwise).
Poultry Farms' characteristics:
X_8= Stock size (number of layers stocked)
X_9 = Mortality rate (%)
X_{10}= Parent stock (dummy = 1 if pullets, 0 otherwise)

Results and Discussions

Socio-Economic Characteristics of Poultry Farmers:
Table 2 presents the socio-economic characteristics of poultry egg farmers. More than three-quarter (74.3%) of the poultry egg farmers are male which indicates that poultry egg farming is still predominantly a male occupation likely because of the high level of risk involved, labour intensity, and other husbandry processes which might be burdensome to women. Consistent with this finding is the findings of Awogbemi *et al.* (2018) and Adeyonu *et al.* (2021)**.** More than three-quarter (75.9%) of the poultry egg farmers are below 50 years which implied that most of these poultry farmers were in their active and productive years that can easily understand and adopt innovations that could enhance the productivity of egg poultry production.

More than half (56.3%) of the farmers were educated above secondary education. This level of education is expected to positively affect their attitude towards the adoption of scientific techniques to improve their level of disease management on the farm as also reported by Adeyonu *et al.* (2021). Majority (84.0%) of the poultry egg farmers are married which indicates that they might have family responsibilities to bear and may hamper funding of the poultry farm. The average poultry egg farming experience is nine years. This is expected to manifest in a high level of disease management as the longer the years of layer rearing experience, the more exposed the farmer becomes and the more efficient the farmer is expected to be in disease management (Mbah, 2018). About three-quarter (69.4%) of the poultry farmers are risk-averse while few (25%) are risk-takers as confirmed in the similar study conducted by Obayelu *et al*. (2017). Majority (85.4.0%) of the poultry farmers have access to credit while only 2% of the farmers insured their poultry farms as shown in Table 2. The implication of this result is that mitigation option in risk management is low among the poultry egg farmers in the study area despite the fact that they have access to credit.

The result in Table 2 shows that the half (51.3%) of the poultry egg farmers stocked more than 1,000 layers and less than 1,500 layers, few (25.7%) of the farmers reared more than 1,500 layers. The mean stock size is 1624 ± 839 layers. The mean stock of poultry kept implies that the poultry farmers are small-scale farmers (Adeyonu *et al.*, 2021), and it is expected that they should ordinarily be able to manage their farms adequately with the small scale of operation.

Multidimensional Risk Management Index:
The contribution of each dimension to the multidimensional risk management index shows that biosecurity risk control contributed largely (72.6%) to explaining the overall degree of risk management practices in poultry production as shown in Table 3a and 3b as computed using equation (7) in the methodology section. Medication strategies contributed 20.5% while the contribution of mitigation was the lowest (6.9%) in the

category. The finding of this study revealed that the relative contribution of disease biosecurity to poultry risk management is high relative to medication and insurance. The membership function for each attribute and the weights for the attributes from Fuzzy Logic analysis were further utilised to determine the risk management level as presented in Table 4.

Risk Management Level:
Table 4 revealed that Ogun State had the highest (95.5%) of the poultry egg farmers that were on the low level of risk management while Osun State had the least (66.9%) among the three states. Generally, the majority (73.5%) of the poultry egg farmers in Southwest Nigeria operated at a low level of risk management as shown in Table 4. Also, 21.0 % was at a moderate level while few (5.5%) were at a high level of risk management.

Determinants of Risk Management in Poultry Egg Production:
Table 5 presents the result of an ordered probit model to analyse the determinants of poultry egg farmers' level of risk management. The level of risk management is categorized as high, moderate, and low. These formed the dependent variable as ordered 3, 2, and 1 respectively. The log pseudo-likelihood of 227.2 and chi-square of 0.0001 reveals that the model is statistically significant. Years of education of the poultry farmers are significant ($p \leq 0.05$) level and had a negative effect on the level of risk management. The marginal effect of years of education revealed that a year increase in education of poultry farmers decreases the probability of risk management level by 1.4%. This might be due to a lack of total dedication and commitment to those poultry farmers with higher degrees because they might consider the poultry business as a means of supplementary to income earned elsewhere. However, this finding disagrees with Adeyonu *et al.* (2021), who found out a positive correlation between the level of education and skill of farmers.

