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Brooding Technology Use and Technical Efficiency among Egg Producers in Oyo State, Nigeria

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Abstract. This paper investigated the types of brooding technology used by egg producers in Oyo State, Nigeria and its effect on technical efficiencies of the producers. The study was carried out in two Local Government Areas (LGAs) of Oyo State with data obtained from a total of 139 egg producers (farmers). Descriptive statistics was used to profile the farmers, probit model was employed to analyse the determinants of choice of brooding management technology, Cobb-Douglas stochastic frontier function was used to estimate technical efficiency among the farmers and Tobit regression model was also employed to ascertain technical efficiency determinants. The results show that only 9.4% of the farmers used modern brooding technology and over 50% of them employed unskilled labour. Sex of the farmer ($p<0.10$), household size ($p<0.05$) and having a secondary income ($p<0.05$) were the significant factors influencing adoption of modern brooding technology. Farmers who adopted the traditional brooding technology were found to be 4.3% more efficient than those using modern technology. Age ($p<0.00$), sex ($p<0.05$) and production experience ($p<0.05$) significantly affected their technical efficiencies. It was therefore recommended that technology subsidies, adequate extension training and skill acquisition be injected into the poultry industry to improve production efficiency.

Keyword: Nigeria, Oyo State, poultry egg farmers, stochastic frontier function, technical efficiency

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1. Introduction

The livestock industry is a key contributor to economic growth and development of any nation. In addition to having the capacity of providing revenue for governments, it provides employment, food, farm energy, manure, fuel and transportation [1]. As [2] argued, livestock, especially ruminant, production is the most efficient use of uncultivated land which contributes to crop production. Efficient crop-livestock integration systems have the tendency to allow nutrients to be recycled more effectively on the farm, thereby enhancing crops' yield. Under such a system, livestock can be fed on crop residue like straw, damaged fruits and grains, as well as other products that would have posed a major waste disposal problem [2].

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Poultry are domesticated birds kept by humans for eggs, meat, and feathers. Poultry meat and eggs are a major source of animal protein in the world. An average hen's egg has been found to contain about 13% protein, 12% fats with a negligible amount of carbohydrates. It is particularly rich in calcium (5%), phosphorus (25%), potassium (3%), zinc (11%), iron (9%), and magnesium (3%) and in the accessory food substances among which are vitamins A, B complex, D and E [3], [4]. In response to public concern over dietary fat, poultry has become a popular substitute for beef and pork.

In Nigeria, turkeys, chickens, geese, quails, ducks, among others are produced and consumed, along with their products, with the most predominant being chickens. Poultry production is a major aspect of Nigerian livestock production. The importance of poultry production in Nigeria is predicated on the fact that it can be rapidly expanded to replace red meat in countries with high population growth rates, it improves human nutrition, generates regular income for women, children and other disadvantaged groups, supplies inputs (e.g. manure) for crop production and is generally accepted by the majority of the population [5].

In Nigeria, the increased demand for wholesome poultry and poultry products by the middle class has been spurring business expansion among existing poultry producers, and also stimulating new investments. There are, however, still a lot of challenges experienced by producers in the country. These include high cost of inputs, non-adoption of improved inputs as well as infrastructure challenges. Smallholder poultry farmers are further constrained by poor access to modern technology (e.g. improved variety of birds and feeds, improved brooding technology), low credit accessibility, poor infrastructure, inadequate access to markets, inadequate research and extension services among others [6].

Poultry production in Nigeria has undergone tremendous changes over the past decades in terms of genotype, management and technological advancement. The poultry industry in Nigeria can take advantage of the potentials of new and improved brooding technology which has the potential to shift the production curve to the left with more output being obtained at the same level of input thereby boosting the technical efficiencies of poultry farmers [6].

Brooding refers to the period immediately after hatching when special care and attention must be given to the chicks to ensure their health and survival. According to [7] during the brooding phase, damage can be caused in the first two weeks of life that may not noticed until later. During this stage the chick has a developing immune system and inefficient temperature regulation and exposure to stress could lead to loss of uniformity in the flock. Creating 'comfort zone' for the chicks, allowing access to heat, feed and clean water at all times, is therefore essential. Research shows that even a few hours of poor conditions during brooding can do significant harm to overall flock performance including reduced growth and development, poor feed conversion, increased disease susceptibility and high mortality rate [7], [8]. Traditional brooders used in Oyo State consist mainly of hand-crafted (often make-shift) conventional cages with kerosene-fueled heating sources. The modern brooders on the other hand are industrial, gas-heated chambers constructed to scientific specifications for optimal brooding. They are sometimes fitted with automatic infrared temperature control mechanisms.

