Original Research

SAGE Open
January-March 2022: 1–13

DOI: 10.1177/21582440211071076
journals.sagepub.com/home/sgo
SAGE

What are the Drivers of Profitability of Broiler Farms in the North-central and South-west Geo-political Zones of Nigeria?

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Abstract

This study analyzed the drivers of the profitability of broiler farms in the north-central and south-west geo-political zones of Nigeria. A multi-stage sampling technique was employed to choose a representative sample. A pre-tested, structured questionnaire was employed to gather cross-sectional data from 645 respondents between November 2017 and February 2018 for 2017 production year by trained enumerators. The data were analyzed with budgetary model, descriptive and inferential statistics. The results show that feed constitute about 75% of the total variable cost of producing 1 kg of the broiler. The cost implication of producing 1 kg of broiler stood at ₦583.20, while revenue realized from the sales of the same quantity of broiler was ₦734.69. The study further revealed that broiler farming is a profitable enterprise with profitability index of 39.85%. Furthermore, the positive drivers of profitability of broiler farms are years of experience of farmers, flock size, other means of livelihood, process broiler, and membership of the poultry association of Nigeria (PAN). Types of feed used and access to credit had a negative effect on the profitability of broiler farms. There will be a need to motivate farmers to increase their flock sizes by subsidizing high-quality day-old chicks, feed, and feed ingredients as well as other facilities. Research efforts should also focus on the development of efficient locally-made processing facilities to improve on the value addition activities of farmers thereby increasing the profitability of the farms. The enforcement of the policy on credit provision to farmers at a reasonable interest rate by commercial banks becomes crucial. In addition, it is suggested that farmers be encouraged to join PAN to increase the profitability of broiler farms.

Keywords

broiler farms, drivers of profitability, multiple regression model, Nigeria

Introduction

Broiler meat is the most common of all the white meat (other poultry, pork, and rabbit) consumed globally. This is because it is fairly cheap, low in fat, and has limited religious and cultural barriers compared to other meat products. Broiler meat production provides employment and regular income for entrepreneurs through its value chain activities. The popularity of broiler meat production can be attributed to a short production cycle, low production cost and product prices, ready market, and high feed-meat conversion ratio (OECD-FAO, 2020). This is because to guarantee reasonable returns on the investment in broiler meat production, it has to be produced at the least cost since net profit is associated with gross return and production. These and other importance make the broiler industry to be one of the most promising agribusinesses that could contribute to the eradication of poverty and food security of any nation (Awad et al., 2015).

Global Livestock Environmental Assessment Model (2016) revealed that the worldwide production of poultry meat was about 100 million tons with almost 92% of it from broiler farms. The industry is expected to grow globally due to the growing population, rising incomes, and urbanization (OECD-FAO, 2018). As reported by FAO (2020), global poultry meat production rose from 9 million tons in 1961 to 122 million tons in 2017. Most of this amount was supplied by the United States of America (about 20 million tons a year), China (18 million tons), the EU, and Brazil (almost

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13 million tons) (OECD-FAO, 2020). While these countries are also the leading exporter of broiler meat, growth in broiler meat consumption is expected to increase in Sub-Saharan Africa due to high population levels and growth rates. This is expected to result in overall growth in the volume of poultry meat consumption in developing countries which will be roughly five times that of developed countries (OECD-FAO, 2020). The increase in consumption in Sub-Saharan African will be met by importing about 66% of the required amount due to low production in the region (OECD-FAO, 2016).

Though Nigeria has the largest number of poultry meat farms in the region (FAO, 2010), the nation is the fourth-largest producer of broiler meat with South Africa being the leading producer (United States Department of Agriculture [USDA], 2013). In 2013 and 2016, poultry meat production in Nigeria stood at 300,000 and 450,000 metric tons respectively (USDA, 2013). Heise et al. (2015) reported that the demand for poultry meat will rise by 200% between 2010 and 2020 in Nigeria. This is expected to grow between 6% and 10% year-on-year between 2020 and 2025. World Bank (2017) opined that the gap between demand and local supply is anticipated to widen in the future. Consequently, in meeting the anticipated greater demand for poultry meat, the broiler farms must function sustainably and achieve optimal profitability to ensure meat availability at a reasonable price.

It should be recalled that to protect the local broiler farmers and grow the economy, the Nigerian government placed a ban on the importation of frozen poultry meat in 2002. Sadly, the activities of illegal importers of frozen products are still popular. The frozen product mainly from the Benin republic is cheaper than local products. This has been attributed to the high cost of poultry feed raw materials which are mainly imported. Most researchers admit that high feed cost affects the performance of the broiler chicken meat industry since it solely depends on the price trend of imported feed ingredients. The research conducted by Elsedig et al. (2015) showed that the feed cost is a major problem in broiler chicken production together with other problems such as lack of knowledge on disease prevention, breeding process, and disease outbreak. Ravindran (2013) also shows that feed cost constituted about 70% of the total variable cost in the production of broilers. According to the author, the second largest contributor to the production cost was day-old chicks (22%), while other materials contributed the remaining 22%. Arbitrary increases in the cost of feed and other inputs led to a reduction in the profit margin of poultry farms. The increase was also above the reach of many broiler farms which led to the liquidation of the business by many farmers.

