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Production Risks and Technical Efficiency of Commercial Laying Hens in South West Nigeria: A Stochastic Production Frontier Approach

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ABSTRACT

This study was carried out to examine production risks and technical efficiency (TE) of laying hens farmers (LHF) in Southwest Nigeria Data were collected using structured questionnaire on LHF socio-economic characteristics (age, poultry farming experience, education, household size, sex, marital status), production risks, flock size, input (pullets, drugs, water, feed), output (eggs, spent layers and waste), and their prices. A three-stage sampling procedure was used. Lagos and Oyo States were purposively selected being the major egg producers in the region. Fourteen Local Government Areas (LGAs) were randomly selected using the list of registered farmers of the Poultry Association of Nigeria (PAN): Lagos (6), and Oyo (8). A total of 507 LHF were randomly selected (Lagos 198) and (Oyo 309) proportionate to the size of registered members of PAN in each LGA. Data were analysed using descriptive statistics, and stochastic frontier production function. Average stock size and farming experience were 3017.0±587.3 and 11.4±5.7 years, respectively. The most prevalent production risks among the LHF were attack by predators, pest, and disease infestation. Age (β=-0.135), education (β=1.180) and livestock insurance (β=-0.572) reduced the probability of exposure to production risks, while household size (β=-0.075), access to extension (β=-0.159) and distance to residence (β=-0.324) increased the probability of LHF exposure to production risks. The TE for LHF was 0.37, indicating that farmers were operating at 63.0% below efficiency frontier. Age, farming experience, access to credit and household size significantly influenced TE in Nigeria. Therefore, policy intervention such as affordable livestock and insurance could improve technical efficiency of laying hen farmers.

Introduction

The poultry business of which the egg laying hen is a component in the 21st century has evolved from tens of thousands of small independent farms to an industry of relatively few large vertically integrated companies, each with multiple farm sites or contract growers, processing, marketing, feed milling and hatchery capabilities. This change has come about because of the many technologies that have been introduced over the past half century by the poultry industry with the help of supporting industries and various educational, research, and governmental institutions. (Ajith, 2019)**.** Laying hen addresses one of the proper frameworks to take care of the quickly developing populace and furthermore assume a significant part in family food supply There are 800 million people that are suffering from malnutrition all over the world due to inadequate animal protein in the diet of a large proportion of the population especially in the rural areas which constitute 70% of Nigeria population (FAO, 2021).

The poultry sub-sector contributed approximately 6.2 million tons of the total livestock contributions to the agricultural Gross Domestic Product in 2012 (CBN, 2018). The types of poultry that are commonly reared in Nigeria are laying hens, broilers, ducks, guinea fowls, turkey, pigeons, quails and more recently

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ostriches. Those that are of economic importance given the trade in poultry however are laying hens, broilers, guinea fowl, and turkeys, amongst which the laying hens and broilers predominate (Heise *et al*., 2018). Laying hen faming provides needed animal protein and creates employment for the teeming population (Heise et al., 2018). Laying hen is one of the world major and quickest developing sources of meat addressing more than 22% of the meat production in 2017 (FAO 2018). Laying hen is an awesome converter of ingredients, particularly those of plant origin into animal protein. Animal protein is fundamental in human nourishment in view of its natural importance. Poultry and poultry products like poultry meat and eggs are significant food sources for improving dietary and wellbeing status (Supramaniam 2018). Laying hen production in Nigeria amount up to 454 billion of tons of meat and 3.8 million eggs per year with standing population of 180 million bird. About 80 million laying hens are raised in extensive system, 60 million in semi-intensive system and 40 million in intensive system.

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 (Akinbile. *et al*, 2013). Other risks and uncertainties include price, market and natural or production risk which is the focus of this study (Hutchings *et al*, 2020). Abimbola et al. (2013), 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. The results of these failures associated with production risks and technical inefficiency include malnutrition and ill health, lower productivity, and output (Benton and Bailey, 2019).

