PROFITABILITY OF DEEP LITTER LAYER ENTERPRISES IN JOS NORTH LOCAL GOVERNMENT AREA OF PLATEAU STATE, NIGERIA.

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ABSTRACT

*This study examined the profitability and continuity of deep litter layer enterprises, especially during periods of egg glut in the study area. Eighty (80) respondents randomly chosen from members of the Poultry Farmers Association of Nigeria, Jos North LGA were sampled. Data were analysed with descriptive and inferential statistics. Results showed a mean age of 46 years. All the respondents are literate with mean years of formal schooling of 15.3 years. They have a mean household size of 6 persons per respondent with a mean of 8.5 years of farming experience. The mean stock size is 1473 laying birds. The results of the profitability analysis show that the Gross Margin is ₦8,408,759.75, Net Farm Income **is** ₦8,282,009.75, Rate of Returns on Investment of 23.58%, Capital Turn Over of 1.24, Return To Feed Ratio of 1.30 and Return to Layer Feed Ratio (RLFR) during egg glut of 0.77. Result of the effects of input costs on the revenue of the respondents shows an R^2 value of 89%. Specifically, stock size (α 0.01), and utilities (α 0.01), have positive and significant effects on the revenue while cost of feed (α 0.01), and cost of labour (α 0.05), have significant but negative effects on the revenue of the farmer respondents. The study recommends an implementable government policy of guaranteed minimum price of eggs, especially during the short period of egg glut, massive expansion of maize production in the country since maize is now a food crop and an industrial crop; and establishment and maintenance of functional strategic grains reserves for lowering of feed prices.*

Keywords: Profitability, Egg glut, Return to Layer Feed Ratio, Return to Layer Feed Ratio during glut.

INTRODUCTION

Poultry keeping has some advantage over other livestock because they are good converters of feed to useable protein in meat and eggs, production cost per unit is relatively low, return to investments is high if properly taken care of and lastly it has a short production cycle such that capital is not tied down over a long period (Heise *et al*., 2015). Food and Agricultural Organization of the United Nations (FAO, 2013) found that eggs rank second to cow milk in terms of nutritive value and the most economically produced animal protein. Thus, the need for increasing the quantity and quality of protein supply in Nigeria is a challenge that is beyond dependence on plant protein alone (Filli *et al*., 2021).

Netherland Enterprise Agency (2020) reported that Nigeria's current per capita consumption rate is meagre 65 eggs and 1.9kg of poultry meat when compared to global average of 150 eggs and 13.8kg of poultry meat per year. This shows a yawning gap begging to be filled.

The calls by various tiers of government for farmers to expand chicken egg production in Nigeria were heeded by farmers in Jos and its environs in the past couple of decades probably because of its clement weather. Hence, Jos environs became a major hub for producing egg for Northern Nigeria and neighbouring northern countries. Many small, medium and large scale egg producing farms were established by individuals, Faith Based Organizations and Non-Governmental Organizations in other to fill the supply gap created by the banning of poultry products by the Federal Government of Nigeria.

According to Maduka *et al*. (2016) deep litter system happens to be the most common system of commercial chicken egg production in the study area. Deep litter, is an intensive system of poultry management that requires raising of chickens on a concrete floor having a layer of bedding materials such as wood shavings, groundnut husk, rice bran etc. The bedding material is what is referred to as "litter" and that is where the name "deep litter system for chickens" stems from (Agro4africa, 2023).

Despite the importance and contributions of chicken egg producing firms to Nigeria's Gross Domestic Product (GDP); the business serving as a veritable means of livelihood and employer of labour both directly and indirectly in the study area, the egg producing farm firms in recent times seem to be faltering; not as a result of low productivity and overall profitability of farm firms but as a result of unfair pricing of chicken eggs. For the chicken egg farms to continue to run their farms continuously, they must receive fair producer prices that would cover the cost of production and leave them with some tangible margin. Consequently, the number of the chicken egg producing firms in recent times, have been noted to be folding due to high cost of production in the midst of the buyer's market facing them. The reasons behind this development have not been empirically ascertained.