To prevent a total collapse of the industry by protecting local farmers, the federal government of Nigeria introduced broiler anchor borrowers' schemes (Central Bank of Nigeria, 2016). This has not yielded any desired results as the industry is still plagued by various constraints such as high cost of feed, disease outbreak, inadequate finance, poor infrastructure, competition with illegal importation among others (Adeyonu et al., 2021; Olorunwa, 2018; Osuji, 2019). The impact of these on the industry is enormous as it resulted in the closing down of the farms, reduction in the flock size, and prevention of new entrants into the industry. An understanding of the drivers of profitability will enable stakeholders to formulate appropriate policies that will enhance the profitability of the business to ensure its sustainability. Hence, the main objective of this study is to evaluate the factors driving the profitability of broiler farms in the north-central and south-west geo-political zones of Nigeria.

Literature Review

Researchers' interest in the profitability, as well as the drivers of the profitability farms (crop and livestock) have grown in recent times. Among research efforts on the levels of profitability of crop farms are those of (Bonabana-Wabbi et al., 2013; Dube et al., 2018; Onoja & Herbert, 2012; Xaba & Masuku, 2013). They all reported that the various crop farms studied were profitable. Some of the researchers who had conducted research on the profitability of livestock farms are (Abdurofi, 2017; Afzal & Khan, 2017; Al-Mamun Rana et al., 2013; Bano et al., 2011; Emokaro & Emokpae, 2014; Milán et al., 2014; Shaikh & Zala, 2011; Singh et al., 2010; Siyaya & Masuku, 2013). They opined that livestock farms are profitable ventures with the exception of Abdurofi (2017), who showed that the enterprise remained profitable in some regions, while they were not profitable in other regions in the study area. Other researchers who studied the profitability of agribusinesses other than agricultural production revealed that the enterprises were profitable (Browne et al., 2013; Jacob & Kollins, 2016).

Furthermore, the research out puts on the drivers of profitability of crop farms showed that education, years of experience in farming and farm size were the main movers of profitability (Onoja & Herbert, 2012; Xaba & Masuku, 2013). The drivers of profitability of livestock farms are flock size, diversification, region, farmer's age, off-farm employment, education, years of experience in livestock farming, and mortality of chicks. Flock size, diversification, region, farmer's age, off-farm employment, education, years of experience in livestock farming had a positive association with the profitability of farms (Jacob & Kollins, 2016; Khan & Afzal, 2018; Milán et al., 2014; Nehring et al., 2015; Siyaya & Masuku, 2013). The mortality of chicks had an indirect relationship with the profitability of farms (Khan & Afzal, 2018).

It is evident from the literature reviewed that most of the studies examined the profitability of crop or livestock farms as well as other agribusinesses and opined that the enterprises were profitable with varying levels of profitability among the farms. Most of these studies, apart from using smaller sample sizes, failed to analyze the drivers of the

Table 1. States, Senatorial Districts and Local Government Areas Surveyed.

Geo-political zone	State	Senatorial district	Local government area
North-central	Benue	Benue west	Makurdi and Gboko
	Kwara	Kwara central	Ilorin South and Ilorin west
South-west	Ogun	Ogun central	Abeokuta North and Odeda
	Oyo	Oyo central	Lagelu and Ona Ara

Source. Authors' compilation.

profitability with the exception of (Jacob & Kollins, 2016; Khan & Afzal, 2018; Milán et al., 2014; Nehring et al., 2015; Siyaya & Masuku, 2013). Aside from this, only Nehring et al. (2015), Khan and Afzal (2018) focused on broiler farms whose inputs and management practices requirement differs from other agricultural enterprises. Not only this, none of the studies reviewed is conducted in Nigeria. Khan and Afzal (2018) opined that regional differential existed in the profitability of broiler farms. Hence, this study attempted to fill this research gap by analyzing the drivers of profitability of broiler farms in north-central and south-west geo-political zones of Nigeria.

Methods

Study Area

To evaluate the drivers of profitability of broiler farms in Nigeria, we collected cross-sectional primary data from commercial broiler farmers in the country. The northern and southern parts of the country are divided into three geo-political zones each for ease of administration. The ones in the north are North-Central (NC), North-East (NE), and North-West (NW), while the three in the southern part are: South-East (SE), South-South (SS), and South-West (SW). The country is further divided into 36 states and the federal capital territory with each of the states separated into three senatorial districts.

Sampling Techniques and Sample Size

The respondents were selected using multi-stage sampling techniques. At the first stage, we purposely selected NC and SW geo-political zones from the northern and southern parts of the country respectively due to the population of poultry farms in the zones. The second stage was a purposive selection of two states from each of the selected zones, also due to the concentration of poultry farms in those states. The third stage witnessed a purposive selection of one senatorial district with the highest concentration of poultry farms from each of the selected states. At the fourth stage, two local government areas known for their popularity in poultry farming from each of the selected districts were purposely selected to give a total of eight LGAs as presented in Table 1 and Figure 1. The lists of broiler farms in each of the selected LGAs were obtained from the state's poultry association of Nigeria (PAN). The Snow-ball method was employed at the fifth stage of the sampling to identify broiler farmers who were not members of PAN and they were added to the obtained list. The sixth and last stage involved a random selection of broiler farms proportionate to the size of broiler farms in each of the LGAs. The process led to a selection of 1,000 respondents.

Data Collection

Pre-tested and structured questionnaires were used to gather information from the respondents. The data were collected between November 2017 and February 2018 for 2017 production year by trained enumerators. Of the 1,000 questionnaires distributed, only 645 questionnaires with appropriate data were used for this study. See the Appendix for the various types of information collected from broiler farmers. Data were analyzed with descriptive statistics, budgetary model, and multiple linear models using STATA version 14 (StataCorp, 2015).