Previous studies have been carried out in Nigeria on poultry risks management such as Oyekale and Oyekale (2008); Nwadu et al. (2016). 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. It is therefore imperative to profile the different production risks and management strategies employed by the laying hen farmers, identifying the determinants of exposure to production risks of laying hen farmers and determine the technical efficiency of laying hen farmers.

Materials and Methods

The study area

This study covers the Southwest zone of Nigeria. Within this zone, there are three distinct ecological sub-zones: the mangrove forest, the rain forest, and the derived savannah. The study area was south-western Nigeria which consists of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states. It is also known as the south-west geographical zone of Nigeria. The area lies between longitude 2°311 and 6°001 East and Latitude 6°211and 8° 371N (Adeyinka et al., 2017) with a total land area of 77,818 km2 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 cover of 842,499 ha. The climate of 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 procedure and sampling size.

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. This was because these states have the bulk of laying hen production farms (Heise et al., 2015). 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. 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 while others were discarded for incomplete information.

Method of Data Analysis

The study employed several analytical tools based on the objectives. These tools include descriptive statistics and stochastic frontier production function.

Descriptive statistics;

The descriptive statistics used in this paper include frequency, tables, percentages and mean value to describe the demographic characteristics of the laying hen farmers in the study areas.

Cobb-Douglas production function

A Cobb-Douglas (CD) production function shows a functional relationship between inputs and output. The Cobb-Douglas (CD) function further assumes constant returns to scale and unitary elasticity of substitution. For two variable inputs, the function can be expressed as:

$$Y = ALb_1Kb_2e \qquad (1)$$

where Y = level of output, L and K = variable inputs, A = multiplicative constant, b_1 and b_2 are the coefficient of L and K and they represent the direct measure of elasticity of the respective factors of production, and e = error term.

The sum of b_1 and b_2 indicates the nature of returns to scale. Upton (1975); Terfa and Terwase (2011) observed that the Cobb-Douglas production function cannot show both increasing and diminishing marginal productivity in a single response curve and as a result it does not give a technical optimum and may lead to the over estimation of the economic optimum. Despite these disadvantages researchers still find the Cobb-Douglas production function useful in analysis of survey where many variable inputs are involved and it is necessary to measure returns to scale, intensity of factors of production and overall efficiency of production. It can also provide a means of obtaining coefficients for testing hypotheses (Cobb and Douglas 1928). While commenting on the superiority of Cobb-Douglas production

Stochastic production frontier

Stochastic Production Frontier (SFP) model has been widely adapted to various disciplines and extensively applied in many studies of agricultural production, cost, revenue, profit and other models of goal attainment Akpan et al. (2017).

The basic stochastic production frontier model is expressed as:

$$Y = \beta X + v - \mu \qquad (2)$$

where; Y is the observed outcome (goal attainment), βX is the deterministic part of the frontier, the components of x are inputs for a production model or input prices for a cost model and v is random error due to stochastic noise, ($v - N$Ï$0, \sigma^2$) is the stochastic part) while μ is randomness (technical inefficiency part). The strength of stochastic production frontier analysis is identification of two sources of production errors; stochastic error term which represents random shocks (factors beyond the control of a producer) and the inefficiency component which is deviation from the production frontier because of the producer's inefficiency. The shortcoming of stochastic production frontier is that it fails to measure and identify sources of productivity growth and other latent information.

The Stochastic Frontier Production Function is typically specified as:

$$Y_i = f(X_{ij};\ \beta) + \ v_i - \ \mu_i (i\ 1, 2, n) \qquad (3)$$

where,

Y_i_iis output of the ith firm.
X_i_ijis vector of actual jth inputs used by the ith firm.
ß is route of production coefficients to be assessed.
V_i_iis Systematic error which account for random variations, the random variability in the production that cannot be influenced by the firm and U_i is the deviation from maximum potential output attributable to technical inefficiency of ith farmer.