Egg production in recent times in the study area has been bedevilled by unstable trends in the economy. The several problems confronting the industry make it difficult for existing firms to expand while new ones seem to be reluctant to continue the business probably because it is no longer profitable and sustainable. Such challenges include high cost of feed, feed price volatility and high cost of other production cost with no commensurate increment in the price of eggs. This situation is forcing many small, medium and even large scale poultry farms to close down in the midst of other challenging uncertainties (Okeke-Agulu, 2023).

Many poultry farmers have been observed to have either shut down or are operating far below their operational capacity. Those farmers still managing to survive seem to be producing at very high cost with little or no profit especially during the period of egg glut. Not much current empirical information is available on the effect of cost of inputs on the revenue of the farms, returns to feed ratio and especially returns to layer feed ratio during egg glut in the study area. Thus, there is a yawning knowledge gap on the effect of these factors on the egg producing enterprises under deep litter system in the study area.

Consequently, the specific objectives of this study are to describe the socioeconomic characteristics of the chicken egg producers, estimate the profitability of chicken egg enterprises, estimate the returns to layer feed during egg glut period and to determine the effects of input costs on the revenue of chicken egg producers.

METHODOLOGY

Study Area

Jos North Local Government of Plateau State, Nigeria is located on latitude 9°56'21.7''North and longitude 8°54'8'' East of Greenwich meridian. It covers a land area of 291 km² with a population of 429,300 According to National Population commission census of 2006, approximated to 643,950 in 2024. The area witnesses two major seasons which are the dry and the rainy seasons with the total precipitation level in the area put at 1750mm of rainfall per annum. The average wind speed in Jos North LGA is 11 km/h. Jos North is noted for its heterogeneity, as it comprises many different ethnic groups among which are Anaguta, Angas, Beroms, Fulani, Igbo, Hausa and Yoruba. Most of these people engage in commercial activities such as Trading, commercial driving, farming, while others are civil servants. There are more than 4000 poultry farmers who are members of Poultry Association of Nigeria (PAN), Jos chapter (Daily Trust, 2022).

Sampling Procedure and size

The sample frame for this study comprised of over 4000 poultry farmers who form the members of Poultry Association of Nigeria (PAN), Jos chapter. The list of the PAN membership was obtained from where purposive samplings of deep litter using egg producing farmers and those who are currently producing eggs (1228) were identified. From this number, a random sampling procedure was used to select 80 respondents used for the study. Primary data were generated through open and closed ended questionnaire schedules. Focus group discussion sessions were also held to elicit more information from the respondents.

Analytical Techniques

Descriptive statistics such as frequencies and percentages were used to describe the socioeconomic characteristics of the respondents, Farm budgeting technique was used to determine the profitability of the enterprises. Returns to feed ratio during egg glut was used to ascertain the sustainability/ continuity of egg producing enterprises while a multiple regression model was used to determine the effect of some farm inputs on the revenue of the enterprises.

Model Specification

Farm Budgetary Technique

The net farm income of the chicken egg producing firms was analysed using net farm income analysis. The Net farm income (NFI) model determines the return to invested capital and return to management (Olukosi and Erhabor, 2008, as cited by Folorunso *et al*., 2018). It is represented in equation (1)

$$\text{NFI} = \sum P_y - \sum P_x - \sum P_k \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where: NFI = Net Farm Income (₦); $\sum$ = Summation sign; P = Unit price; y = Output (₦); X = Input (Variable); K = Input (fixed)

Financial Indices for deep litter laying enterprises in the study area.

