NATIONAL AGRICULTURAL AND FOOD CENTRE
RESEARCH INSTITUTE FOR ANIMAL PRODUCTION NITRA

Slovak J. Anim. Sci., 57, 2024 (4): 41–50
ISSN 1337-9984, E-ISSN 1338-0095
SCICELL

PRODUCTION CHALLENGES OF COMMERCIAL LAYING HEN AND FARMERS' MITIGATION STRATEGIES

Samuel Kehinde ODETOLA[1], Sikiru AJIJOLA[2*], Ayodeji Babatunde IDOWU[2], Taiwo Timothy AWOYEMI[1], Bright IRHIVBEN[1]

[1]Department of Agricultural Economics, University of Ibadan, Nigeria
[2]Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria

ABSTRACT

Laying hen farming is an important sub-sector of the Nigerian livestock industry as it provides significant proportion of the needed animal protein to the populace as well as creating employment opportunities. Despite the significance of the laying hen industry to the national economy, farmers are usually faced with a lot of risks and uncertainties such as heat stress, flood, fire outbreaks, theft and unpredicted damages. They pose serious threat to the success of the laying hen farming enterprise in Nigeria. A multi-stage sampling technique was employed in selecting Laying Hen Farmers (LHF) in Lagos and Oyo States. The first stage was the purposive selection of Lagos and Oyo states in South-west (SW) being the highest poultry production areas in the SW, Nigeria. The second stage involved the selection of six Local Government Areas (LGAs) from Lagos state and eight Local Governments from Oyo state. The third stage was the random selection of one hundred and ninety-eight (198) and three hundred and nine (309) laying hen farmers selected from Lagos and Oyo State, respectively, giving a total of five hundred and seven (507) laying hen farmers selected for the study. Majority have access to credit facilities (87.1 %) and extension services (84.7 %), while there was poor access to insurance across the locations. The most prevalent production risks among the LHF were attack of predators, pest and disease infestation. Age, education and livestock insurance reduced the probability of exposure to production risks, while household size, access to extension and distance to residence increased the probability of LHF exposure to production risks. Educational status, flock size, access to livestock insurance and access to credit significantly increased TFP, while farming experience, feed quantity, hired labour and extension access reduced TFP. The probit results show that age, household size, education, access to resources and insurance significantly affect production risks.

Key words: mitigation strategies; laying hens; production challenges; farmers; total factor productivity

INTRODUCTION

Agricultural productivity have been assessed among countries to examine productivity gaps, technological challenges and inefficient production in several countries and overseas trade boundaries. A production is efficient when there is maximum production of output using less than the required inputs with the lowest possible unit cost. Laying hen production in Nigeria amount up to 454 billion tons of meat and 3.8 million eggs per year with standing population of 180 million birds. About 80 millions laying hens are raised in extensive system, 60 millions in semi-intensive system and 40 millions in intensive system (Akinola, 2014).

The significance of the poultry industry cannot be overemphasized as the industry has been described as the fastest mean of bridging the protein deficiency gap prevailing in Nigeria (Nwadu *et al.*, 2016). Laying hen farming is an important sub-sector of the Nigerian livestock industry as it provides significant proportion of the needed animal protein to the populace as well as creating employment for a considerable percentage of

Correspondence: E-mail: ajsik1967@yahoo.ca
Sikiru Ajijola, Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria

Received: May 22, 2024
Accepted: September 23, 2024

https://doi.org/10.36547/sjas.915

the population (Obike *et al.*, 2017). FAO (2018) reported that the poultry sub-sector comes fourth amongst sources of animal protein for human consumption in Nigeria and contributes about 27 % of the national meat production.

Laying hen production system in Nigeria includes free-range system (extensive): semi-intensive system and intensive system. Intensive system of laying hen production is the focus of this study. In this system, farmers keep more than 2000 exotic birds of one species, producing either meat or eggs for the market. This system ranges from small, medium to large scale commercial enterprise and high premium is given to stock breed, feeding, housing and health. This system is dominant in the southern region of the country. The classification of birds in line with small, medium and large scales are 250 – 1900, 2000 – 5000 and 5000 – 12000 birds, respectively. Also, its prevalence as the extensive system in the study area corroborated the reports of Oguntunji and Ayorinde (2015) that the extensive management system, feeding of low-quality feed, provision of substandard housing and absence of routine veterinary care were practiced by majority of duck farmers in Nigeria.