The above specifications have been expressed in terms of a production function, with the Ui interpreted as technical inefficiency effects, which cause the firm to operate below the stochastic production frontier (Eq. 4).

$$LnC_a = f(\ P_a, Y_a;\ \beta) + (\ V_i - \ U_i\ ) \qquad (4)$$

where,

Y_a_ais output of the ith firm,

β is parameters to be assessed,

V_i_iis regular component which represents random disturbance cost due to factors outside the scope of the firm, U_i is one sided disturbance term used to represent cost inefficiency and is independent of V_i

The production efficiency (CE) of an individual firm is defined in terms of the ratio of observed cost C_b the corresponding minimum cost (C_{min}) under a given technology.

$$Technical\ Efficiency\ (TE) = \frac{Y_i}{Y_i^*} \qquad (5)$$

$$TE = f(X_i, E)\ exp\left(V_i - \frac{u_i}{\rho}\right)(X_i, E)\ exp(V_i) \qquad (6)$$

$$TE = \exp(-U_i\ ) \qquad (7)$$

where Y_i is the observed output and Y_i^* is the frontier output.

Literature reveals that Cobb-Douglass and Translog production functions are the most widely used functional forms in agriculture production functions. However, Translog production form suffers from multicollinearity problem because of the square and interaction terms of the input use. (Hussain et al., 2011)

Total factor productivity analysis:

This was used to estimate the productivity of the laying hen farmers. Total Factor Productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs (Akintayo and Rahji, 2011 and Adepoju and Salman, 2013). Total factor productivity is therefore measured as the inverse of unit cost following Key and McBride, (2003) and Biber (2017). This is the ratio of outputs in naira value to the total variable cost (TVC) of production.

$$TFP = \frac{Y}{TVC} \qquad (8)$$

where Y = Output in Naira value in line with Mwuese and Okorji (2015).
TVC = total variable cost
TFP = Y

ΣPiXi i= 1, 2...n (9)

where Y = quantity of output in Naira and TVC= Total Variable Cost
Where Pi= unit price of ith variable input and Xi = quantity of ith variable input
The inputs used in line with Fakayode, (2009) 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

Following Key and McBride (2003) and Biber (2017), as adapted by Akintayo and Rahji (2011), 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 (R2), F - Statistics, standard error, and their values. Thus, The Cobb-Douglas production is specified as:

$$Qi = \ b_o \ + \ X_i \ b_i + \ X_2 \ b_2 \ldots\ldots X_n b_n \qquad (10)$$

The expanded form is:

$$Log\ Q = \log\ b_o + \ b_1 log X_1 + \ b_2 log X_2 + \ b_3 log X_3 \ldots\ldots\ldots\ldots b_n log X_n + e \qquad (11)$$

According to Olayemi (2004), the Cobb – Douglas production function is probably the best-known homogenous production function. Following Gujarati (1995), the empirical model

to be used for this study can be cast in double-log form as follows:

$$LnQ_i = lnA + b_1 lnX_1 + b_2 \ln X_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 \dots\dots b_{12} lnX_{12} \quad (12)$$

where, Q= TFP

Based on the view adapted by Adepoju and Salman (2013); Akintayo and Rahji (2011); and Ukoha et. al., (2010) the factors below were taken as the determinants of TFP of laying hen farmers in the study area.