The following financial indices were calculated:

i. Rate of Returns on Investment (%)
$$\text{RRI} = \frac{NFI}{TC} \times 100\% \dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Where: TC = Total cost, hence (TVC + TFC) Equation (3) shows the ratio of the accounting profit to the investment in the farm, expressed as a percentage. The RRI should be greater than the cost of capital for the investment to be worthwhile. The RRI should also be greater than or equal to the interest/hurdle rate on fixed deposit.

ii Capital Turnover (CTO): $= \frac{TR}{TC}$ .... (3)

Where: TR= Total Revenue CTO is defined as the total revenue divided by total cost of production. It describes roughly how much naira in revenue the farm can generate for each naira invested over a given period. That is, it is used to analyse the relationship between the money used to fund operations on the farm and the sales generated from the operations. This ratio should be greater than 1 for the investment to be profitable.

iii Return to feed Ratio:

Return to feed Ratio (RFR)

$$RFR = \frac{Revenue(₦)}{Feed\,(₦)} \,……………………………………………………….(4)$$

This ratio is expected to be more than 1 if fair price prevails in the farm gate egg market.

iv Return to Layer Feed Ratio (RLFR) during glut

$$= \frac{Revenue\,during\,egg\,glut(₦)}{LM\,consumed\,during\,egg\,glut(₦)} \,…………………………………….(5)$$

This ratio from equation 5 is expected to be more than 1 for the business to remain profitable during the period of egg glut. If it is zero, the birds can feed themselves but will leave the farmer without profit. If the ratio is less than zero during period of egg glut, the farmer will not be able to pay for layers mash. This is the critical period the farms will close down if they cannot get external support/intervention to feed the laying birds.

Multiple Regressions Analytical Technique.

A multiple regression model was used to elicit the effect of some farm inputs on the revenue of the enterprises. The model is implicitly stated as:

$$Y=f(X_1 + X_2 + X_3 + X_4 + 5 + Ui)……………………………………………………..(6)$$

Where:

Y = Revenue (Value of eggs sold and spent/culled layers, manure, empty bags, home consumed/gifts) (₦)

$X_1 = Price\,of\,day\,old\,chicks$ (₦)

X_2=Number of laying birds

= Cost of veterinary services (₦)

X4=Feed (₦)

X_5 =Hired labour

$X_6 = Utilities\,(made\,up\,of\,electricity, water\,supply, litter, transportation,$₦)

U_i = Error term

The explicit functional forms that were tried are as follows:

a.   Linear functional form:

Y= b$_0$ + b$_1$X$_1$+b$_2$X$_2$+b$_3$X$_3$+b$_4$X$_4$+b$_5$X$_5$+b$_6$X$_6$+U……………………………………….(7)

b.   Semi-log form

Y = b$_0$+b$_1$ logX1+b$_2$ logX$_2$+b$_3$ logX$_3$+b$_4$ logX$_4$+b$_5$ logX$_5$+b$_6$ logX$_6$+U…………..(8)

c.   Double-log form

LogY=b$_0$+b$_1$logX$_1$+b$_2$logX$_2$+ …………………..b$_6$logX$_6$+U ………………….(9)

d.   Exponential functional form:

LogY = b$_0$+b$_1$logX$_1$+b$_2$+ ……………b$_6$logX$_6$+logU ………………   (10

Where: b_0 is a constant term and $b_1…b_n$ are estimated coefficients of the variables; $X_1…X_6$ are the independent variables respectively, as defined in equation 6. The variables $X1…X_6$ were expected to have positive causal relationships with Y and were added to the model to determine the extent to which each of them explained variation in total revenue of the chicken egg producing firms in the study area. The semi-log form was eventually chosen as it was the lead equation.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents in the Study Area.

The socioeconomic attributes of the respondents described in this study include Age, level of education, household size, years of farming experience and stock size of respondents.