Household size was found to be significant ($p \leq 0.01$) and positively increases the level of risk management. Household size increases the probability of risk management level by 4.4%. This shows that the larger the household size, there is a tendency for more hands to assist the poultry farmers in disease management consequently improving the level of risk management. This is in line with the findings of Obike *et al.* (2017) who established positive relationship between household size and risk management of small-scale poultry farmers. Years of experience was significant at ($p \leq 0.01$) level and shows a positive relationship with the level of risk management. A year increase in the years of experience increases the likelihood of risk management by ($p \leq 0.01$). It is expected that with more years of poultry farming; there is a tendency for poultry farmers to be well acquainted with a rudimentary knowledge of poultry management. This agrees with the assertion that the longer the years of poultry keeping experience, the more exposed the farmer becomes, and the more efficient the farmer is expected to be in risk management (Obike *et al.* 2017; Adeyonu *et al.,* 2021). The mortality rate was significant at 10% and had a negative sign. Its marginal effect revealed that a unit decrease in number of death of birds increases the probability of risk management by 0.8%. This result implies that with a decrease in the level of mortality rate, there is a tendency for the poultry farmers to be relaxed in risk management strategies. This finding is in consonance with Victor and Merlin (2021 who observed a negative effect of birds' mortality on risk management in poultry production.

Conclusion and Recommendations

The empirical findings emanating from this study revealed that poultry farming is dominated by male farmers. Most of the poultry egg farmers were married and in their active age with an average of nine years of poultry farming experience. More than half of the farmers were educated above secondary education. Most of the poultry farmers had access to credit while almost all the farmers did not insure their farm. Most of the poultry farmers operated at a low level of risk management. Household size and years of experience had a positive effect on the level of risk management. Also, education and birds' mortality had a negative effect on the risk management level. Arising from the findings of this study and the conclusion drawn that most of the poultry farmers operated at a low level of risk management, the study recommends that policy focus should be geared towards enlightenment campaigns on the significance of biosecurity as a crucial component of poultry disease risk management. They should make sure that strict hygienic conditions and biosecurity rules are implemented in the poultry farm to avoid disease outbreak and to comply with the instructions of the animal health professionals. The extension agency in Nigeria should, therefore, be mandated to disseminate improved biosecurity practices and better medication techniques that will improve the present low level of risk management in poultry production in South-western Nigeria.

The mitigation option using livestock insurance policy was very low amongst the poultry egg farmers in the study area. Poultry birds are primarily exposed to the risk of death caused by various types of diseases. In many cases, epidemic diseases can cause catastrophic losses from the deaths of the entire stock of livestock. The study also recommends that poultry farmers should be encouraged by extension agents to participate in a livestock insurance policy, while adequate dissemination of knowledge on the benefits of livestock insurance by extension agents is crucial, to increase the level of participation of poultry farmers in the use of livestock insurance, to mitigate against disease outbreak in poultry enterprise.

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Table 1: Dimension and Attributes for Risk Management Index in Poultry Production