X1 = Age of laying hen farmer (Years)
X2= Sex of laying hen farmer (1 = Male 0 = Female)
X3 = Years of formal education of laying hen farmer (Years)
X4= Household size of laying hen farmer (Number)
X5 = Laying hen farming experience (Years)
X6 = Access to credit (Dummy Variable; Yes = 1 otherwise = 0)
X7= Hired Labour (Labour Day)
X8=Feed quantity (Kg)
X9= Flock size (Number)
X10 = Extension contacts (Yes = 1 otherwise = 0
X12 = Access to livestock insurance (Yes=1; otherwise=0)
X13 =Membership of Cooperative Societies (Yes=1 otherwise=0)
μ = error term

Results and Discussion

Socio economic characteristics of commercial laying hen farmers

Table 1 shows the socio economic characteristics of the commercial laying hen farmers. The results showed that most of the commercial laying hen farmers were between the 41-50 years with a mean age of 49.1 years. This means they are economically productive which corroborates the findings of Obike *et al.*, (2017). The distribution of laying hen farmers by educational status shows that more than half (53.5%) have tertiary education. The level of education among the laying hen farmers had significant impacts to the production of poultry. This also agreed with the findings of Salmonu and Falusi (2009). The majority of laying hen producers were married (97.3%) and the average household size was 7. The implication of this is that it reduces cost of labour and if members of the family are the labour employed on the farm, the farm will be secured and safe on the laying hen farm. Also, the larger the family size, the higher the resource utilization needs and given a fixed size of farmland utilized for laying hen lodging, the lower the readiness of the rancher to accept hazards. This is steady with the discoveries of Iheke and Ukaegu (2015).

Table 1 Commercial laying hen farmers' socio-economic characteristics

Variables	Frequency	Percent (%)	Mean (SD)
Age(years)			
21-30	9	2.19	
31-40	31	7.54	49.13 (7.36)
41-50	199	48.42	
51-60	154	37.47	
>60	18	4.38	
Sex			
Female	52	12.05	
Male	359	87.35	
Education			
No formal	14	3.41	
Primary	27	6.57	
Secondary	150	36.50	
Tertiary	220	53.53	
Household Size			
1-4	8	1.95	7.40 (2.60)
5-8	252	61.31	
9-12	145	35.28	
13-16	6	1.46	
Marital status			
Single	11	2.68	
Married	400	97.32	
Farming Exp.			
< 5	29	7.06	11.41 (5.72)
6-10	204	49.64	
11-15	95	23.11	
16-20	66	16.06	
21-25	12	2.92	
>25	5	1.23	
Member of Coop Society			
No	67	16.30	
Yes	344	83.70	

Source: Field Survey, 2021

Most of the laying hen farmers (83.7%) are members of cooperative association. Socially

this will have a positive effect on funding of the farm. This could be an opportunity for the laying hen farmers to acquire credit, get inputs and get data on significant and on-going practices/ developments concerning laying hen cultivating exercises. As indicated by Iheke (2010). Agreeable participations likewise fill in as wellsprings of good quality info, credit data, and work and coordinated showcasing of items. Ohajianya (2015) set that individual from helpful social orders have upgraded capacity to receive developments than non-individuals.

Commercial Laying Hen Farmers Reasons for the Choice of Risk Management Strategies

Table 2 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 %). This indicates that experience played an important role in the choice of management strategy employed by the farmer. This is in tandem with the discoveries of Effiong et al. (2014) who observed that the longer the years of farming experience the more efficient the farmers becomes and the more knowledgeable in the choice of risk management strategies. This suitability of a choice of production risk management is of major concern to the laying hen farmers as revealed by the result because this rank second in the reasons for the choice of management strategies employed by the laying hen farmers. Cost in the choice of management strategies rank third. This shows that cost in risk management strategies also affect the choice of management strategies employed by the laying hen farmers in the study area. This agrees with the findings of Adeoti (2019) who revealed that with more funds, farmers will be able to adopt the best mitigating strategies on risk management.

Table 2: 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

Source: Field Survey, 2021

Determinants of Technical Inefficiency among Commercial Laying Hen Farmers

Table 3 shows the maximum likelihood estimate (MLE) of the Stochastic Frontier analysis of laying hen farmers in southwest, Nigeria. It was used to determinants of technical inefficiency among commercial laying hen farmers. From the result obtained, the sigma-square (δ^2) estimate of 0.955 confirms the correctness and good fit of the model; while the gamma (γ) estimate of o.955 indicates the amount of variation in output of laying hen resulting from the technical inefficiencies of the laying hen farmers. This means that 95% of the variation in laying hen farmers' output was due to technical efficiency.