Table 1: Distribution of Respondents According to Socioeconomic Attributes

Variables	Frequency	Percentage	Mean
AGE			
≤40	24	30	
41-45	24	30	
46-50	12	15	
41-55	12	15	
> 55	8	10	
TOTAL	**80**	**100**	**46**
Level of Education			
No formal education	-	-	
Primary	-	-	
Secondary	16	20	
Undergraduate	28	35	
Postgraduate	36	45	
TOTAL	**80**	**100**	**15.3**
Household size			
Less than 3	4	5	
4-7	56	70	
>7	20	25	
Total	**80**	**100**	**6**
Years of farming Exp			
<3	8	10	
4-7	24	30	
8-11	32	40	
>11	16	20	
Total	**80**	**100**	**8.6**
Stocksize			
≤ 500	4	5	
501-1000	24	30	
1001-1500	28	35	
1501-2000	16	20	
>2000	8	10	
Total	**80**	**100**	**1473**

Source: Field Survey, 2023.

Table 1 shows that 90% of the respondents are aged less than 55 years with a mean of 46 years. The importance of age as a socio-economic characteristic that determine the level of awareness of farmer respondents can never be overemphasized. Aged farmers may not be aware of latest technology and innovations due to lack of information ((Aldosari *et al.*, 2019). The finding of this study is similar to Akintude (2015) who found that 71% of his poultry farmer respondents were below 50years of age with a mean of 45.5 years. The finding is also similar to Onogwu *et al*. (2017) who reported that all their poultry farmer respondents were less than 50 years with a mean of 46years.

Table 1 also indicated that no respondent belonged to the category of no formal education and primary education. Twenty (20%) had secondary education (12 years of schooling), 35% are undergraduates (16 years of schooling), 45% are post graduates (more than 17 years of schooling) with a mean years of schooling of 15.3. Earlier studies have shown that farmers with formal education have greater ability to adopt new technologies and innovations. This is expected to have a positive influence on their level of production efficiency (Oli et al., 2025). Haruna *et al*. (2002) also found that 71% of their respondents had access to tertiary education while the remaining 28% had secondary education.

The Table also shows that 70% of the respondents have household sizes of 4 – 7 while 25% have 7 or more persons with a mean of 6 persons. This finding is almost similar to the findings of Muhammad *et al*. (2019). The importance of sizeable household in small scale farming can never be overemphasized because of the farm hands in the form of family labour which they readily provide.

A look at the years of experience of the respondents shows that 20% of the respondents have more than 11 years of poultry farming experience, 40% have 8 – 11 years, 30% have 4 – 7 years while only 10% have 3 and below years of farming experience and mean of 8.5. The importance of experience in any business enterprise can never be overemphasized. Filli *et al*. (2021) had posited that majority of the poultry-egg farms owners in his study area were fairly new entrants into the business; they are not expected to be as productive as farmers who have longer years of experience. More experienced farmers are generally expected to master the techniques of production without making previous mistakes. The implication is that more experienced poultry-egg farm owners are likely to make better decisions to enhance productivity and income all things being equal, because it is expected that experience in poultry-egg production usually determines the effectiveness of farmers' decision with respect to making and taking rational decisions on input combinations or resource allocation.

Table 1 also shows that only 10% of the respondents have laying stock of more than 2000 birds. Twenty percent (20%) have laying stock of 1500 – 2000 birds, 35% of the respondents have laying stock of 1000 – 1500 birds, 30% have laying stock of 501 – 1000 birds while only 5% have laying stock of less than 500 birds. The mean stock size is 1473 birds.

This means that using Busari and Okanlawon, (2015) and Haruna *et al*. (2007) classification of stock sizes, that most of the respondents have stock sizes that can be classified as small (<1000) and medium scale (>1000 - <5000) poultry egg production farms. Onogwu *et al*. (2017) had earlier posited a direct relationship between stock size and productivity. Hence larger stock sizes are expected to bring in higher income all things being equal.

Profitability of chicken egg farming under deep litter system in the study area.
The profitability and other financial analysis of chicken egg farming under deep litter system in the study area are presented in Table 2. The calculations from Table 2 show that respondents have a Gross Margin ₦8,408,759.75; a Net Farm Income of ₦8,282,009.75; a Return on Investment value of 23.58%; a Capital Turnover Ratio of 1.24 and a Return to Feed Ratio of 1.30. Consequently, the study posits that chicken egg production in the study area is profitable with the robust balances of gross margin of ₦8,408,759.75 and the Net Farm Income of ₦8,282,009.75, all things being equal. This finding agrees with Folorunso *et al*. (2018) and Akanbi *et al*. (2020) who also submitted a profitable outcome in their studies.