Poultry meat and eggs offer considerable potential for bridging the nutritional gap in view of the fact that high yielding exotic poultry are easily adaptable to the Nigerian environment and the technology of production is relatively simple with returns on investment appreciably high [9]. However, as opined by [10], [11], one of the major problems of poultry production in Nigeria is that of low productivity and inefficiency in resource allocation and utilization. Based on the foregoing, this paper sought to examine the nature of brooding technology adoption as well as its effect on the technical efficiencies of poultry egg farmers in Oyo State, Nigeria.

2. Materials and Methods

The study was conducted in two local government areas (LGAs) in Oyo state. Oyo State is an inland state in Southwestern Nigeria, with its capital at Ibadan. It is bordered to the north by Kwara state, to the east by Osun State, to the south by Ogun state and to the west partly by Ogun state and The Republic of Benin. It lies between latitudes 2°38ˈand 4°35ˈeast of the Greenwich meridian. The climate is equatorial with distinct dry and wet seasons and relatively high humidity. The two LGAs used for the study were Afijio and Oluyole LGAs. While Oluyole Local Government consists mainly of urban areas, Afijio Local Government is mostly a rural LGA. Afijio LGA covers a total land mass of 1,365 square kilometers, with about 30 towns and villages and a population of 84,504 [12]. Oluyole LGA, on the other hand, has a land area of 629 square kilometers and a population of 203,461 [12]. There are high concentrations of poultry farmers in both LGAs, making them suitable for this study.

2.1. Data Collection

Simple random selection of producers in each LGA based on proportionate to size, led to the selection of 54 respondents in Oluyole LGA and 85 in Afijio LGA, making a total of 139 respondents chosen for the study. Different brooding systems were selected as these impacts on productivity and eventually the profit of the farmers. A structured questionnaire was used to elicit responses from the producers on egg output, inputs used, input and output prices as well as their key socioeconomic characteristics. Specifically, information was collected on stock of birds, feed intake (in kilograms) labor used, cost of veterinary services, number of eggs produced, brooding technology adopted, cost of brooding management tools, management techniques employed, years of experience in poultry egg production, educational status and household size. Data obtained were based on poultry egg production activities of the previous production year.

2.2. Data Analysis

Descriptive statistics were used to profile the socio-economic characteristics of the farmers, their awareness of modern brooding technology, input and output variables and the distribution of farmers' technical efficiency levels. The Probit model was used to explore the factors that influence poultry egg farmers' choice of brooding technology.

Technical efficiency (defined as the ratio of farmer's actual output to the technically maximum possible output, at given level of resources) was estimated using a stochastic production frontier function that incorporated inefficiency factors. A Maximum Likelihood Estimate (MLE) technique was employed to obtain farm-specific technical efficiencies as well as their determinants.

2.3. Model Specification

2.3.1. The Probit Model

The Probit model is used to analyze binomial response variables, where the dependent variable can only take values of 1 or 0. The Probit regression model was specified as follows:

$$Y_i = \beta_0 + \beta_i \mathbf{X} + \mu_i \quad (1)$$

where: Y_i = Choice of brooding management technology (1 = modern, 0 = traditional); B_0 = Constant term; β_i = Estimated parameters explaining the participatory variables respectively; $\mathbf{X}$ = Vector of respondents' characteristics explaining their choice of brooding management technology; μ_i = error term.

The independent variables are explicitly stated as follows: X_1 = Age (in years); X_2 = Sex of the farmer (Male = 1, 0 otherwise); X_3 = Number of years of formal education; X_4 = Marital status (Married = 1, otherwise = 0); X_5 = Household size (Number); X_6 = Secondary occupation (Yes = 1, 0 otherwise); X_7 = Income from egg production (Naira); X_8 = Type of labor used (Skilled = 1, otherwise = 0); X_9 = Experience in poultry egg production (Years); X_{10} = Average number of birds lost per month (Number); X_{11} = Poultry management system (Intensive = 1, otherwise = 0). These variables were selected based on the findings of [13] and [11].

2.3.2. The Stochastic Production Function

The stochastic production function adopted for this study follows a cost-decomposition procedure of estimating technical, allocative and economic efficiencies. Following [14], [15], the functional form used was the Cobb-Douglas equation. A perfectly efficient farmer was considered to be one operating on the production frontier (thereby earning an efficiency score of 1) while an inefficient farmer was considered to be operating below the production frontier (thereby earning an efficiency score < 1).