Again, out of the six variables that were used for the model, scale of operation and feed quantity were positively significant while stock type was negatively significant. In addition, the results further reveal that variables such as feed quantity, and scale of operation are factors which influence the quantity of outputs of laying hen positively in the study area. These findings are in line with studies like Ayinde et al. (2015), Oni and Oyewo (2011) and Shehu et al. (2007)

Table 3: Estimation of Stochastic Frontier Analysis and Inefficiency Model

Variables	Coefficient	Std.Err.	t-value	p-value
Scale of Operation	1.147	0.233	4.91	0.000***
Stock Type	-0.538	0.112	-4.81	0.000***
Land ownership	-0.082	0.133	-0.62	0.537
Management system	-0.022	0.210	-0.11	0.916
Feed Quantity	0.327	0.089	3.67	0.000***
Farm size	0.075	0.050	1.49	0.137
Constant	-1.798	0.456	-3.94	0.000
Number of Obs.	411			
Prob > chi2	0.000			
Sigma Square	0.955			
Gamma	1.0259			
Wald chi2	36.82			

Source: Field Survey, 2021 *** *p<0.01, ** p<0.05, * p<0.1*

Determinants of Technical Efficiency among Commercial Laying Hen Farmers

As shown in Table 4, the results of the inefficiency model, those determine the TE of the laying hen farmers. The result shows that age ($p<0.05$) and farming experience ($p<0.05$) of the respondents are significant determinants of technical inefficiency. The sign of the variables in the inefficiency model is very important in explaining the observed level of technical efficiency of the farmers. A negative sign implied that the variable had the effect of reducing technical inefficiency of the laying hen farmers, hence increasing farmers' efficiency, while a positive coefficient indicate that the variable has the propensity of increasing inefficiency, thus reducing farmers' technical efficiency.

Therefore, an increase in age and farming experience would significantly increase technical efficiency of the farmers. Also, as the farmers get older, they garnered more experience in their production activities, since they have been practicing it for long. Household size and access to credit had a negative coefficient. This indicated that these variables negatively affect productivity, and in line with the findings of Bamiro et al. (2013).

Table 4: Determinants of Technical Efficiency of the Commercial Laying Hen Farmers (Inefficiency Model)

Variable	Coefficient	Str. Err	t- value	P-value
Sex	6.401	8.395	0.76	0.446
Access to credit	-1.739	9.364	-3.39	0.001***
Extension access	3.905	6.839	0.57	0.568
Education	-0.874	1.287	-0.68	0.497
Age	8.554	3.405	2.51	0.012**
Household size	-2.049	0.985	-2.08	0.037**
Farming experience	2.518	1.018	2.47	0.013**
Constant	15.527	27.128	0.57	0.567
Number of Obs.	411			
Prob > F	0.0172			
Root MSE	0.30855			

Source: Field Survey, 2021 *** *p<0.01, ** p<0.05, * p<0.1*

Table 5 showed that the technical efficiency of the sampled farmers in the small scale was less than one (1.00) in the study area. The distribution of technical efficiency shows that the most efficient Commercial laying hen farmer has a technical efficiency of 0.99, that is (99.00%) while the least efficient farmer has a technical efficiency of 0.029, that is (2.90%) with a mean technical efficiency of 0.31 that is (31.00%). The mean technical efficiency of 31% means that an average farmer was able to achieve about 31% of optimal output from a given set of inputs under given technology. Thus, the mean technical efficiency shows a reasonable average level of technical efficiency of a farm. Small-scale farmers were not optimally efficient as their observed output is 69% less than the optimum output. Hence, the output of the small-scale laying hen farmers can be raised by 69% through improved resource allocation with no additional cost. Table 6 showed that the technical efficiency of the sampled farmers in the medium scale category was less than one (1.00) in the study area. This implies that Commercial laying hen farmers in the study areas are producing below the optimum output. The distribution of technical efficiency shows that the most efficient laying hen farmer has a technical efficiency of 0.99, that is (99.00%) while the least efficient farmer has a technical efficiency of 0.08, that is (8%) with a mean technical efficiency of 0.31 that is (31%). The mean technical efficiency of 31% means that an average farmer was able to achieve about 31% of optimal output from a given set of inputs under given technology. Thus, the mean technical efficiency shows a reasonable average level of technical efficiency of a farm. The laying hen farmers were not optimally efficient as their observed output is 69% less than the optimum output. Hence, the output of the commercial laying hen farmers can be raised by 69% through improved resource allocation with no additional cost.