Return to feed ratio during egg glut in the study area.

Calculations from Table 2 show that the returns to feed ration during egg glut is 0.77 whereas the feed ratio in normal time is 1.33. This result brings to light why many farmers sell off their birds during periods of egg glut in the study area. This turbulent times lasts from late January to April, when revenue from egg sales does not cover the cost of feeding the birds.

The ratio of 1.33 in normal times shows a surplus of revenue over cost of feeds, whereas the ratio of 0.77 during period of egg glut means that the farmer still requires additional revenue of .33 from sale of eggs or external funding to be able to feed the birds. Farmers without robust lifelines will initially start underfeeding the laying birds before eventually shutting down production.

Table 2: Financial Analysis of chicken egg production in the study area.

Items	Value	%TVC
Cost of Labour	₦92,000.00	0.26
Cost price of Day Old Chicks	₦599,250.00	1.71
Cost of Brooding	₦19,085.50	0.05
Cost of Chick Mash	₦159,402.00	0.45
Cost of Growers Mash	₦403,501.50	1.15
Cost of Layers Mash	**₦32,918,850.00**	**94.05**
Cost of Debeaking	₦33,630.00	0.096
Cost of Medication	₦501,100.00	1.43
Cost of Litter material	₦33,831.25	0.09
Electric/water Cost	₦241,625.00	0.69
Total Variable Cost	**₦35,002,275.25**	
Rental value of Poultry house	₦126,750.00	
Total Fixed Cost (depreciated value)	**₦126,750.00**	
Egg Revenue	₦38,690,142.50	
Manure sales	₦839,225.00	
Sales of Empty bags	₦185,917.50	
Price of spent layers	₦3,695,750.00	
Gross Returns	**₦43,411,035.00**	
Gross Margin	**₦8,408,759.75**	
Net Farm Income	**₦8,282,009.75**	
Rate of Returns on Investment	**23.58%**	
Capital Turn Over	**1.24**	
Returns to Feed Ratio	**1.30**	
Return to Layer Feed Ratio (RLFR) during egg glut	**0.77**	

Source: Calculations from field survey data 2023.

Effects of input costs on the revenue of chicken egg producers in the study area.
Estimates of the OLS on the effect of input costs on the revnue of chicken egg producers is presented in Table 3.
Price of Day-Old Chicks (DOC): The coefficient is 4,930,624, and the variable is not statistically significant at conventional levels (5% or 1%). This suggests that, at the current price of day-old chicks, there is no likelihood that revenue of the respondents will be significantly affected.
Number of Laying Birds: The Number of Birds Laying in the farm has a substantial positive impact on revenue. The coefficient of 72,965,214 was found to be statistically significant at the 1% level, suggesting that revenue increases significantly when more birds are laying eggs.

Table 3: Multiple Regression output of the effects of input costs on the revenue of chicken egg producers in the study area.

Term	Coef	SE Coef	T-Value
Constant	-417991275	123809441	-3.38
DOC	4930624	9795661	0.50NS
Stock size	72965214	15956121	4.57***
Vet	7645976	5860101	1.30NS
Cost of Feed	-42584134	15032766	-2.83***
Cost of Labour	-530378	230866	-2.30**
Utilities	40848198	8717927	4.69***

F-value: 99.33***
R-Squared: 89.09%
Adjusted R^2: 88.19%

*** and ** represent 1% and 5% probability levels respectively.

The implication of this result is that a higher number of laying birds out of the entire stock size all things being equal will result to higher revenue for the farmer. This is in agreement with the findings of) Folorunso *et al*. (2020), Onogwu *et al*. (2017) and Akanbi *et al*. (2020). This is where the issue of efficiency in production comes in. A high stock size with lower laying percentage will ultimately result to lower farm revenue.