The stochastic production frontier function was specified as

$$Q_i = F(\mathbf{G}, \beta) + V_i - U_i \tag{2}$$

where: Q_i = Egg output from the *ith* farm (measured in physical terms of number of eggs); $\mathbf{G}$ = Vector of inputs used by the *ith* farmer; β = Vector of parameters to be estimated; V_i = The symmetrical disturbance which captures the random error effects on output. It is assumed to account for measurement error and other factors not under the control of the farmer. Also, it is assumed to be independently and identically distributed as N(0, S^2v) and U_i = The asymmetrical error component. It captures the inefficiency of the farm and is assumed to be non-negative truncations of N(0, S^2_v) distribution (i.e., half-normal distribution)

Consequently, the Cobb-Douglas function used for thus study is specified as follows:

$$Q_i = A \prod_{i=1}^{N} \boldsymbol{G}_i^{\beta_i} e^{-U_i + V_i} \tag{4}$$

where: A and β_i are the efficiency parameter and the output elasticity coefficients, respectively. The estimating equation then becomes:

$$LnQ_i = LnA + \sum_{i=1}^{n} Ln\mathbf{G} + e \tag{4}$$

Where, $e_i = V_i - U_i$ and $Ln\ e = 1$. Hence, Equations 4 and 5:

$$LnQ_i = LnA + \sum_{i=1}^{n} \beta_i Ln\mathbf{G} + (V_i - U_i) \tag{5}$$

$$LnQ_i = LnA + \beta_1 LnG_1 + \beta_2 LnG_2 + \beta_3 LnG_3 + \beta_4 LnG_4 + (V_i - U_i) \tag{6}$$

The MLE has however been found to be asymmetrically more efficient than the corrected OLS estimators [16]. Therefore, Maximum Likelihood Estimator (MLE) provides estimates for γ, λ and σ as shown in equations 7 – 9:

$$\lambda = \frac{\sigma u}{\sigma v} \tag{7}$$

$$\sigma = \sigma^2 u + \sigma^2 v \tag{8}$$

$$\gamma = \frac{\lambda^2}{1+\lambda^2} \tag{9}$$

Measurement of variables: Q_i is the output in terms of the total number of eggs produced; X_1 = Farm size (measured as number of birds); X_2 = Labor input (Man days); X_3 = Total feed intake (kg); X_4 = Total cost of brooding management tools adopted (₦).

On the other hand, the estimated stochastic cost function was specified as:

$$LnC_i = \beta_0 + \sum \beta_1 LnP_{ij} + \sum \beta_2 LnQ_i + (V + U) \quad (10)$$

where: Ln = Natural logarithm; C_i = Total input cost for the *ith* farm (in naira); P_{ij} = Unit price for input (j = 1, 2, …, 6); P_{i1} = Unit price of birds (Naira); P_{i2} = Wage rate for hired labour (Naira); and P_{i3} = Average price of brooding management tools adopted (Naira).

The inefficiency function was specified as:

$$R = b_0 + b_1Z_1 + b_2Z_2 + b_3Z_3 + b_4Z_4 + e \quad (11)$$

Where, R = Inefficiency; Z_1 = Age; Z_2 = Years of experience in poultry egg production; Z_3 = Years of formal education; and Z_4 = Mortality (measured as the number of birds lost per month).

2.3.3. The Tobit Regression Model

The Tobit regression model was used to analyze the determinants of technical efficiency among the farmers. The Tobit model was specified as follows:

$$TE_i = \alpha_0 + \alpha_i \mathbf{Z} + \varepsilon_i \quad (12)$$

where: TE_i = Technical efficiency of the *ith* farmer; $\mathbf{Z}$ = Vector of covariates of technical efficiency among poultry egg farmers including brooding management used (traditional brooding management = 0, modern brooding management = 1), age of egg farmers, sex (male = 1, female = 0), years of formal education, years of experience in poultry egg production, marital status (married = 1, otherwise = 0) and household size.

2.3.4. Limitation(s) of the Study

The study was completely self-sponsored and as such only a relatively small sample of 139 respondents could be surveyed given the limitations of resources available.

3. Results and Discussion

3.1. Brooding Technology Use and Profile of Poultry Egg Farmers in Oyo State

Table 1 reveals that improved brooding technology was not well adopted in the study area as only 9.4% of farmers used modern brooding management.