Table 5: Efficiency scores of commercial small scale laying hen farmers

Efficiency	**Frequency**	**Percentage**
0.01-0.39	15	35.71
0.40-0.49	15	35.71
0.50-0.69	1	2.38
0.70-0.89	2	4.76
0.80-1.00	9	21.43
Total	**42**	**100**
Mean Efficiency Score	0.31	
Max Efficiency Score	0.99	
Min Efficiency Score	0.029	

Source: Field Survey Data, 2021

Table 6: Efficiency scores of commercial medium scale laying hen farmers

Efficiency	**Frequency**	**Percentage**
0.01-0.39	116	33.82
0.40-0.49	135	39.36
0.50-0.69	39	11.37
0.70-0.89	16	4.66
0.80-1.00	37	10.79
Total	**343**	**100**
Mean Efficiency Score	0.31	
Max Efficiency Score	0.99	
Min Efficiency Score	0.08	

Source: Field Survey Data, 2021

Table 7 showed that the technical efficiency of the sampled farmers in the large-scale category was less than one (1.00) in the study area. This implies that laying hen farmers in this category are producing below the optimum output. The distribution of technical efficiency shows that the most efficient laying hen farmer has a technical efficiency of 0.98, that is (98.00%) while the least efficient farmer has a technical efficiency of 0.06, that is (6.00%) with a mean technical efficiency of 0.53 that is (53%). The mean technical efficiency of 53% means that an average farmer was able to achieve about 53% of optimal output from a given set of inputs under given technology. Thus, the mean technical efficiency shows a reasonable average level of technical efficiency of a farm. Also, the Commercial laying hen farmers were not optimally efficient as their observed output is 47% less than the optimum output. Hence, the output of the laying hen farmers can be raised by 47% through improved resource allocation with no additional cost.

Table 8 showed that the technical efficiency of the group sampled commercial laying hen farmers was less than one (1.00) in the study area. This implies that commercial laying hen farmers in the area are producing below the optimum output. The distribution of technical efficiency shows that the most efficient laying hen farmer in the combined group has a technical efficiency of 0.99, that is (99%) while the least efficient farmer has a technical efficiency of 0.029, that is (2%) with a mean technical efficiency of 0.37 that is (37%). The mean technical efficiency of 37% means that an average farmer was able to achieve about 37% of optimal output from a given set of inputs under given technology. Thus, the mean technical efficiency shows a reasonable average level of technical efficiency of a farm. The laying hen farmers were not optimally efficient as their observed output is 63% less than the optimum output. Hence, the output of the laying hen farmers can be raised by 63% through improved resource allocation with no additional cost.

Summary of the Study

The result showed that the mean age of laying hen farmers in the Southwest zone of Nigeria was 49 years while some of the farmers (48.4%) fell with the age range of 41 – 50 years majority of the laying hen farmers were male (80.3%). Majority of the laying hen farmers were married (97.3%) with average household size of 7 persons. The findings revealed that some of the farmers (56.7%) had between 1-10yrs of laying hen farming experience with the mean year being 11 years. The educational level of the respondents was high with 53.5% of the respondent having attained one form of tertiary education of the other. More so, majority of the farmers had access to credit (87.1%).