Despite the significance of laying hen industry to the national economy, laying hen farmers are usually faced with a lot of risks and uncertainties such as heat stress, flood, fire outbreaks, theft and damages, whose occurrence cannot be readily predicted. They pose serious threat to the success of the laying hen farming enterprise in Nigeria. Other problems include high and rising costs of production inputs such as feed, day-old chicks, medications and low level of technical expertise (Ogundipe and Sanni, 2002). These problems to a large extent have reduced the number of poultry enterprises in Nigeria and also contributed to the low intake of protein from animal sources in the nutrition of most Nigerians (Dietmar, 2005; Abotsi *et al.*, 2014).

Previous studies (Effiong *et al.*, 2014, Obike *et al.*, 2017 and Nwadu *et al.* 2016) have been carried out in Nigeria on poultry risks management. Despite these studies, the problem undermining laying hen productivity persists, an indication that some areas still need to be explored and addressed for proper planning and well-targeted policy. Governmental efforts aimed at bridging the demand-supply gap in terms of protein production, in which laying hen products (egg and meat) is one of the major sources, has not yielded any appreciable results.

Over the years, there has been more consumption and more importation of laying hen meat and eggs in African countries due to production deficiencies. In 2016, 1,218,000 tonnes were imported to meet local demand, though the import volume for shell egg was much smaller by about 46,000 tonnes (FAOSTAT, 2018). Laying hen industry, though, presumed to be making progress in terms of meat and egg production has not produced substantial growth because of problems such as risks and uncertainties (Effiong *et al.*, 2014). It is, therefore, imperative that issues relating to strengthening of production of meat and eggs demand from laying hen should be given the needed attention to meet animal protein requirement from domestic sources (Obike *et al.*, 2017).

Effiong *et al.* (2014) stated that production decisions are sometimes made under the environment of risk and uncertainties as yield. Product prices, input prices and quantities are usually not known with certainties when investment decisions are being made. Many of the factors that affect the decisions cannot be predicted with complete accuracy. The study enumerated these factors to include climate variability, inputs prices variability, technology change, theft, high cost of veterinary services, pests and diseases. However, risks in laying hen farming include the danger or possible occurrence of injury, damage, loss or uncertainties that agricultural production will yield expected outcome or not (Akinola, 2014).

Baruwa and Adesuyi (2018) revealed that the unprotected nature of the farmers by the government and stakeholders to mitigate and cope with risks could lead to devastating effect on the laying hen farming. In particular, the failure to rise to this challenge to salvage the industry could lead to a serious reduction in laying hen and protein intake of people. Therefore, the study profiles the different production risks and management strategies employed by the laying hen farmers and identified the factors that affect technical efficiency of laying hen farmers in the study area.

MATERIALS AND METHODS

Study area

The study area was south-western Nigeria comprises of 6 states. The area lies between longitude 2°31' and 6°00' East and Latitude 6°21' and 8° 37' N with a total land area of 77,818 km^2 and a projected population

of 28, 767, 752 in 2002 (NPC, 2006). The study area is bounded in the East by Edo and Delta states, in the North by Kwara and Kogi states, in the West by the Republic of Benin and in the south by the Gulf of Guinea. The study area had 85 constituted forest reserves with a forest area covering 842,499 ha. The climate of the south-western Nigeria is tropical in nature and it is characterized by wet and dry seasons. The temperature ranged between 21 and 34 °C, while the annual rainfall ranged between 150 and 3000 mm.

Sampling techniques

A multistage sampling technique was employed in selecting the laying hen farmers in the study area. The first stage was the purposive selection of Lagos and Oyo state from the six states that made up the South-west, Nigeria. The second stage involved purposive selection of six (6) local government areas (LGAs) from Lagos state and eight (8) local governments from Oyo state. The LGAs chosen from each state was based on available records of the number of registered members of the poultry Association of Nigeria (PAN), in which Oyo State has the higher number of laying hen farmers than Lagos State (FDLPCS, 2016). However, the purposive selection of the local governments in Lagos State was based on the Poultry Association of Nigeria (PAN) dividing the laying hen farmers into (6) zones in the state, namely, Ikorodu, Epe, Badagry, Eti-Osa, Alimosho and Agege local government areas. The purposive selection of the local government in Oyo state was based on those with the highest number of registered members of the Poultry Association of Nigeria (PAN). They are Akinyele, Atiba, Ona-Ara, Egbeda, Lagelu, Oyo west, Oyo east and Afijio.

