FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 6 No. 1, March, 2022, pp 60 - 67
DOI: https://doi.org/10.33003/fjs-2022-0601-791

TECHNICAL EFFICIENCIES OF POULTRY TOLL FEED MILLS IN KADUNA AND PLATEAU STATES, NIGERIA

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ABSTRACT
This study investigated the technical efficiencies of poultry feed firms in Kaduna and Plateau States, Nigeria. Primary data were collected using a structured questionnaire from a sample of 51 poultry feed firms, analyzed using descriptive statistics and stochastic frontier technical efficiency function. The findings indicate that poultry feed firms have an average production capacity of 4.2 tonnes per day, operating on an average of 5 days per week using not more than 1 shift per day. The feed mills were found to be technically inefficient with mean technical efficiency of 0.67. The determinants of technical efficiency were found to be operating capacity, distance to major market, number of employees, and availability of ingredients in required quantity as well as ownership type. The high cost and adulteration of ingredients, low patronage, and high competition from larger firms amongst others were factors identified as constraints to efficient poultry feed production. The study recommends that the firms should improve on the deployment of labour as well as improved wages, outsource for cheaper inputs or buy input in group to derive economies of scale and also increase their production in other to potentially maximize output.

Keywords: Efficiency, Feeds, Firms, Ingredients and Poultry

INTRODUCTION

The task of meeting the increasing demand for animal-based protein can best be realized through increased production and availability of feeds. Increasing population, urbanization and rising incomes are expected to double the demand for livestock products in the developing countries. In Nigeria, livestock, including cattle and poultry, are a major contributor to household livelihoods, through income and nutrition related benefits. (Food and Agriculture Organization, 2018; and Abdullahi, Wan Embong and Soh, 2011). Also, the Nigerian poultry industry comprises about 180 million birds – Nigeria has the second largest chicken population in Africa after South Africa (SAHEL, 2015) – producing 650 000 tonnes of eggs and 300 000 tonnes of poultry meat in 2013 (FAOSTAT, 2017). Based on this demand, there has been a rise in the production of poultry products in the world being the quickest source of animal protein. However, this situation is not the same in Nigeria but rather opposite. It has been a common experience that with increased demand for animal proteins, there is a corresponding increased demand for feeds, particularly for ingredients which have high protein and energy values, (Mengesha, 2012).

Animal feeds in general can be segmented into five classes, based on livestock category thus, poultry, swine, ruminant, aquaculture and pet animals, and the cost of their feeding is generally on the high side (Agbota, 2016). Feed is the major component and most important input in any livestock production enterprise as it accounts for an average of 60 to 75 percent cost of production, any attempt to reduce the feed cost may lead to a significant reduction in the total cost of production (Oladejo, 2012; Swain, 2017; and Adetutu *et al.*, 2017). The feeds industry in Nigeria is made up of few large-scales firms who supply feeds all over the nation and many medium and small scales firms who only supply their output within their State or town of operation. They also concentrate mainly on poultry feeds production and few aqua- feeds production due to capital constraints.

Poultry feed mills are found all over the country, with the largest concentration in the south-west zone of the country than any other (Eniola, 2019), and the production is carried by three categories of mills within the country, namely; commercial, toll and on-farm mills (Nigerian Institute of Animal Science NIAS, 2021). The commercial mills are large scale mills, which mill and market their feeds under registered trademark whose hourly output ranges from 5 tonnes and above (Adetifa and Okewole, 2015; Eniola, 2019). The toll mills are micro, small and medium scale mills which produce hourly output ranges between 0.5 tonnes to 4 tonnes per hour directly for farmers (Munkaila *et al*., 2014 and Highnet Resources, 2022),. They are spread across major locations with significant concentration of small to medium scale poultry farms. They will mill feed to the specification of customers (poultry and aquaculture farmers) and charge a fee (toll) per quantity milled. The third category of feed mills is the integrated poultry farms, with private feed mills produce for own use.