Dimension	Attributes	Categories
Biosecurity	Location of farm	Poultry farm's distance from public roads, poultry farm's distance from the next poultry farm, and poultry farm's distance from a pond or lake.
	Traffic on and off the farm	Poultry farm has a gate; poultry farm is surrounded by a fence and disinfection of vehicles that come to the poultry farm.
	Pest management of other livestock and animals.	Rodent control plan, keeping grass and weeds trimmed around the poultry house, regular checking, and repairing of wire screening on the sides of the house, and control of other livestock within 50 metres of the poultry houses.
	Poultry house cleaning and disinfection	Total cleanout of the facility, the time interval of litter removal, litter that is removed is stored in a covered shed, litter is composting in an approved composting facility, spreading of litter on fields adjacent to the poultry houses, and regular cleaning and disinfection of feed bin and boot.
	Poultry farmer's hygiene	Wearing the street clothes or shoes in the poultry houses, separate cap and pair of coveralls for each house, separate pair of boots for each house, disinfectant dip pans at every poultry house entrance, the time interval of changing the disinfectant, and visitors who wish to enter the poultry houses must wear clean, sanitized caps, overalls, gloves, and boots.
	Flock Health Care and Monitoring	The time taken to learn more about the types of diseases that affect poultry, stocking multiple age groups of layer chickens on the farm, and specific employees caring for the different age groups.
Medication	Vaccination	Vaccination of chicken for agents known to have caused problems on the farm in the past and vaccination of day-old chicks is done at the hatchery.
	Vaccination Programmes	Application of Immucox vaccine at 1-5 days, Marek vaccine at 1 day old, Newcastle Disease Vaccine 1/0 at one-day-old chicks, 1st Gumboro vaccine at 8-10 days old and 2nd vaccination a week after, Newcastle Disease Vaccine Lasotaat 2nd week and 5th week, vaccination against Fowl Pox at 8 weeks, Newcastle Disease Vaccine Komorov at 12th week and routine Newcastle Disease Vaccine Lasota every month.
	Drugs	The time interval of a routine deworming, time interval of routine application of antibiotics, and weeks at which delousing is done.
	Veterinary services	Contact with a veterinary doctor and regular examination of sick or dead layer chickens.
Mitigation		Use of livestock insurance.

Source: Adapted from Ritz (2011).

Table 2: Socio-economic Characteristics of Poultry Egg Farmers

Characteristics	Frequency	Percentage (%)
Age		
≤ 29	23	6.7
30-39	101	29.5
40-49	136	39.7
≥ 50	83	24.1
Mean = 42.0	S.D = 8.86	
Sex		
Male	255	74.3
Female	88	25.7
Marital Status		
Single	36	10.5
Married	288	84.0
Divorced	7	2.0
Widowed	12	3.5
Household Size		
≤ 3	53	15.5
4 – 6	244	71.1
≥ 7	46	13.4
Mean = 5.0	S.D = 2.0	
Level of Education		
Adult Literacy Training	9	2.2
Primary	32	9.7
Secondary	109	31.8
Tertiary	193	56.3
Poultry Keeping Experience		
≤ 5	50	14.6
6 – 10	218	63.6
11 – 15	46	13.4
≥ 16	29	8.5
Mean = 9.0	S.D = 5.4	
Risk Behaviour		
Risk Averse	238	69.4
Risk Neutral	86	25.0
Risk Taker	19	5.6
Access to Credit		
No	50	14.6
Yes	293	85.4
Use of Livestock Insurance		
No	7	2.0
Yes	336	98.0
Access to extension services		
Yes	100	29.2
No	243	70.8
Stock Size		
500-1000	79	23.0
1001-1500	176	51.3
≥ 1500	88	25.7
Mean = 1624 birds	S.D = 839.0	

Source: Field Survey Data, 2018.

Table 3a: Absolute and Relative contributions to Poultry Risk Management Index

Attributes	Absolute Contributions	Relative Contributions
Biosecurity		
Poultry farm's distance from public roads	0.0700	5.4544
Poultry farm's distance from the next poultry farm	0.0170	3.6425
Poultry farm's distance from a pond or lake	0.0136	4.5688
Poultry farm has a gate that restricts vehicle access	0.0114	3.6133
Poultry farm is surrounded by a fence	0.0258	3.4947
Disinfection of vehicles that come to the poultry farm	0.0413	6.2365
Rodent control plan	0.0226	2.6015
Keeping grass and weeds trimmed around the poultry house	0.1099	2.1359
Regular checking and repair of wire screening on the sides of the house	0.1219	1.6392
Control of other livestock within 50 metres of the poultry houses	0.0165	2.8115
Recent total cleanout of facility	0.1053	2.4613
Time interval of litter removal	0.1103	2.0995
Litter that is removed is stored in a covered shed	0.0192	2.6113
Composting litter in an approved and properly managed composting facility	0.1087	2.6475
Litter is not spread on fields adjacent to the poultry houses	0.0165	2.9384
The feed bin, boot, and auger are regularly cleaned and disinfected	0.0103	2.0782
Wearing street clothes or shoes in the poultry houses	0.0224	1.6585
Separate cap and pair of coveralls for each house	0.0098	2.8814
Separate pair of boots for each poultry house	0.0097	2.7816
Disinfectant dip pans at every poultry house entrance	0.1058	2.7233
The time interval of changing the disinfectant	0.1126	3.4456
All visitors who enter poultry houses must wear clean, sanitized caps, coveralls, and gloves.	0.0112	2.5486
The time taken to learn more about poultry diseases	0.01092	2.2167
Multiple age groups of birds on the farm	0.01563	2.4113
Specific employees caring for different age group	0.0224	3.2325 **(72.60)***