The third stage was the random selection of one hundred and ninety-eight (198) and three hundred and nine (309) laying hen farmers selected from Lagos and Oyo State respectively. The number of laying hen farmers selected in each selected Local Government Area was proportionate to the size of registered numbers of the Poultry Association of Nigeria (PAN) in each LGA. In all, a total of five hundred and seven (507) laying hen farmers were selected. However, responses from four hundred and eleven (411) questionnaires were used after cleaning of the data. The proportionate factor used in the selection of laying hen farmers is stated as:

$$N_1 = \frac{n_1 \times 507}{N} \quad (1)$$

where:

N_1 – number of sampled laying hen farmers to be selected from local government (i = 1 – 10)

n_1 – number of laying hen farmers in local government

N – total number of poultry farmers in all the local governments

507 – the desired number of commercial poultry farmers to be selected from all local government of both Lagos and Oyo.

Analytical techniques

Total Factor Productivity (TFP) was used following Akintayo and Rahji (2011) and Adepoju and Salman (2013) to estimate the productivity of the laying hen farmers. TFP is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs. This is the ratio of outputs in naira value to the total variable cost (TVC) of production.

$$TFP = \frac{Y}{TVC} \quad (2)$$

where:

Y – output in Naira

TVC – total variable cost

$$TFP = \frac{Y}{\Sigma P_i X_i} \qquad i = 1, 2...n \quad (3)$$

where:

Y – quantity of output in Naira

TVC – total variable cost

P_i – unit price of i^{th} variable input

X_i – quantity of i^{th} variable input

The inputs used are: Cost of labour, Cost of birds (POL), Cost of production, risks management strategies used (Drugs, Sanitation and Medication), cost of feed and cost of water used.

Determinants of total factor productivity

To draw statistical inference about the determinants of productivity, regression analysis was used to estimate marginal impact of selected farm/farmer characteristics as well as production risks management practices. The TFP estimate was subjected to ordinary least square regression to obtain the coefficient of multiple determinations (R^2), F – Statistics, standard error and their values. Thus, The Cobb-Douglas production is specified as:

$$Q_i = b_o + X_1^{b1} + X_2^{b2} \ldots X_n^{bn} \quad (4)$$

The expanded form is:

$$\text{Log } Q = \log b_o + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 \ldots b_n \log X_n + e \quad (5)$$

According to Olayemi (2004), the Cobb-Douglas production function is probably the best-known homogenous production function. The empirical model to be used for this study can be cast in double-log form as follows:

$$1n\ Q_i = 1nA + b_1 1nX_1 + b_2 1nX_2 + b_3 1nX_3 + b_4 1nX_4 + b_5 1nX_5 \ldots b_{12} lnX_{12} + e \quad (6)$$

where:

Q = TFP

The factors below were taken as the determinants of TFP of laying hen farmers in the study area.

X_1 – age of laying hen farmer (years)
X_2 – sex of laying hen farmer (1 = male 0 = female)
X_3 – years of formal education of laying hen farmer (years)
X_4 – household size of laying hen farmer (number)
X_5 – laying hen farming experience (years)
X_6 – access to credit (dummy variable; yes = 1; otherwise = 0)
X_7 – hired labour (labour day)
X_8 – feed quantity (kg)
X_9 – flock size (number)
X_{10} – extension contact (yes = 1; otherwise = 0)
X_{12} – access to livestock insurance (yes = 1; otherwise = 0)
X_{13} – membership of Cooperative Societies (yes = 1; otherwise = 0)
μ – error term

Principal Component Analysis (PCA) and Ordered Probit were used to analyse the determinants of exposure to production risk in the study area. In mathematical terms, from an initial set of *n* correlated variables (X_1, X_2, X_3..., X_n), PCA generates uncorrelated indexes or components, where each component is a weighted linear combination of the initial variables as follows:

$$PC_m = a_{m1}X_1 + a_{m2}X_2 + a_{m3}X_3 + \ldots + a_{mn}X_n \quad (7)$$

where: a_{mn} represent the weighted for the m^{th} principal component and the n^{th} variable. The components are ordered so, that the first component explains the largest amount of variable in the data subject to the constraint that the sum of the squared weight ($a_{m1}+a_{m2}+a_{m3}+\ldots+a_{mn}$) is equal to 1. Each subsequent component explains additional but less proportion of variation of the variables. PCA was used in reducing various risks facing by the farmers into a small variable and an index was generated from the new variable. Risk variables used in the PCA are diseases outbreak, pest outbreak, theft, predators, fire outbreak and rainfall shock.