The total commercial feed production in Nigeria has witnessed an increasing output as well as capacity in the recent time. According to NIAS Field Survey, (2016), the total commercial poultry feed production for egg and meat from the year 2013 to 2015 (in metric tonnes) rose from 3,300,000 to 5,300,000, indicating about 61% increase in total production where feed for egg (layers) increased with about 42% and that for meat (broilers) with about 92%. This implies a significant growth in the total commercial feed production within a period of two years in the country with more demand for broilers feeds than that of layers. Plant capacity distribution in the feed industry shows that only 7 firms operate a capacity distribution of 25 tonnes per hour and above, 125 firms operate capacity distribution of 5 – 10 tonnes per hour, 400 operate capacity distribution of 1 – 2 tonnes per

hour and 258 operate capacity distribution of less than 1 tonne per hour (Oyedele, 2016). This means that about 83% of poultry feed firms in Nigeria operate on a small and medium scale.

It has been reported that the Toll feed producers are inefficient in the utilization of productive resources in studies on the efficiency of feed mills by Sani *et al* (2017) and Akerele *et al.* (2019). The result of this inefficiency and other factors are expected to be shifted to the poultry farmers who are the end users of the feed which will come in form of extra charges for feed they purchase. Since the target of the feed industry is not only to supply feed in required quantity or quality, but to reduce the high cost emanating from inefficient resource utilization by the poultry farmers, it becomes necessary to study the efficiency of the poultry feed industry. An increase in the level of efficiency of the industry will likely reduce the cost and consequently increase the level of profits enjoyed by both the mills and the poultry farmers (Sani, 2015; Eruvbetine, 2009).

There are however few studies that have been carried out on the technical efficiency of poultry feed firms in Nigeria (Sani 2015; Sani *et al.,* 2017 and Akerele *et al.,* 2019). Most of these studies found that there is a high level of inefficiency among the feed mills sampled for the studies. However, empirical evidence on the technical efficiency of poultry feed firms remains inadequate in Nigeria. This study therefore examines the production efficiency of poultry feed firms in Kaduna and Plateau States, Nigeria. Specifically, the study examined:

i) the characteristics of the poultry feed firms,
ii) the technical efficiency of the poultry feed firms, and
iii) the constraints faced by poultry feed firms in the study area.

MATERIAL AND METHOD

The Study Area

The study was carried out in Kaduna and Plateau States, Nigeria, being the two states in the Northwest and North central with most investment in poultry feed firm. Kaduna state is located in the Northern Guinea Savannah ecological zone. The state is located between latitude 9^0 N and 12^0N and longitude 6^0E and 9^0E of the prime meridian. The population of the state was estimated to be 9,805,858 people in 2021 at population growth rate of 3.2%. The state occupies an area of approximately 68,000 square kilometers. Plateau state on the other hand, is located at the Northern Guinea Savannah. The state is located between latitude 80^0 24'N and longitude 80^0 32' and 100^0 38'E of the Greenwich meridian (Dossah, Mohammad and Ndahi, 2016). The state occupies an area of about 30,913 square kilometers with a projected population of about 5,143,276 people in 2021, at growth rate of 3.2% annually.

Sampling Technique and Sample Size

Multistage sampling technique was employed for the study. The first stage was a purposive selection of four (4) local governments out of the twenty-three (23) in Kaduna state (Sabon Gari, Igabi, Kaduna North, and Kaduna South Local government) based on the high concentration of feed mill firms and two Local Governments from Plateau State were selected out of the 17 in the state (Jos North And Jos South based) on same reason. The second was the selection of areas that have high concentration of these feed mills in the selected local governments and the final stage was a snowball sampling technique to get the number of the feed mills within those areas. 60 feed firms constitute the sampling frame of the study and a total of 51 firms make the sample size of this study.

Table 1: Poultry Feed Firms in Kaduna and Plateau State, Nigeria

State	Local Government Area	Sample Frame	Sample Size
Kaduna			
	Sabon Gari	7	5
	Igabi	7	5
	Kaduna North	2	1
	Kaduna South	21	17
Plateau			
	Jos North	19	19
	Jos South	4	4
TOTAL 2	8	60	51

Data Collection

Primary data was collected for this study through the administration of structured questionnaire. The questionnaire was administered by the researcher and spread across six local government areas of Kaduna State as well as two local governments from Plateau State to the respondents. Information collected from the mills include: experience of owners/operators of the feed mills, educational level of operators, mill capacity, type of technology used, location of the mill, access to and availability of electricity, distance from sources of inputs, access to credit, years of membership of millers' association etc. Production information collected include: quantity of inputs such as maize, soybean, groundnut cake, maize, rice and wheat bran, palm kernel cake and fish meal used in feed production, the outputs and their prices, various costs (fixed and variable) incurred in the production process, revenue generated and the constraints of the feed mills.