Analytical Techniques

Budgetary Model

This was employed to analyze the profitability of broiler farms as specified in equation 1. Total production costs and total revenue for each farm in a year were divided by kilograms of broiler sold for comparative purposes as previously done by (Md Isa et al., 2019).

$$\Pi_{iu} = Q_c P_c + Q_m P_m - \sum_{i=1}^{n} (X_j P_j) - TFC_i \quad (1)$$

Where:

Π_{iu} = profit in \$/Kg by ith farm; Q_c = quantity of mature live broiler in Kg; P_c = price in \$ per kg of mature live broiler; Q_m = quantity of manure in bags; P_m = price/unit of manure; X_j = quantity of a given variable input in unit; P_j = price per unit of the variable input; = TVC_i, TFC_i = total fixed cost in \$/Kg by ith farm. It is worthy of note that the average exchange rate at parallel market between November 2017 and February 2018 when the survey was conducted was US\$ 1 = ₦500.

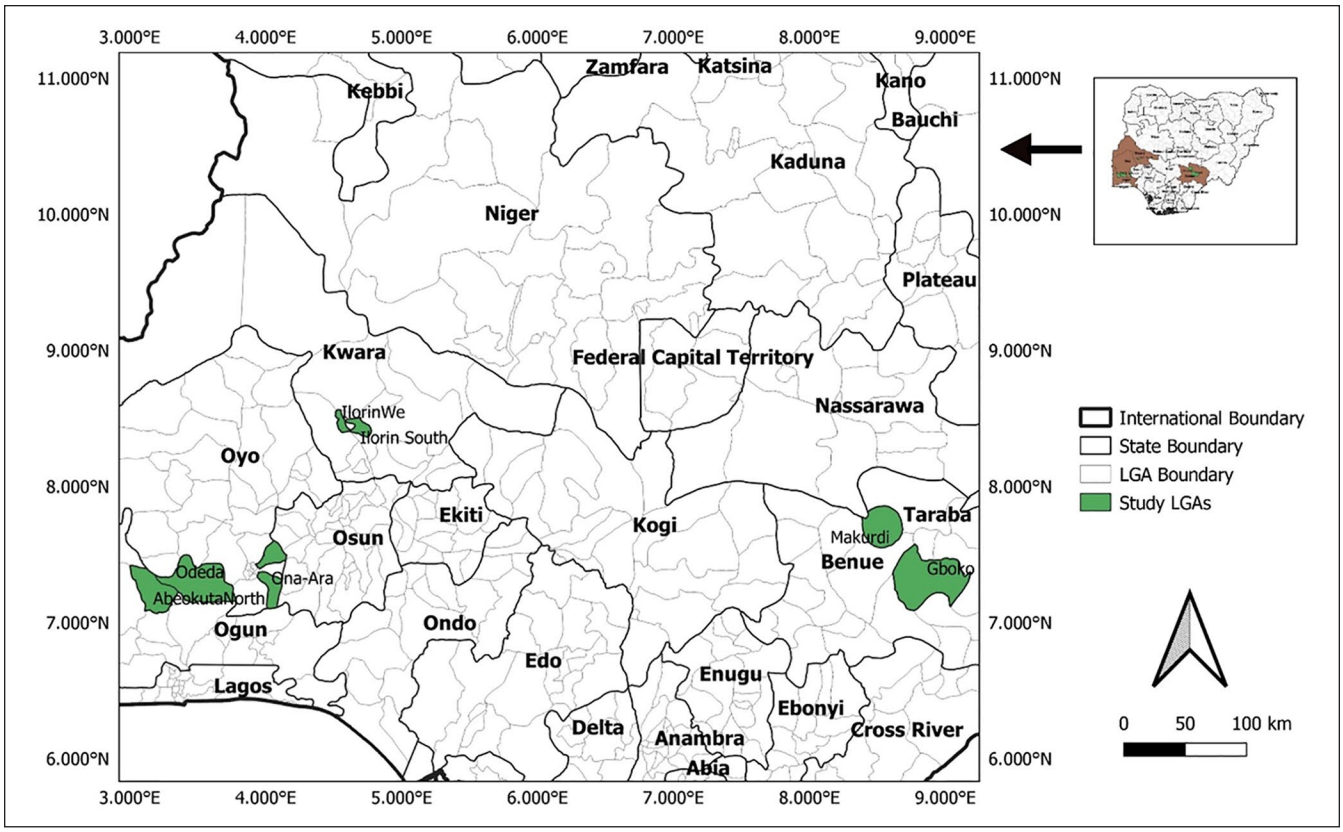

Figure 1. Map of Nigeria showing the study area.

Profitability Evaluation

$$\Pi_{pi} = \frac{\Pi_i}{TC_i} X \frac{100}{1} \tag{2}$$

Where:

Π_{pi} = profitability index of ith broiler farm in 1 year

TC = TVC + TFC

Multiple Linear Regression Model

We employed a multiple linear regression model using the ordinary least square procedure to analyze the effects of some variables on the profitability of broiler farms. The model is stated explicitly as follows:

$$\Pi_{pi} = \alpha_0 + \alpha_1 V_1 + \alpha_2 V_2 + \alpha_3 V_3 + \alpha_4 V_4 + \alpha_5 V_5 + \alpha_6 V_6 + \alpha_7 V_7 + \alpha_8 V_8 + \alpha_9 V_9 + \alpha_{10} V_{10} + \alpha_{11} V_{11} + \epsilon_s \tag{3}$$

where:

Π_{pi} = profitability index per kg

α_0 = constant;

α_1 - α_{10} = unknown parameters;

V_1 = age in years

V_2 = years of experience

V_3 = years of schooling

V_4 = flock size (number)

V_5 = number of cycles

V_6 = sex (male = 1, 0 otherwise)

V_7 = other means of livelihood (yes = 1, 0 otherwise)

V_8 = types of feed (self-mixed = 1, 0 otherwise)

V_9 = process broiler (yes = 1, 0 otherwise)

V_{10} = access to credit (yes = 1, 0 otherwise)

V_{11} = membership of PAN (yes = 1, 0 otherwise)

ϵ_s = error term

In the multiple regression model, adjustment was made for the effect of feed technology on the profitability of farms. Based on this, three feed technologies were introduced such as self-mixed feed, already-made feed, and concentrate-based feed. The farms that adopted concentrate technology were few, hence, they were matched with the self-mixed feed category. This led to the inclusion of two feed technology: Self-mixed and already made. The variable was included given the importance of feed in the production of broiler, which may have a great influence on the level of profitability. Other variables are from the literature and researchers' personal field experience.

Table 2. Descriptive Statistics of Farms Per Kg of Broiler Produced Per Year.

Variable	Unit	Value	Minimum	Maximum
Weight of live broiler at market age	Kg	2.326 (0.410)	1.6	3.5
Variable costs	$	1.141 (0.165)	0.822	1.555
Fixed cost	$	0.025 (0.008)	0.009	35.76
Total cost	$	1.166 (0.169)	0.844	1.592
Total revenue	$	1.469 (0.176)	0.940	1.910
Proft/loss	$	0.292 (0.135)	−0.224	0.513
Profitability	%	39.8451 (23.4013)	−24.099	141.0215

Source. Authors' calculation.
Note. Figures in parenthesis are the standard deviation.

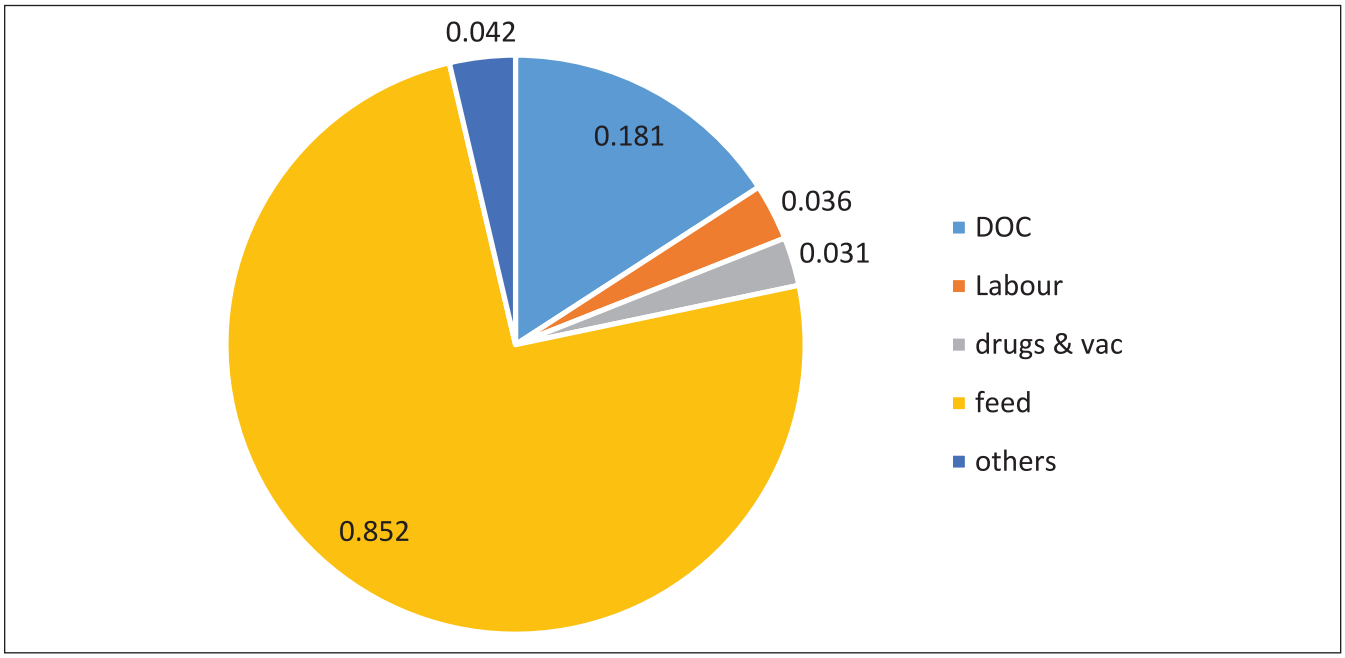

Figure 2. The proportion of cost of variable inputs.
Source. Authors' calculation.

Data were checked for the presence of multi-collinearity and heteroskedasticity so as to ensure statistical adequacy. We employed the variance inflation factor (VIF) to check for the presence of multicollinearity, while Breusch-Pagan/Cook-Weisberg test was used for the presence of heteroskedasticity. The VIF model is specified as:

$$VIF = (1 - R_i^2)^{-1} \quad (4)$$

Where R_i^2 is the coefficient of determination when one of the explanatory variables is regressed against the remaining ones.