In the ordered probit model, 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;

$$Y_i^* = X_i' \beta_i + \varepsilon_i \quad (8)$$

where ε_i is a vector of random error terms.

The observed Y_i is determined from the latent variable,

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

The probabilities of observing each value of Y are given by

$$\Pr(Y_i = 0 | X_i, \beta, \theta) = F(\theta_i - X_i' \beta) \quad (9)$$

$$\Pr(Y_i = 1 | X_i, \beta, \theta) = F(\theta 2 - X_i' \beta) - F(\theta 1 - X_i' \beta)$$
$$\Pr(Y_i = 2 | X_i, \beta, \theta) = F(\theta 3 - X_i' \beta) - F(\theta 2 - X_i \beta)$$
$$\Pr(Y_i = n | X_i, \beta, \theta) = 1 - F(\theta n - X_i' \beta)$$

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 dependent variable Y is the level of exposure to production risks, which was generated using the Principal Component Analysis (PCA). This were later categorised into high, medium and low levels based on the range of their scores and the values 3, 2 and 1 assigned to the levels, respectively.

The independent variables used in the regression are itemized below:

X_1 – age of laying hen farmer (years)
X_2 – age squared of laying hen farmer (years)
X_3 – gender of laying hen farmer (X_1 = 1 if male and 0 if female)
X_4 – household size (number)
X_5 – educational level of laying hen farmer (years)
X_6 – years of laying hen farming experience (years)
X_7 – laying hen system of management (1 = intensive, 2 = semi-intensive, 3 = extensive)
X_8 – flock size (number)
X_9 – distance of farm to residence (km)
X_{10} – low price
X_{11} – access to agricultural extension (= 1 if farmer has access and 0 if otherwise)
X_{12} – access to agricultural insurance
X_{13} – poor market access
X_{14} – pest outbreak
X_{15} – diseases outbreak
e – error term

RESULTS AND DISCUSSION

Commercial laying hen farmers farm characteristics

Table 1 reveals that most commercial laying hen producers (87.1 %) have access to credit, while the rest (12.9 %) have no source of credit. Access to credit relieves financial constraints and improves the acquisition of inputs for laying hens. The more credit is available, the greater the propensity to higher production because of technical efficiency and management. Finances also enhance timely and prompt application of farm inputs. These findings corroborated the findings of Bukunmi and Yusuf (2015). The study revealed that only 13.14 % of the commercial laying hen farmers had access to livestock insurance, while larger proportion had no livestock insurance. This indicates a low participation in agricultural insurance by the laying hen farmers in the study area. The implication of this is that farmers will be unwilling to venture on riskier enterprises. Majority (84.67 %) of the laying hen farmers had access to livestock extension services, while 15.33 has no access to extension services. This implies that majoity of the laying hen farmers had access to advisory services and adequate information on improved production risk management techniques. Majority of the farmers (72.68 %) adopted control measure in managing risk, while 27.32 % did not. The results indicate that the commercial laying hen farmers that adopt control measures, has the greater opportunity of reducing loss in the enterprise. The results revealed that small scale laying hen farmers constitute more than half (79.08 %) that have access to stocking materials. This agrees with the studies of Yusuf *et al.* (2016).

Table 1. Commercial laying hen farmers access to resource facilities

Access to resources	Frequency	Percentage
Access to credit		
Yes	358	87.10
No	53	12.90
Access to insurance		
Yes	54	13.14
No	357	86.86
Access to extension services		
Yes	348	84.67
No	63	15.33
Access to control measure in managing risk		
Yes	299	72.68
No	112	27.32
Access to stocking materials		
Yes	325	79.08
No	86	20.92

Commercial laying hen farmers management strategies

Table 2 shows the risk management strategies adopted by laying hen farmers in the study area. The most utilized production risk management practice adopted were proper and timely vaccination, good housing, maintaining good hygiene, water and feed management, disinfection of poultry house, use of foot dip, fencing/netting, disease resistant species, cooperative activities and regular predator bating. Furthermore, the least utilized risk management practice adopted were farm relocation, insurance, change to rearing of other stock, formal borrowing, reinforcing infrastructure, diversification, mixed farming and upgrading sanitary measures. This finding agrees with the work of Obike *et al.* (2017), that enterprise diversification, cooperative support, good hygiene, water and feed management are the major risk management strategies employed by the egg laying farmers.