Analytical Techniques

The analytical techniques that were used for this research to achieve its objectives include: Descriptive Statistics, which was used to described the characteristics of the poultry feed mills and stochastic frontier production function, used to estimate production efficiency and its determinants.

Model Specification

Empirical stochastic frontier model specification

The Cobb–Douglas frontier production function was used in this study. Taylor and shonkwiler (1986) noted that as long as interest rests on efficiency measurement and not on the general structure of the production technology, the Cobb–Douglas production function provides an adequate representation of the production technology. This was used to achieve objective 2 of the study. The model is specified as:

$$\ln Y_i = ß_0 + ß_1 \ln x_1 + ß_2 \ln x_2 + ß_3 \ln x_3 + \ldots\ldots ß_{17} \ln x_{18+} (V_i - U_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where; $\mathbf{Y_i}$ = output of feed from the ith mill (Kg), $\mathbf{X_1}$= quantity of maize (Kg), $\mathbf{X_2}$ = groundnut cake (Kg), $\mathbf{X_3}$ = soybean cake (Kg), $\mathbf{X_4}$ = palm kernel cake (Kg), $\mathbf{X_5}$ = wheat bran (Kg), $\mathbf{X_6}$ = Maize bran (Kg), $\mathbf{X_7}$ = fish meal (Kg), $\mathbf{X_8}$ = Bone meal (Kg), $\mathbf{X_9}$ = Limestone (Kg), $\mathbf{X_{10}}$ = Vitamin premix (Kg), $\mathbf{X_{11}}$ = Salt (Kg), $\mathbf{X_{12}}$ = Enzymes (Kg), $\mathbf{X_{13}}$ = Methionine (Kg), $\mathbf{X_{14}}$ = Lysine (kg), $\mathbf{X_{15}}$ = labour (man / days), $\mathbf{X_{16}}$ = electricity consumed (kilowatts), $\mathbf{X_{17}}$ = diesel fuel (Litres), $\mathbf{X_{18}}$ = Mill Size (tonne/hour), $\mathbf{V_i}$ = A random error term ("white noise") assumed to be independent of $\mathbf{U_i}$, identical and normally distributed with zero mean and constant variance N (0, $\delta^2{}_v$), which accounts for the random variation in output by factors such as distance to source of ingredients, source of power, number of millers/competitors nearby that are beyond the control of the millers, $\mathbf{U_i}$ = A random variable called technical inefficiency effects (disturbance term). This is associated with technical inefficiency of production of millers involved which are assumed to be independent of V_i. They are non-negative truncations at zero or half normal distributions with N (0, $\delta^2{}_u$), **In** = the natural logarithm (to base e) and $\mathbf{ß_0 – ß_{18}}$ = parameters that were estimated. Estimation of equation (1) was accomplished using the Maximum Likelihood Estimation (MLE) technique available in the computer program called frontier version 4.1 developed by Coelli (1996).

Determinants of Technical Efficiency

Apart from determining the mills technical efficiency in poultry feed production; this study also identified their determinants of technical efficiency in terms of firm's characteristics. In this respect, an inefficiency model, which assumes that the inefficiency effects are independently distributed having **N** (O, $\delta^2{}_u$) distribution and mean $\mathbf{U_i}$ was used, (Coelli and Battese, 1996). The model is specified as follows.

$$Ui = \gamma_0 + \gamma_1 W_1 + \gamma_2 W_2 + \gamma_3 W_3 + \ldots \gamma_{11} W_{11} + e_i \quad \ldots\ldots (2)$$