Table 1. Brooding Technology Use among Poultry Egg Farmers

Brooding Technology	Frequency	Percentage
Traditional brooding management	126	90.6
Modern brooding management	13	9.4
Total	139	100.0

The socioeconomic profile of the farmers delineated by their choice of brooding technology is shown in Table 2. It can be seen from the table that the younger farmers (aged 26 – 45 years) made up the bulk (92.4%) of the adopters of modern brooding management indicating that the more innovative and energetic young people were more likely to try out the less popular modern brooding management system. Further, the table shows that poultry egg production is male-dominated in Oyo State as the bulk of the respondents (85.6%) were men.

Table 2. Distribution of Socioeconomic Characteristics of Poultry Egg Farmers

Characteristics	Brooding Technology Choice		Pooled Data (n=139) (%)
	Traditional (n=126) (%)	Modern (n=13) (%)	
Age			
≤25	10.3	0	10.3
26-35	25.4	46.2	27.3
36-45	38.9	46.2	38.4
46-55	22.2	7.6	20.8
>55	3.2	0	3.2
Mean	56	53	55.7
Sex			
Male	86.5	76.9	85.6
Female	13.5	23.1	14.4
Marital Status			
Single	4.8	0	4.8
Married	87.3	84.6	86.4
Divorced	6.3	15.4	7.2
Others	1.6	0	1.6
Educational Background of the Respondents			
No formal Education	8.7	0	8.7
Primary	8.7	7.7	8.6
Secondary	43.7	53.8	44.1
Tertiary	33.3	38.5	33.0
Others	5.6	0	5.6
Household Size			
≤ 3	19.8	23.1	20.1
4 – 6	75.4	76.9	75.1
>6	4.8	0	4.8
Mean	5	4	4.9
Years of Brooding Experience			
≤5	17.5	30.8	18.7
6 – 10	60.3	15.4	56.1
11 – 15	19.0	53.8	22.0
>15	3.2	0	3.2
Mean	8	9	8.1
Secondary Occupation			
Civil Servant	15.9	15.4	15.4
Trader	22.2	46.2	24.4
Private Firm Employee	10.3	15.4	10.8
Self-employed	35.7	23.0	33.5
Handcraft	15.9	0	15.9
Income From Secondary Occupation			
≤₦30,000	48.4	23.1	44.0
₦30,001 – ₦50,000	29.4	76.9	33.8
₦50,001 – ₦100,000	17.4	0	17.4
> ₦100,001	4.8	0	4.8
Mean	₦54, 049	₦48, 078	₦53, 490.6

The information in the table also suggests that educational attainment is important to the choice of brooding technology by the respondent farmers as it can be seen that 92.7% of the adopters of the modern brooding management system had at least secondary education with 38.5% having obtained tertiary education. It is also instructive to note that while nearly 9% of those who adopted the traditional system had no formal education at all, all the users of the modern system had at least some form of formal education. This scenario is understandable as some measure of education is required to understand and apply modern techniques in agriculture.

Table 2 further reveals that the more experienced farmers were the majority of adopters of modern brooding management as more than half (53.8%) of the poultry egg farmers who used this system had between 11 to 15 years of brooding experience. Also, it can be deduced from the table that low income tended to make farmers adopt the cheaper traditional brooding system since almost half of those who adopted it earned ₦30, 000 or less from their secondary occupations.

3.2. Profile of Farming Operations of Poultry Egg Producers

A profile of the farming operations of the egg producers decomposed by their choice of brooding system is shown in table 3.

Table 3. Distribution of Poultry Egg Farmers by Their Farming Operations

Characteristics	Brooding Technology Types (Methods)		Pooled Data (n=139) (%)
	Traditional (n=126) (%)	Modern (n=13) (%)	
Production System			
Intensive	95.2	92.3	94.9
Semi intensive	4.8	7.7	5.1
Labour Used			
Skilled	1.6	7.7	2.2
Semi-skilled	38.1	38.5	38.1
Unskilled	60.3	53.8	59.7
Income from Poultry Egg Production			
≤₦50,000	63.5	84.6	65.5
₦50,001 – ₦100,000	19.8	7.7	18.7
₦100,001 – ₦500,000	15.9	7.7	15.1
>₦500,001	0.8	0	0.7
Mean	₦97, 421 ($90)	₦55, 769 ($100)	₦93, 525.5 ($88)

Most poultry egg production done in Oyo State follows the intensive system, often using battery cages. Expectedly, therefore, table 3 shows that approximately 95% of the sampled farmers adopted the intensive approach in their production. Similar statistics were observed between both sets of brooding technology adopters. Furthermore, the results in the table reveal that skill is not a major consideration in hiring labour for poultry egg production in the study area as less than 3% of the farmers employed skilled labour; more of the adopters of modern brooding systems employed skilled labour (7.7%) than their counterparts who didn't (1.6%), albeit only a slightly higher proportion. Incomes were also generally low as most (84%) of the farmers earned less than ₦100, 000 monthly from their enterprises.