The choice of these least utilized production risk management practices was due to high cost involved, since majority of them are small scale producers. Obike *et al.* (2017), however, enunciated that this strategy of diversification, if given adequate attention and concentration, would have helped to improve their farm income positively to offset any negative influence of risk.

Choice of risk management strategies commercial laying hen farmers

Table 3 showed the reasons for choice of production risk management methods by the laying hen farmers in the study area. The result revealed that experience (31.93 %) is the major reason for the choice of management methods, followed by suitability (26.51 %) and cost (18.67 %). The least reason for their choice of management strategies was farm location (2.11 %) and flock size (3.92 %).

The implication of this is that experience played an important role in the choice of management strategy employed by the farmer. This is in accordance with the observations of Effiong *et al.* (2014).

The TFP values of the three-production systems were 0.452, 0.511 and 0.611 for small, medium and large-scale laying hen farmers, respectively (Table 4.). These results are in line with the findings of Akintayo

Table 2. Commercial laying hen farmer risk management strategies

Risk coping strategies	Perception of level of occurrences								
	Low = 1		Moderate = 2		High = 3				
	Freq	%	Freq	%	Freq.	%	Mean	St.D	Rank
Vaccination	28	7.01	176	42.93	207	50.48	2.36	0.724	1st
Good housing	31	7.56	152	37.07	227	55.37	2.33	0.817	2nd
Maintaining good hygiene	45	10.98	160	39.02	205	50.00	2.30	0.787	3rd
Water & feed management	44	10.73	159	38.78	207	50.49	2.29	0.800	4th
Disinfecting of poultry house	50	12.20	151	36.83	209	50.98	2.23	0.861	5th
Foot dip	40	9.76	128	31.22	242	59.02	2.13	1.015	6th
Fencing/Netting	66	16.10	131	31.95	216	51.95	2.06	0.990	7th
Disease resistance species	52	12.68	205	50.00	153	37.32	2.04	0.959	8th
Regular predator bating	60	14.63	139	33.90	211	51.46	1.90	1.059	9th
Cooperative activities	45	10.98	223	54.39	142	34.63	1.85	1.103	10th
Upgrading sanitary measure	65	15.85	119	29.02	226	55.12	1.62	1.158	11th
Mixed farming	63	15.37	245	59.76	102	24.88	1.43	1.187	12th
Diversification	207	50.49	133	32.44	70	17.07	1.32	1.124	13th
Informal borrowing	58	14.15	287	70.00	55	15.85	1.30	1.117	14th
Reinforcing infrastructure	227	55.36	89	21.71	94	22.93	1.26	1.221	15th
Formal borrowing	66	16.10	318	77.56	26	6.34	0.81	0.998	16th
Outsourcing/ contracting	282	68.78	107	28.10	21	5.12	0.78	1.002	17th
Change to rearing of other stock	304	74.14	52	12.68	54	13.17	0.70	1.121	18th
Insurance	368	89.75	23	5.61	19	4.63	0.39	0.794	19th
Farm relocation	395	96.34	06	1.46	09	2.200	0.18	0.555	20th

Source: Field Survey Data

Table 3. Commercial laying hen farmers major reasons for the choice of risk management strategies

Reasons for choosing risk management strategies	Frequency	Percentage
Cost	124	18.67
Availability	48	7.23
Suitability	176	26.51
Flock size	26	3.92
Ease of use	64	9.64
Experience	212	31.93
Farm location	14	2.11
Total	664*	100

* indicates multiple responses

and Rahji (2011) that laying hen farmers involved in large scale production are more productive, as reflected in this study. The outcome of this study, based on computation, indicates that the large-scale system with TFP of 0.611 was most productive, followed by the medium-scale system. Poor productivity of the small-scale laying hen farming system could be attributed to little capital outlay, poor routine sanitation, small stock and poor laying hen production facilities.

Determinant of total factor productivity among commercial laying hen farmers

Table 5 shows the Cobb-Douglass production analysis used to determine the productivity of laying hen farmers; the results revealed an R^2 of 0.333. This implied that 33 % of the variation in the TFP was explained by the independent variables and this include: sex, age, education, household size, farming experience, flock size, feed quantity, hired labour, extension access, access to livestock insurance, access to credit and membership of cooperative. As shown in the table, education, flock size, access to livestock insurance and access to credit were all positive and statistically significant while farming experience, hired labour, extension access and feed quantity were statistically significant but with negative sign implying inverse relationship with total factor productivity.