Source: Field Survey Data, 2018.

* Sum of Relative Contributions for Biosecurity Practices.

Table 3b: Absolute and Relative contributions to Poultry Risk Management Index

Attributes	Absolute Contributions	Relative Contributions
Medication		
Birds are only vaccinated for agents known to have caused problems on the farm in the past	0.0324	2.6838
Vaccination of day-old chicks is done at the hatchery	0.0376	0.1332
Application of Immucox vaccine at 1-5 days	0.0113	0.3811
Application of Marek vaccine at 1 day old	0.0107	0.1397
Newcastle Disease Vaccine 1/0 at one-day-old chicks:	0.0117	0.2126
Vaccination of 1st Gumboro vaccine at 8-10 days old and 2nd vaccination a week after	0.0112	0.2595
Application of Newcastle Disease Vaccine Lasota at 2nd week and 5th week	0.1109	0.2413
Vaccination against Fowl Pox at 8 weeks	0.0217	0.2156
Application of Newcastle Disease Vaccine Komorov at 12th week	0.2208	0.2496
Routine Newcastle Disease Vaccine Lasota every month	0.0206	0.2312
Time interval of routine deworming	0.2236	1.0566
Time interval of routine application of antibiotics	0.1232	0.3448
Weeks at which delousing is done	0.0047	1.3068
Frequency of contact with a veterinary doctor	0.2124	2.6643
Regular examination of sick or dead birds	0.2103	3.6835**(20.50)***
Mitigation		
Use of livestock insurance	0.0081	2.3947 **(6.90)***
Total	**0.3383**	**100%**

Source: Field Survey Data, 2018.

Table 4: Distribution of Risk Management Level of the Poultry Egg Farmers

State	Risk Management Level		
	Low (0 up to 0.33)	Moderate (0.34-0.66)	High (0.67-1.0)
Ogun	93 (95.5%)	31 (27.3%)	6 (7.2%)
Osun	67 (66.9%)	19 (19.1%)	5 (5.0%)
Oyo	92 (89.6%)	22 (25.6%)	8 (6.8%)
Total	252 (73.5%)	72 (21.0%)	19.0 (5.5%)

Source: Field Survey Data, 2018.

Table 5: Determinants of Risk Management in Poultry Egg.

Variables	dy/dx	Std. Err.	t value	P>|z|
Age	0.0221	0.0315	0.70	0.482
Education	-0.0139**	0.0060	-2.30	0.021
Household size	0.0436***	0.0154	2.83	0.005
Rearing Experience	0.0097**	0.0046	2.10	0.036
Credit	0.0523	0.0491	1.06	0.287
Stock size	0.00003	0.00002	1.18	0.237
Extension Access	-0.0162	0.0514	-0.32	0.752
Mortality	-0.0084*	0.0043	-1.91	0.056
Hired Labour	0.0030	0.0029	1.06	0.289
Breeds	-0.0025	0.0156	0.16	0.873
Log likelihood	227.2			
Prob> Chi^2	0.0001			
Wald Chi^2	34.68			
Pseudo R^2	0.070			

Source: Field Survey Data, 2018.
*Significant at 10%; ** Significant at 5%; *** Significant at 1%