Cost of Veterinary services: The Veterinary variable's coefficient of 7,645,976 was found not to be statistically significant at any of the conventional levels even though the coefficient is positive. This is against the findings of Onogwu *et al*. (2017) who found that medications and drug variable was positive and significant at 5% level. An increase in this variable expectedly will result to an increase in the dependent variable.

The reason why the costs of veterinary services seem not statistically significant may be due to the fact that farmers in the study area during the survey period did not encounter any major disease outbreak that would have necessitated expending much on veterinary services.

Cost of Feed: The negative coefficient of -42,584,134 for the "Cost of Feed" variable was found to be statistically significant at the 1% level. This finding corroborates the findings of Haruna *et al*. (2007). This implies that higher costs of feed are associated with lower revenue to the farm firm. Price of Poultry feed especially layers' mash has been known to be very volatile in the study area because of ever rising costs of feed making ingredients, especially maize. This makes it difficult for both buyers of the feed and the suppliers of the feed materials and manufactured feeds to plan adequately.

Cost of Labour: Result from table 3 shows that the coefficient has a negative sign and was found to be statistically significant at 5% level of probability. The negative coefficient suggests that an increase in labour costs is associated with a decrease in revenue. The negative sign aligns with the a priori expectation that higher labour costs might reduce profitability. The statistical significance at the 5% level suggests that this relationship is not likely due to random chance in the sample. This result is corroborated by the findings of Folorunso *et al*. (2018), that cost of hired labour used in poultry-egg production had negative coefficients in small and medium scale farms.

Cost of Utilities (Coefficient: 40,848,198): Table 3 also show that the cost of utility variable was found to be statistically significant and positive at 1% level of probability. The positive coefficient implies that an increase in utility costs is associated with higher revenue. This might be a bit counterintuitive and should be interpreted cautiously. It could mean that higher utility costs are related to increased production or business activities, leading to higher revenue.

The statistical significance at the 1% level suggests that this relationship is less likely to be a random occurrence. The regression model as a whole was found to be statistically significant at the 1% level, suggesting that the combination of the independent variables effectively explains variations in dependent variable (revenue). The R-squared value of 89.09% indicates that the model explains a substantial proportion of the variability in revenue.

CONCLUSION

Determining the profitability and continuity of poultry egg production enterprises under deep litter system in the study area has brought into clearer focus what the issues are. The business generally is profitable since both the Gross Margin and Net Farm Income are positive. Rate of Returns on Investment is 23.58%, the Capital Turn Over was 1.24, while the overall Return To Feed Ratio was 1.30. However, the issue of continuity of the business during the period of egg glut is the major problem because of the very low (0.77) Return to Layer Feed Ratio (RLFR) during egg glut. This critical period is when the farmers require lifelines to keep them afloat. Layer feeds are usually bought on cash and carry basis; hence without an external intervention the farmers' continuation of the enterprise will be threatened.

RECOMMENDATIONS

In view of the implications of these results, the following recommendations are made:

i.   The problem of high cost of layers feeds which constitutes 94% of the total variable cost can be solved through massive expansion of maize production in the country since maize is now both a food crop and an industrial crop. Excess harvest can be mopped up by government through maintenance of functional strategic grains reserves.

ii.   The problem of egg glut with low prices for eggs in the face of high cost of feed can be solved by concerted efforts by all stakeholders especially the government through implementable policies that will reduce poverty so as to increase the food purchasing power of the masses.

iii.   The policy makers can also come up with policies of guaranteed minimum prices for eggs during period of egg glut; and for maize when there is bumper harvest. These will drive up the price above the fair price for the egg producer and the maize farmer.

Farmers can equally form functional cooperative groups that can enable them enjoy the economies of scale in obtaining credit to finance the feeding of the birds during the short period of glut; and in marketing their eggs more efficiently.

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