Table 7: Efficiency scores of commercial large scale laying hen farmers

Efficiency	**Frequency**	**Percentage**
0.01-0.39	11	42.31
0.40-0.49	7	26.92
0.50-0.69	6	23.08
0.70-0.89	-	-
0.80-1.00	2	7.69
Total	**26**	**100**
Mean Efficiency Score	0.53	
Max Efficiency Score	0.98	
Min Efficiency Score	0.06	

Source: Field Survey Data, 2021

Table 8: Commercial Laying Hen Farmers Efficiency Scores – 3 Categories

Efficiency	Frequency	Percentage
0.01-0.39	142	34.55
0.40-0.49	157	38.20
0.50-0.69	46	11.19
0.70-0.89	18	4.38
0.80-1.00	48	11.69
Total	**411**	**100**
Mean Efficiency Score		
Max Efficiency Score	0.37 0.99	
Min Efficiency Score	0.029	

Source: Field Survey Data, 2021

Only 12.07% of the laying hen farmers had access to livestock insurance. Majority of the respondents (91.5%) had access to livestock extension services. The studies also revealed that majority of the respondent are members of co-operative society (83.7%). The most severe production risk factors in the study area were attack of predators, pests Infestation, and disease infestation, poor housing, rainfall shock, cannibalism, poor housing, and high temperature. The most utilized production risks 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 regular predator bating, fencing/netting, and use of disease resistant species. The choice of risk management strategies was due to experience of the farmer and suitability of the method.

The productivity of laying hen farmers was determined based on the three scales of farming namely small, medium, and large-scale farms. The TFP of the three-production system were 0.452, 0.511 and 0.611 for small, medium, and large-scale laying hen farmers respectively. The outcome of this study based on computation indicates that the large-scale system with TFP of 0.611 was most productive followed by medium scale system and that of the small-scale system. The frequency distribution of TFP from the study shows that 64%, 24% and 23% of large scale, medium scale and small-scale farmers respectively based on the range of TFP of ≥2.00.On the determinants of TFP of laying hen farmers, 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. The socio-economic factors examined in this study include age of farmers, educational level, household size, farming experience, marital status, gender, extension contact, access to livestock insurance, access to credit and membership of co-operative.

Technical Efficiency of laying hen farmers was determined. The maximum likelihood estimate (MLE) of the Stochastic Frontier analysis of laying hen farmers showed that out of the six variables that were used for the model, scale of operation and feed quantity were positively significant while stock type was negatively significant. This implied that variables such as feed quantity, and scale of operation are factors which influence the quantity of outputs of laying hen positively in the study area.

Conclusion

The quest to bridge the gap on protein supply and demand has been compromised by risks associated with production and technical inefficiency of laying hen farmers in Southwest Nigeria. This study focused mainly on providing an answer to the question of the relationship between production risks, technical efficiency, and productivity of laying hen farmers.

The study shows that most severe production risk factors in the study area were attack of predators, pest infestation, disease infestation, high temperature, rainfall shock and power failure. 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.

Based on the findings of the study, factors such as household size, distance to residence, access to extension services and livestock insurance awareness could enhance exposure to production risk .Some of these variable listed above are instrumental to reducing technical efficiency and by extension reduces the productivity of laying hen farming The study also shows that most severe production risk factors in the study area were attack of predators, pest infestation, disease infestation, high temperature, rainfall shock and power failure.

Recommendation

The study therefore recommends that there is need to improve and sustain extension services for laying hen farmers on practices and better management techniques that will improve the present level of production risk management, thereby increasing their agricultural productivity. Also, laying hen farmers should be encouraged to form cooperative association due to the importance of cooperative in promoting productivity and reducing technical inefficiency among the farmers. Therefore, effort should be directed towards policies and programmes that will further enhance farmers' participation and utilization of cooperative in ameliorating production risk.

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