Results

Descriptive Statistics of Farms

Figure 2 and Table 2 present the descriptive statistics of farms in the study area. As shown in Figure 2, the cost of feed constituted the highest variable cost ($0.852) while the least was drugs and vaccine ($0.031) to produce 1 kg of the broiler. The average weight of live broilers reared stood at about 2.33 Kg, while the highest total variable costs for producing 1 Kg of broiler were $1.555, and the least was about $0.822 with a mean of $1.141. The mean fixed cost stood at about $0.025, while the highest and lowest fixed costs were $35.76 and $0.009 respectively. While the highest total cost of producing 1 kg of broiler was $1.592, the least total cost amounted to $0.844 with a mean of $1.166. The mean revenue received from 1 Kg of broiler and litter (manure) was about $1.47 with $0.94 and $1.91 being the least and highest received respectively. Also, the highest amount of profit made on 1 kg of broiler stood at $0.513, while the minimum loss was $0.224 with a mean amount of $0.292. The mean, lowest, and highest profitability index calculated stood at about 40%, -24%, and 141% respectively.

Table 3. Descriptive Statistics of Variables (Continuous and Categorical Variables Used in Multiple Regression).

Continuous Variable	Unit	Mean	Standard deviation	Minimum	Maximum
Age	Years	43.775	8.691	22	66
Experience	Years	7.219	4.617	2	35
Education	Years	13.544	2.652	0	15
Hours of training received	Hours	3.245	7.896	0	72
Flock size	Number	5159.944	11347.5	1340	217000
Number of cycle	Number	2.386	0.851	1	6
Period of cycle	Weeks	8.547	1.243	6	12
Number reared/cycle	Number	2036.496	2340.831	482.667	36166.67
Categorical variable	**Type**	**Frequency**	**Percentage**		
Sex	Male	497	77.05		
	Female	148	22.95		
Other livelihood	Yes	393	60.93		
	No	252	39.07		
Type of feed	Self-made	170	26.36		
	Concentrate	14	2.17		
	Ready made	461	71.47		
Process broiler	Yes	36	5.58		
	No	94.42	94.42		
Credit access	Yes	392	60.78		
	No	253	39.22		
Membership of PAN	Yes	246	38.14		
	No	399	61.86		

Source. Authors' calculation.
Note. Drivers of profitability in broiler farms.

Descriptive Statistics of Variables Used in Multiple Regression

The descriptive statistics of the explanatory variables used in multiple regression are depicted in Table 3. The analysis presented in the table shows that farmers' age ranged between 22 and 66 years with an average of 43.8 years. While the most experienced broiler farmer had spent 35 years in broiler enterprise, the least experienced had spent barely 2 years at survey time with the mean years of experience of about 7 years. The highest, mean, and least years of schooling were 15, 13.54, and 0 (no formal education) respectively. Entrepreneurial training was not a popular exercise among the farmers given the mean hours of training of 3.25 over a period of 1 year before the commencement of the survey. The highest number of broiler sold (flock size) in 1 year was 217,000 Kg, while some farmers sold as low as 1,340 Kg for the same period considered. The birds were reared on an average of about two cycles over a period of 8.5 weeks. While the mean number of birds reared per cycle stood at 2,037, it ranged between 483 and 36,167. Furthermore, like other farming activities in the country, broiler production was dominated by males (77%). Our findings show that a majority of the respondents: had other means of livelihood (60.93%), used ready-made/commercial feed (71.47%), did not process broiler (94.42%), had access to credit (60.78%), and were not members of PAN (61.86%). All the aforementioned variables may drive the profitability of broiler farms.

Statistical tests were carried out on the data to detect the presence of multicollinearity and heteroskedasticity. The results returned a mean VIF of 1.11 which ranged between 1.01 and 1.28 signaling the absence of multicollinearity among the explanatory variables. However, the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity shows a chi-squared (11) value of 13.46 which was significant at 1% implying the presence of heteroskedasticity. We controlled for this by analyzing and reporting a robust standard error. The outcomes of the multiple regression we performed to ascertain the drivers of profitability are presented in Table 4.

As indicated in the table, *R* squared of .693 was obtained and the model is significant at 1%. The coefficient of years of experience of farmers (.459) is statistically significant and positive. The flock size is another positively significant variable with a coefficient of .901 at a 5% level of significance. Types of feed used by farmers with a coefficient value of .926 are negative and significant at 5% level. Other means of livelihood (.479), process broiler (9.226) and membership of PAN (9.895) are positively significant at 10% and 1% levels respectively. Another notable driver of the profitability of broiler farms is access to credit with a coefficient of 3.562

Table 4. Estimates of Parameters of Multiple Regression Model.

Variable	Coefficient	Robust standard error	$P>\|t\|$
Age	.083	0.119	.486
Sex	−1.818	2.167	.402
Experience	.459***	0.148	.004
Education	.415	0.304	.128
Flock size	.901**	0.405	.029
Other livelihood	.479*	0.284	.050
Type of feed	−.926***	0.195	.000
Process broiler	9.226***	2.935	.002
Access to credit	−3.562*	2.079	.087
Membership of PAN	9.895***	2.045	.000
Number of cycles	−.495	0.342	.100
Constant	33.129***	7.417	.000
n	645		
R squared	. 693		
Prob > *F*	0.000		

Source. Authors' tabulation.
Note. ***, ** and * imply coefficients statistically significant at 1%, 5%, and 10%, respectively. The reference category for the categorical variables are: no other livelihood; process broiler; access to credit; membership of PAN and ready-made feed.

and is negative. Other variables such as age, sex, education, and number of cycles reared though not significant had the expected sign.