Table 4. Total factor productivity of the three production system

Size of farm	No of Obs.	Mean	Minimum	Maximum
Small	325	0.452	0.017	0.734
Medium	58	0.511	0.176	0.723
Large	28	0.611	0.254	0.771
Total	411	0.471	0.016	0.771

Table 5. Regression result of the determinant of total factor productivity (Cobb-Douglas production function)

Variables	Coefficients	Standard Error	P>|t|
Sex	0.188	0.147	0.200
Age	-0.504	0.398	0.207
Education	0.471	0.201	0.020**
Household size	-0.027	0.146	0.855
Farming experience	-0.49	0.104	0.000***
Flock size	0.540	0.077	0.000***
Feed quantity	-0.225	0.076	0.003***
Hired labour	-0.234	0.088	0.008***
Extension access	-0.305	0.136	0.025**
Access to NAIC policy	1.126	0.316	0.000***
Access to credit	0.299	0.134	0.025**
Bird Loss	-0.078	0.090	0.387
Cooperative member	0.131	0.160	0.82
Constant	-1.24114	2.001	0.000
Root MSE	0.89331		
R-Squared	0.3330		

Source: Field Survey Data, 2016
Note that ***, **, * Rep Sig at 1 %, 5 % and 10 %, respectively

The coefficient of educational status 0.47 was positive and statistically significant at 5 % level, implying that if all other variables are kept constant, increase of educational status by 5 % will increase TFP by 4.7 %. The positive sign of educational status is expected to increase total factor productivity. This is an agreement with studies of Biber (2017) and Onubuogu *et al.* (2014). The coefficient of flock size 0.54 was positive and statistically significant at 1 % level, implying that if all other variables are kept constant, increase of flock size by 1 % increases TFP by 5.4 %. The positive sign of flock size follows a prior expectation that increase in flock size is expected to increase total factor productivity. The coefficient of access to credit was 0.3, positive and statistically significant at 10 % level implying that an increase in credit access by 10 % will increase TFP by 30 %. The positive coefficient of access to credit follows a prior expectation that access to credit (capital) has dynamic relationship with total factor productivity. In addition, laying hen farmers, who have access to credit to produce are more economically efficient. Access to credit eases financial constraints in laying hen farming and enhances the acquisition of inputs. Access to livestock insurance (coefficient of 1.13) was positive and statistically significant at 1 % level. This implies that an increase in access to livestock insurance by 1 % will increase TFP by 11.3 %. Though farming experience was statistically significant at 1 % level, but the coefficient was of negative sign. This inferred that the farming experience has negative impact on farm output.

The coefficient of hired labour (-0.234) at 1 % level infers that hired labour has negative impact on TFP. The result shows that a 1 % increase in hired labour employed by laying hen farmers decrease productivity

by 2.3 %. This, however, disagrees with the findings of Omonona and Babaloba (2007). The coefficient of the extension variable estimated is negative and statistically significant at 5 %. This shows that contact with extension contributes negatively to total factor productivity. It can be inferred that farm level extension visits have unfavourable effects on farmers' productivity. Feed quantity coefficient (-0.225) shows that feed quantity has negative impact on TFP. More feed is needed to maintain layers. More feed increase expenditure on feed thereby reducing total factor productivity. Likewise, hired labour increase expenditure thereby reducing total factor productivity.

Determinant of exposure to production risks among commercial laying hen farmers

Table 6 presents the result of ordered probit model to investigate the determinants of laying hen farmers' exposure to production risks. The three categories of extent of exposure to production risk are high, moderate and low, and they formed the dependent variable, as ordered 3, 2, and 1, respectively. Fifteen variables were allowed in the model as independent variables and only six were significant at various levels of significance. The log pseudo likelihood of 246.545 and chi-square of 0.000 reveals that the model is statistically significant and it is a good fit.