3.3. Determinants of Poultry Egg Farmers' Choice of Brooding Management System

Table 4 shows the parameter estimates of the probit model of the determinants of poultry egg farmers' choice of brooding management system. Three variables were found to significantly influence the choice farmers make: sex of the farmer, household size and secondary occupation. Sex showed a negative and significant relationship ($\alpha_{0.10}$) with the dependent variable indicating that male poultry egg producers were more likely to adopt modern brooding management techniques than their female counterparts. Household size also significantly negatively affected the dependent variable ($\alpha_{0.05}$). This means that the larger the household of a farmer, the smaller the probability that they would adopt modern brooding techniques. Studies have shown that large household sizes are often associated with reduced purchasing power due to pressure on the household income [17], [18]. Therefore, farmers with larger households might find it more difficult to pay for modern brooding technology. On the other hand having a secondary occupation might increase the a farmer's total income, allowing him to pay for improved brooding technology, hence having a secondary income source was found to be positively and significantly related to the dependent variable ($\alpha_{0.05}$).

Table 4. Parameter Estimates of Factors Affecting Choice of Brooding System

Variable	Coefficient	Std Error	Z	t-ratio
Age	0.078	0.083	0.94	0.349
Sex of the farmer	-2.076	1.258	-1.65	0.099*
Years formal education	-0.117	0.172	-0.68	0.497
Marital status	-0.734	0.857	-0.86	0.392
Household size	-0.682	0.334	-2.04	0.041**
Secondary occupation	1.293	0.568	2.28	0.023**
Income from egg production	-0.701	0.000	-0.42	0.675
Type of labor used	-0.802	1.048	-0.77	0.444
Experience in production	-0.911	1.398	-0.65	0.515
Av. Number of birds lost/month	-50.516	37.177	-1.36	0.174
Poultry management system	2.636	1.648	1.60	0.110
Constant	7.991	4.646	1.72	0.085
LR Chi^2 (15) = 24.050				
Prob. > Chi^2 = 0.064				
Log likelihood = -13.281				
Pseudo R^2 = 0.475				
Number of Observations = 139				

*Note: ** indicates significance at 5% level, * indicates significance at 10% level*

3.4. Maximum Likelihood Estimates of the Cobb-Douglas Stochastic Frontier Function

The result of the maximum likelihood estimates for parameters of the Cobb-Douglas production function is presented in Table 5. These parameters represent the percentage change in the output of poultry eggs as a result of a percentage changes in inputs used. An inefficiency model is estimated simultaneously to expose any socioeconomic traits of the farmer that might prevent him from operating on the efficiency frontier. The sigma square value of 0.569 which was significant at 1% level attests to the correctness of the specified assumptions with regards to the distribution of the composite error term.

Table 5. Maximum Likelihood Estimates of the Stochastic Frontier Function

Variables	Coefficient	Std. Error	t-ratio
Efficiency Model			
Number of birds	0.284	0.032	0.000***
Labor in man-days	-0.038	0.038	0.324
Cost of technology	0.000	0.000	0.069*
Constant	1.805	0.155	0.000
Inefficiency Model			
Age of the farmer	0.005	0.051	0.916
Years of production experience	1.501	0.389	0.000***
Years of formal education	-1.520	1.463	0.299
Mortality	-1.660	1.696	0.328
Constant	-9.510	2.239	0.000
Diagnostic Statistics			
Variance of parameter	-1.127	0.382	0.003
Sigma square (σ^2)	0.569	0.109	

*Note: *** indicates significance at 1% level, * indicates significance at 10% level*

Based on the results, number of birds ($\alpha_{0.01}$) and cost of technology ($\alpha_{0.10}$) were the major productive inputs that impacted positively on the efficiency of poultry egg farmers in Oyo State. This means that farmers can increase their egg output considerably by expanding their flock size and increasing their expenditure on productive technology. This agrees with the findings of [13]. The inefficiency model, on the other hand, revealed that years of production experience was a significant factor ($\alpha_{0.01}$) that could increase the technical efficiency of the poultry egg farmer. Similar findings were made by [19]. The mean technical efficiencies estimated on the basis of the Cobb-Douglas frontier function for the two groups of poultry egg farmers are shown in Table 6.