Discussion

Descriptive Statistics of Farms

The findings on the cost incurred on each of the variable inputs imply that feed constituted the highest variable cost in producing 1 kg of the broiler. It accounted for about 75% of the total variable cost. The only possible explanation for this may be as a result of the high cost of imported feed ingredients such as maize, soya bean meal, fish meal, and premix. Our findings agree with the submission of Onyeagocha et al. (2010), Balamurugan and Manoharan (2013), Xie and Marchant (2015), Amanor-Boadu et al. (2016), El-Tahawy et al. (2017), Udo et al. (2017), Sumberg et al. (2013), Arslan et al. (2018) who stated that feed constitute the highest variable cost in broiler production. The second highest cost component is DOC constituting 15.83% of the total variable cost and the least are other costs (wood shavings, transport energy among others). Day-old chicks are another input in the production of broiler that is being imported into the country in the absence of viable improved local breeds. The wide variation between the lower and upper limit of total production cost and flock size is a sign of high polarity among the broiler farms sampled and an indication that most of the farms still operate on a small scale. The weight of broilers of as low as 1.6 Kg and a mean of about 2.33 Kg at eight and half weeks of age is an indication of poor feed management by the farmers and this may have an effect on the profitability of the farm. The average weight is however consistent with the submission of Abdurofi (2017), Md Isa et al. (2019), Rahman et al. (2020) who opined that the mean age of broiler in the first 8 weeks of production was below 3.0 Kg. While Rifky (2016) reported similar period of rearing as ours, the study by Rahman et al. (2020) revealed a lower mean age of rearing. The average value of profit received by farmers indicates that the broiler farming was a profitable enterprise in the study area notwithstanding the loss incurred by some of the farmers in one production year. Our view on this is similar to earlier evidence by Al-Mamun Rana et al. (2013), Anang et al. (2013), Balamurugan and Manoharan (2013), Abdurofi (2017), Sumberg et al. (2013) who showed that broiler farming was profitable. The profitability index also shows that broiler farms in the study area are profitable and this is supported by the findings of (Balamurugan & Manoharan, 2013; Md Isa et al., 2019; Oseghale et al., 2017).

Further to that, the mean age of the farmers signifies that farmers were relatively young and are expected to be innovative with greater ability to learn and adopt improve production technology. All these are expected to boost productivity, and hence, optimal profitability. The mean years of experience show that broiler farmers are educated. This is an indication of the potentials for improved broiler farming that will enhance profitability through effective management as previously reported by (Mbuza et al., 2017). The mean hours of training depict a low level of training among farms with some of them not have received any training for the past year prior to the survey. Adequate training is required for up-to-date management practices in broiler production if profitability is to be ensured. This result justifies the earlier evidence by Rahman and Chima (2016) who reported low level of training among farmers.

The average flock size of one-year production seems to be low. This may however be due to the fact that farmers did not have enough capital to expand their farms as the survey time coincided with the time the country was just recovering from the economic recession experienced between 2016 and 2017. Onyeagocha et al. (2010) and Emokaro and Emokpae (2014) had reported low average flock size in support of our findings. The rearing of just about two cycles of broilers by farmers with an average of 2,037 in 1 year implies that most of the farmers are small-scale farmers and the enterprise is grossly underdeveloped given its six cycles per year potential. Our finding on the number of cycles reared in 1 year is in line with Dziwornu (2016) who reported similar number of cycles. The number of broilers reared per cycle is higher than 666 reported by (Emokaro & Emokpae, 2014). However, the number reared per cycle is below the average of 4,000 recommended by (FAO, 2003). Similarly, South African Poultry Association (2016) opined that the production of 40,000 birds per cycle is considered to be small-scale production.

Our analysis shows that more than three-quarters of the farmers were males. This could be because broiler production requires capital that most female farmers cannot afford. Similar results were obtained by (Adeyonu et al., 2021; Ekong, 2018; Mbuza et al., 2017**)**. Over 60% of the farmers had other means of livelihood. This may be because of the high level of risk associated with broiler farming. The other livelihood sources may be a way of mitigating risk. Also, income from other sources is to assist farmers in the timely purchase of inputs and to also buy in large quantities to be able to minimize production costs and increase profitability. This observation deviates from the earlier evidence by World Bank (2017) and Ekong (2018) who revealed that a majority of broiler farmers did not have other sources of income. Feed, which can be produced in different ways is an important input in the production of broiler. Choosing the right type of feed will result in reduction in production costs to improve profitability level. Our findings show that self-made feed and concentrate based feed was not popular among the farmers in the study area as shown by the high proportion of them that subscribed to the ready-made feed. Ekong (2018) revealed that most of the broiler farms in Ghana adopted a self-made feed option. Processing is expected to enhance the profitability of the enterprise by getting a fair price for mature broilers. The low proportion of farmers that processed broiler is an indication of a low level of broiler value adding activity among the respondents. The low level may however be attributed to the high cost of processing plants which the farmers may not be able to pay for.

The high percentage of farmers that had access to credit may be a result of the proliferation of private money lenders in the country at the time of the survey. The results is in sharp contrast to the evidence provided by Adeyonu et al. (2017) who reported that access to credit among poultry farmers was low. Membership in a poultry association could help to increase the production capacity, marketing of their produce, training, access to credit which in turn affects profit obtained. This notwithstanding, we found that a majority of the farmers did not belong to PAN. This may be a result of their perception that the terms and conditions of membership, as it is in many organizations of similar status is not fair.