The age of laying hen farmers shows positive relationship with exposure to production risk at 10 % level of significance. This implies that as the age of farmers increase, there is a likelihood of decrease in exposure to production risk. The marginal effect shows that an increase in age will lead to 3.5 % decrease in exposure to production risks. This is at variance with the findings of Dietmar (2005), who found a weak association between farmer's age and production. Household size is significant at 10 % and has a negative sign, which means that it negatively affects production risk. This shows that with an increase in a household's number, there is likelihood of 19 % exposure to production risk. This shows that

Table 6. Ordered probit regression result of determinants of exposure to production risk

Variables	Coefficients	Standard Error	P>|t|	Dy/dx
Age	0.135	0.077	0.082*	-0.035
Age square	0.001	0.001	0.189	0.000
Sex	-0.001	0.145	0.189	-0.012
Household size	-0.075	0.033	0.024*	0.019
Educational qualifications				
Primary	1.136	0.541	0.036*	-0.348
Secondary	0.676	0.421	0.108	-0.224
Tertiary	1.180	0.421	0.005**	-0.358
Farming experience	0.001	0.013	0.936	-0.000
Flock size	-0.000	0.000	0.116	$4.37e^{-06}$
Distance to residence	-0.324	0.060	0.000***	0.084
Low price	-0.402	0.162	0.013	0.103
Extension access	-0.159	0.214	0.003**	0.619
Pest outbreak	-0.115	0.140	0.418	0.011
Disease outbreak	-0.115	0.142	0.418	0.030
Livestock insurance awareness	0.572	0.199	0.004**	-0.147
Poor market access	-0.054	0.142	0.705	-0.014
Disease prevention cost	$-4.34e^{-07}$	0.142	0.735	$1.12e^{-07}$
Constant	0.403		0.105	0.34
Log likelihood	246.545			
Prob > Chi^2	0.000			
Wald Chi^2	94.45			
pseudo R^2	0.1693			

Note that ***, **, * Rep Sig at 1 %, 5 % and 10 %, respectively

the lower the household size, the more the willingness of the farmer to take risk, and the higher the household size, the lower will be the willingness to take risks. The results are consistent with the findings of Yusuf *et al.* (2016).

Primary and tertiary educations are significant at 10 % and 5 %, respectively and positively affect production risk. The marginal effect shows that with little or more primary education, there is a likelihood of production risk to reduce by 3.5 % and with little or more tertiary education – there is a likelihood of production risk to reduce by 36 %. This finding agrees with that of Akinola (2014). They found out that level of education determines the quality of skill of farmers and, therefore, add to the productivity of farmers.

Distance to residence is significant at 1 % and negatively affects production risk. The marginal effect reveals that with one-kilometre increase in distance to residence there is likelihood of exposure to production risk to increase by 8.4 %. Access to extension is significant at 5 % and positively affects production risk. This implies that with an increased access to extension, there is likelihood of reduction in exposure to production risk. The marginal effect shows that with increase access to extension, exposure to production risk will be reduced by 62 %. Onubuogu *et al.* (2014) reported that extension contact is the channel, through which agricultural innovations and information are passed to farmers for improvement in their production.

Livestock insurance is significant at 5 % and positively affects production risk. This implies that with an increase to access to livestock insurance, there is a likelihood that exposure to production risk will be reduced. The marginal effect shows that increased access to livestock insurance will reduce production risk by 15 %, which agrees with that of Obike *et al.* (2017).

CONCLUSION

The TFP values of the three-production system for small, medium and large-scale laying hen farmers based on the range of TFP of ≥ 2.00 indicate that the large-scale production system with the highest TFP was the most productive, followed by medium-scale system and the small-scale system. Education, flock size, access to livestock insurance and access to credit positively influenced productivity. While farming experience, hired labour, extension access and feed quantity were significant but have inverse relationship with total factor productivity.

The age of laying hen farmers has positive relationship while, household size, distance to residence, access to extension services and livestock insurance awareness were negatively significant at varying degrees but raise productivity of the laying hen farmers.

The production risk of the laying hen farmers was positively influenced by access to credit facilities. Majority of the laying hen farmers managed production risk through timely vaccination, good housing, maintaining good hygiene, water and feed management, regular predator bating, disinfection of poultry house and use foot dip. Experience of the farmer and suitability of the method are the two major reasons for the choice of management strategies.

Factors such as household size, distance to residence, access to extension services and livestock insurance awareness could enhance exposure to production risk. These variables were instrumental to reducing technical efficiency and by extension reduces the productivity of laying hen farming. Also, most severe production risk factors were the attack of predators, pest infestation, disease infestation, high temperature, rainfall shock and power failure.

AUTHOR'S CONTRIBUTIONS

Conceptualization: ODETOLA , S. K.

Methodology: ODETOLA, S. K., AJIJOLA, S.

Investigation: IDOWU, A. B., AWOYEMI, T. T.