Table 6. Mean Technical Efficiencies of Poultry Egg Farmers

Brooding Management Type	Mean	n	Std. Deviation
Traditional brooding management	0.771	126	0.141
Modern brooding management	0.728	13	0.111
Total	**0.767**	**139**	**0.138**

Going by the results obtained, poultry egg farmers who adopted the use of the traditional brooding system were more efficient in the combination of their inputs than those who adopted the modern brooding technology. While this result contradicts *a priori* expectations (such as the findings of [20]. It is worthy of note that, as observed by [21], [22], most of the existing studies on stochastic frontiers and technical efficiency focus on the static analysis of a producer's behavior, and therefore, fail to capture the dynamic nature of a firm's optimization process. In other words, these studies assume that when a unit of input is introduced into the production system, it immediately contributes to production at its maximum possible level. However, it is reasonable to assume that following its introduction into a production system, an input requires some time for adjustment within the system. Therefore, it might not be possible for a firm to catch up with the production frontier instantaneously following the introduction of a new technology.

The overall mean technical efficiency of 0.767, however, implies that poultry egg farmers in Oyo State are 23.3% off the optimal possible production frontier given their existing level of inputs. [23], suggested that this kind of scenario represents a window of opportunity for increased efficiency either through increased output or reduced cost of production under the prevailing technology and business climate.

3.5. Determinants of the Technical Efficiency of the Poultry Egg Farmers

The Tobit regression model estimated showed that the age, sex and years of production experience of a farmer are the significant factors (at $\alpha_{0.01}$, $\alpha_{0.05}$ and $\alpha_{0.05}$ levels of significance respectively) that influence his technical efficiency. Age had a negative coefficient (-0.141) implying that the older the farmer is, the less efficient he becomes. [24] also found a similar inverse relationship between both variables among poultry egg farmers on a national scale. The positive coefficient for sex indicates that being male meant that the farmer would be more likely to be technically efficient than being female in the study area.

Table 7. Parameter Estimates of the Tobit Model of Determinants of Technical Efficiency

Variable	Coefficient	Standard error	t-ratio
Brooding technology	-0.860	0.646	0.894
Age of the farmer	-0.141	0.103	0.000***
Sex of the farmer	0.123	0.513	0.016**
Years of formal education	0.934	0.151	0.535
Years of production experience	0.393	0.213	0.065**
Marital status	0.693	0.151	0.645
Household size	0.337	0.388	0.386
Model size: Observations = 139 Parameters = 7, Deg. of Freedom = 144 Residuals: Sum of squares = 6.401665899 Standard Deviation = 0.21085 Diagnostic: Log-L = 24.3748 Restricted (b=0) Log-L = 79.5182			

*Note: *** indicates significance at 1% level, ** indicates significance at 5% level*

Years of production experience was shown by the results to be an important factor that could improve a farmer's technical efficiency as it was positively related to the dependent variable (0.393, $\alpha_{0.05}$). This is expected since experience comes with increased expertise and management skill which can impact positively on the output/efficiency of a poultry egg farmer. Brooding technology choice was not a significant factor affecting technical efficiency among poultry egg farmers in Oyo State.

4. Conclusion And Recommendations

This study revealed that the prevalent brooding method used in Oyo State, Nigeria is the traditional brooding system. However, the use of modern brooding technology did not make its adopters more technically efficient. While poultry egg farmers in the study area were relatively close to the efficiency frontier, there still remains some room for efficiency improvement.

Based on the foregoing, the following recommendations are made:

- Income was revealed to be a limiting factor in the adoption of modern technology in the poultry industry in Oyo State, Nigeria. Therefore, subsidy programmes can be implemented in order to boost the ability of farmers to embrace productive technology.
- The lower technical efficiency of poultry egg farmers who adopted modern brooding technology might be attributed to the fact that accessibility to these improved brooding tools does not necessarily mean utilization. Lack of technical knowhow and managerial skills among poultry egg farmers, inexperience, information asymmetry and other socioeconomic factors could limit optimal utilization of brooding technology. Hence it is recommended that capacity building of farmers through adequate training by extension officers can help farmers to use available technology efficiently.
- It was revealed that poultry egg farmers in Oyo State mostly employed unskilled labour. This might hinder the use of these technologies due to lack. It is therefore recommended that the poultry industry in Oyo State be empowered to absorb persons with adequate and relevant competencies in agriculture and poultry management to enhance efficiency.

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