The results of the multicollinearity test returned VIF which ranged between 1.01 and 1.28 with a mean of 1.11 signaling the absence of multicollinearity. A VIF of any of the independent variables which are greater than 10 is an indication of multicollinearity (Gujarati, 2006). However, the results of the Pagan/Cook-Weisberg test for heteroskedasticity was 13.46 and significant at 1% level implies the presence of heteroskedasticity which was addressed by analyzing and reporting robust standard error as presented in Table 4. As shown in Table 4, the summary statistics presented indicate that the model has a good fit to the data. The value of R squared means that about 69% of the variation in the profitability of broiler farms is explained by the independent variables. The analysis shows that years of experience of farmers, flock size, other livelihood, types of feed, access to credit, and membership of PAN were the drivers of the profitability of broiler farms.

As shown in the table, a one year increase in experience increases profitability by 0.46% *ceteris paribus*. This perhaps may be because experienced farmers applied their experiences to minimize cost in terms of reduction in mortality, purchase of inputs at a reduced rate among others. Imtiaz (2012) and Khan and Afzal (2018) also reported a positive association between experience and profitability of broiler farms. Also, for every increase in flock size by one broiler, profitability increases by 0.90%, other things being equal. This is understandable because agribusiness like other businesses is a game of number. The farms with large sizes are supposed to take advantage of the economy of scale to buy their inputs at a cheaper rate compares to their small flock size counterparts. The economy of scale will naturally lead to a reduction in the production cost, and hence, enhanced profitability. Our result is supported by the findings of Emaikwu et al. (2011), Mishra et al. (2012), Etuah et al. (2013), Nehring et al. (2015), Khan and Afzal (2018), Aryemo et al. (2019) who had earlier reported a positive association between flock size and profitability.

The positive effect of other means of livelihood is an indication that farmers with other sources of livelihood's profitability is higher by 0.48% compare to their counterparts who relied solely on broiler farming. This is expected because the income generated from other sources may be used for the prompt purchase of inputs in the production system which leads to an increase in profitability. Our submission on this and those of Mishra et al. (2012), Nehring et al. (2015) and Ekong (2018) are similar. The results on types of feed indicate that farms that adopted ready-made feed technology have 0.93% higher profitability than their counterparts that

adopted self-made feed technology, *ceteris paribus*. The only explanation for this is that achieving and sustaining the quality of ready-made feed may not be as difficult as a self-made feed that supposed to be cheaper. Poor quality feeds apart from retarding the growth of broilers can also lead to nutritionally related diseases which may result in a high fatality which will, in turn, lead to increase in average production cost and hence, reduced profit level. The findings by Charo-Karisa et al. (2013), Mbuza et al. (2017), Ekong (2018) which showed a direct relationship between types of feed and profitability are in support of our results.

We found an inverse correlation between access to credit and profitability of broiler farms implying that farms that had access to credit had 3.56% lower profitability than the ones without access, all things being equal. This is perhaps a striking outcome. This may however be unconnected with the fact that farms with access to credit got their credit from private lenders who charged exorbitant interest rate (as high as 15% per month with no moratorium). Farmers are left with no option in the face of difficulty in accessing government loans and bureaucracy associated with obtaining a loan from formal loan sources. Similar studies by Rahman and Chima (2016), Etuah et al. (2013), Wei et al. (2020) showed a positive association between access to credit and profitability. Furthermore, *ceteris paribus*, farmers who are members of cooperative society have 9.90% higher profitability index than those that are not members. Perhaps, this may be because farmers who are members of PAN benefited from services provided by the association which resulted in to increase in their profitability level. Among such services are training, storage facilities, marketing, and networking.

Conclusion

This study analyzed the drivers of the profitability of broiler farms in the north-central and south-west geo-political zones of Nigeria using cross-sectional primary data in the absence of panel nationally representative data. The analysis shows that broiler production is profitable. This serves as an eye-opener to farmers who may want to invest in broiler farming as there is every likelihood that their investment in the industry will not go down the drain. Policymakers can also leverage this to formulate policy that will encourage the teeming unemployed youths to consider broiler farming thereby reducing the high rate of unemployment in the country and contributing to the food security policy of the present administration.

The results also depict that years of experience in broiler farming is a driver of profitability. New entrants into the industry will be able to enhance their profitability by joining the poultry association of Nigeria where they can learn from more experienced farmers. The services of the livestock extension agents should also be employed for the training of farmers on best management practices that will result in an increase in enterprise profitability. Flock size was also found to be another important driver of profitability. It is suggested that the current livestock development program be extended to the poultry industry through the provision of high-quality day-old chicks and inputs at a subsidized rate. Given that we found a direct association between types of feed and profitability, the livestock development program should be extended to the regulation of the activities of local feed millers while ensuring the availability of high-quality feed raw materials at an affordable rate. We also reported that the processing of broilers before selling is a profitability enhancer. Thus, research efforts of agricultural engineers should be directed into the manufacturing of simple locally-made processing machines. Access to credit had an unexpected negative relationship with farms' profitability. To address this awkward situation, there should be enforcement of the policy on the lending of loans by commercial banks to farmers. This will ensure that farmers can access loans with ease at a low interest rate. In view of the positive effect of farmers' membership of association on profitability, farmers are hereby encouraged to join the poultry association of Nigeria so as to benefit from the various services the association has to offer notwithstanding its perceived shortcomings.