Data curation and supervision: ODETOLA, S. K., AJIJOLA, S., IDOWU, A. B.

Writing-original draft preparation: ODETOLA , S. K.

Writing-review and editing: AJIJOLA, S., AWOYEMI, T. T.

Project administration: AJIJOLA, S., ODETOLA , S. K.

All authors have read and agreed to the published version of the manuscript.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

Abotsi, A. K., Dike. G. T. & Agyeping, R. A. (2014). Factors influencing Risk Management Decision of Small and Medium Scale Enterprises in Ghana. *Contemporary Economics*, 8(4), 397–414.

Akinola, B. D. (2014). Risk Preferences and Coping Strategies among Poultry Farmers in Abeokuta Metropolis, Nigeria. *Global Journal of Science Frontier Research: D Agriculture and Veterinary*, 14(5), 22–30.

Akintayo, O. I. & Rahji, M. A. Y (2011). Determinants of factors of productivity in rain fed lowland rice production system in Nigeria. *Journal of Agriculture, Forestry and Social Science*, 9(1). DOI: 10.4314/joafss.v9i1.4

Baruwa, O. I. & Adesuyi, A. Z. (2018). Managing farm risk: issues and strategies in small scale poultry farmers in Osun State, Nigeria. *Journal of Fishery and Livestock Production*, 6(3), 45–52.

Biber, E. A. (2017). Contribution of Total Factor Productivity in economic growth rate. *IJRDO-Journal of Social Science and Humanities Research*, 2(11), 68–73.

Bukunmi, F. R. & Yusuf, H. A. (2015). Analysis of Socio-Economic Factors Influencing Poultry Egg Production among Poultry Farmers in Ondo State, Nigeria. *British Journal of Applied Science & Technology*, 10(3), 1–7.

Dietmar, K. F. (2005). Breeding of laying hens to meet requirements of producers and Consumers in Africa. In: Peters, S. O., Idowu, O. M. O., Ola, S. I., Sonaiya, E. B. (Eds): *The proceedings of the first Nigeria International Poultry Summit (NIPS)*, The World Poultry Science Association, Nigeria Branch, Nigeria, 223–224.

Effiong, E. O., Enyinihi, E. A. & George, A. A. (2014). Analysis of farming risk among small scale poultry farmers in Etim Ekpo Local government area of Akwalbom State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 10(1), 59–64.

FAO (2018). *Food and Agricultural Organisation Statistics*. online www.fao.org

FAOSTAT (2018). *Food and Agriculture Data FAOSTAT*, http://www.fao.org.faostat

FDLPCS (2016). *Federal Department of Livestock and Pest Control Services*.

Nwandu, P. I., Ojogbane, J. A., Okoh, C. & Okechukwu, F. (2016). Poultry production business: a means of alleviating poverty among farmers. *New York Science Journal*, 9(7), 92–100.

Obike, K. C., Amusa, T. A. & Olowolafe, H. B. (2017). Risk management and determinants of farm output among small scale poultry farmers in Ekiti State. *Nigeria Journal of Tropical Agriculture, Food, Environment and Extension*, 16(2), 9–16.

Omonona, B. T. & Babalola, D. A. (2007). Determinants of the Production of Fluted Pumpkin (*Telfaria Occidentals*) among farmers in Nigeria. Evidence from Lagos State. *Journal of Agricultural and Food Information*, 8(1), 95–105.

Onubnogu, G. C., Esiobu, N. S., Nwosu, C. S. & Okereke, C. N. (2014). Resource Use Efficiency of Small Holder Cassava Farmers in Owerri Agriculture Zone, Imo State Nigeria. *Schorlarly Journal of Agricultural Science*, 7(8), 142–152.

Ogundipe, S. O. & Sanni, S. A. (2002). Economic of poultry production in Nigeria. In: Gefu, J. O., Adeyinka, I. A. and Sekoni, A. A. (Eds). *A training manual on National Training Workshop on poultry production in Nigeria.* National Animal Production Research Institute, Ahmadu Bello University, Zaria, Nigeria, pp. 27–45.

Oguntunji, A. O. & Ayorinde, K. L. (2015). Duck Production in Nigeria: Characteristics, management, and mortality. *Archiva Zootechnica*, 18, 27–40.

Yusuf, T. M., Tiamiyu, S. A. & Aliu, R. O. (2016). Financial analysis of poultry production in Kwara State, Nigeria. *African Journal of Agricultural Research*, 11(8), 718–723.