Appendix: Questionnaire

Dear Sir/Ma,

This is a research survey aimed at examining "drivers of profitability of broiler farms in the north-central and south-west geo-political zones of Nigeria." Kindly provide the necessary information as truthfully as you can. All information will be held with the strictest confidence, remain anonymous, and be used for the purpose of research only. Please note that your participation in this survey is voluntary and you are at liberty to discontinue at any time you so desire or decline to respond to any question. Also, kindly note that this interview may take up to 20 minutes. Do you have any questions you will like us to answer? Will you like to take part in this survey?

You can contact us on: 08075598216, 08142664478.

Thank you for your anticipated cooperation.

Kindly fill, circle or tick your response as may be appropriate

Section A (Respondent's Personal Information)

1. State.....
2. Local Government Area.....
3. Name of the farm.....
   .....
4. Sex: Male = 1, Female = 0
5. Age..... (years as at last birthday)
6. Are you married? : Yes = 1, No = 0
7. Are you the head of your household? Yes = 1, No = 0

8. How many people are in your household? .....
9. What is the average total income/month earned by other members of your household?..... (₦)
10. What is the highest level of education you completed?: (i) No formal education = 0 (ii) Primary education = 1 (iii) Secondary education = 2 (iii) Tertiary education = 3

Section B (Information Relating to Broiler Farming)

11. How long have you been in broiler production? ..... (years)
12. State the most common of the breeds of broiler you have been rearing.....
13. How many cycles of broilers did you rear in 2017? .....
14. On average, how much does one day old chick (DOC) cost?..... (₦)
15. How many of the DOC stocked were reared to market weight and sold?.....
16. If there is a difference between the numbers stocked and sold, which of these was responsible for the difference? Choose all that is applicable.
    (i) diseases (ii) theft (iii) accident (iv) household consumption (v) gift to friends and families (vi) others (kindly specify)
17. How many did you lose to each of the following? (i) diseases..... (ii) theft..... (iii) accident ..... (iv) household consumption (v) gift to friends and families (vi) others.....
18. At what age do you always sell your mature broilers? .....(weeks)
19. Approximately what was the average weight of broiler at market age?..... (Kg)
20. Approximately how much did you sell one life broiler in 2017?..... (₦)
21. On the average, how much was 1 kg of life broiler in 2017?..... (₦)
22. Did you realize any income from sales of other products from broiler production e,g. poultry manure and empty bags? Yes = 1, No = 0
23. If yes, how much from poultry manure?..... .....(₦) and empty bags?..... (₦)
24. Where/to whom did you sell your mature birds? (Choose all that is applicable) (i) local processors (ii) traders (iii) direct consumers (iv) exporters (v) others (specify)
25. How far is the nearest live broiler market to your farm?.....(Km)
26. In what terms did you sell your mature broilers? cash = 1, credit = 0, both = 2
27. Please supply the information about inputs used for all the cycles of broilers you reared in 2017

Type of input	Input supplier or source	Quantity of input and unit or no of workers	Total costs of input (₦)
DOC			
Feed (Kg): broiler starter, broiler finisher			
Vaccines			
Drugs including disinfectant			
Lighting and charcoal			
Rent on pen or depreciation			
Equipment (depreciation)			
Wood shavings			
Phone bills			
Skilled labour			
Other attendants			
Casual workers			
Transport			
Interest on loan if any			
Other costs (specify)			

Section C (Other Relevant Information)

28. Do you process broiler before selling? Yes = 1, No = 0.
29. Apart from broilers, which other type (s) of poultry do you have on your farm? (i).....(ii) . .....(iii)..... (iv)
30. How much is your earning/month from each of the other types of poultry? (i)..... (₦) (ii)..... (₦) (iii)..... (₦) (iv)..... (₦)
31. Do you have any other means of livelihood apart from poultry? Yes = 1 No = 0
32. If yes, which of these is/are applicable to you?: (i) crop farming (ii) other livestock (iii) non-farm work (iv) pension (v) others (specify)

33. How much is your total earning/month from the other sources of income?..... (₦)
34. Are you a member of any cooperative society? Yes = 1 No = 0
35. Do you have access to credit? Yes = 1 No = 0
36. Is your farm insured by Nigerian Agricultural Insurance Corporation (NAIC): Yes = 1 No = 0
37. Do you have access to extension services? Yes = 1, No = 0
38. Do you operate a feed mill? (circle) Yes = 1 No = 0
39. Are you a member of the Poultry Association of Nigeria (PAN)? Yes = 1 No = 0
40. Did you get any training on farming since you started the broiler business? Yes = 1, No = 0
41. If yes, how many hours of training did you receive last year?.....
42. What is your perception about these risk factors as they relate to your broiler business? Kindly choose the appropriate option:

		Responses				
S/N	Constraints	Not at all important = 1	Moderately important = 2	Important = 3	Very important = 4	Extremely important = 5
1	The high cost of chicks					
2	The high cost of feed					
3	Unavailability of high- quality chicks					
4	High chicks mortality rate					
5	Lack of credit facilities					
6	Unreliable market					
7	Heat stress					
8	Outbreak of disease (s)					
9	Inadequate availability of vaccines/ vaccine failure					
10	Unavailability of inputs					
11	Theft					
12	Weak infrastructure (electricity, roads)					
13	The high cost of processing and storage facilities					
14	Weak enforcement of the ban on imported chicken					
15	Lack of agripreneurial training					
16	High-interest rate if any					
17	Others (please specify)					

Acknowledgments

We thank Abiodun Okunola and Monisola Alao for collecting part of the data used for this study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Landmark University Centre for Research, Innovation, and Discoveries provided grants to collect the data used for the research.

Ethics Statement

The authors confirmed that this is not applicable

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