Where; **Ui** = Technical inefficiency of the ith miller, $\mathbf{W_1}$ = Operating capacity of the millers, $\mathbf{W_2}$ = Amount of credit accessed (amount of loan obtained in N), $\mathbf{W_3}$ = Year of feed milling experience, $\mathbf{W_4}$ = Average Distance to source of major ingredients, $\mathbf{W_5}$ = Source of power (1= National Grid, 2 = Generator), $\mathbf{W_6}$ = Number of millers/competitors nearby, $\mathbf{W_7}$ = Access to major market for output (distance from market outlets), $\mathbf{W_8}$ = Years of Membership of miller's association (year of cooperative participation), $\mathbf{W_9}$ = Number of employees/operators, $\mathbf{W_{10}}$ = Number of Months ingredients are available during the season, $\mathbf{W_{11}}$ = Number of Years of Education of operators, $\mathbf{W_{12}}$ = Ownership type (1= owners, 2= otherwise) $\mathbf{e_i}$ = Error term, While γ_0, γ_1... γ_{11} are parameters to be estimated. Above were included in the model to indicate their possible influence on the TE of the poultry feed firms in the study area.

Results and Discussion

Characteristics of the Poultry Feed Firms.

The result in Table 2 shows that most of the firms have considerable number of years in milling business (about 12 years). The years of experience ranges from 2 to 25 years. About 61% of the mills are members of millers' association with an average of 3.4 years of membership and operating on an average of 5 working days in a week. In addition, the firms produce a minimum of 1 tonne of feed per day and an average of 4.1 tonnes per day operating on an average of 9 hours per day. The Feed mills spend a minimum of 1 hour to a maximum of 2.5 hours with an average of 1.3 hour per batch. The result further shows a minimum installed capacity of 1 tonne/hour was installed by the firms, with an average of 1.7 tonnes/hour. This finding is similar to that of Sani *et al.* (2017) and Akerele *et al.* (2019) who both studied efficiency of poultry feed production enterprises in Yewa Division, Ogun State and Nigeria respectively.

Table 2: Distribution of Feed Firms According to Years of Experience, Mill Capacity, and Hours Per Batch Produced, Hours of Operation Per Day, Output Per Day, Installed Capacity and Achieved Capacity.

Variables	Minimum	Maximum	Mean	Standard Deviation
Years in milling business	2	25	11.47	5.39
Years of membership of association	2	20	3.45	4.21
Days Operation/Week	5	7	5.82	0.43
Output/day	1	20	4.18	3.21
Hours of operation	5	16	9.41	1.74
Hours/batch	1	2.5	1.31	0.42
Mill Capacity	4	40	13.93	7.78
Mill Installed Capacity	1	4	1.77	0.80
Achieved Capacity	10	80	36.65	19.20

Source: Field Survey, 2019

Technical Efficiency of the Poultry Feed Firms

The results of the maximum likelihood estimation of production function (Table 3) revealed that Gamma (ɣ) = 0.53 and is statistically significant at 1% level. This implies that about 53% of the residual variation in output of feed firms was due to technical inefficiency. The sigma square (σ2) on the other hand was 0.2187 and also significant at 1%, indicating the correctness of the specified assumption of the distribution of the composite error term.

The result in Table 3 on the estimated coefficients for parameters for the poultry feed firms shows that maize, soya beans, fish meal, limestone, pkc, diesel and labour all have positive coefficients but different level of significance. Maize, soya bean, fish meal and diesel were significant at 1%, while labour, PKC and limestone were significant at 5% and 10% respectively. This implies that a 1 unit increase maize, soya beans, fish meal, pkc, limestone, diesel and labour will increase output of the feed mills by 0.37%, 0.35%, 0.19%, 0.02%, 0.07%, 0.32%and 0.69% respectively. This means that some resources are being underutilized while others are over utilized by the mills. These findings conform to a similar study by Akerele *et al*, (2019), who found mills in Ogun state having both positive and negative estimates of their coefficients. In their study, they found the coefficient of raw materials (ingredients) and labour to be positively related to output while operating expenses and fixed capital were negatively related to output of the mills. Therefore, the poultry feed firms can improve on their level of efficiency by increasing maize, soybeans, palm kernel cake, fish meal, limestone, diesel, labour and mill size utilization by 0.37%, 0.35%, 0.02%, 0.19%, 0.07%, 0.32%, 0.69%, 0.05%, while decreasing maize bran, enzymes, methionine and electricity utilization by -0.37%, -0.75%, -0.38% and 0.43% respectively.

Table 3: Maximum Likelihood Estimation results of Stochastic Frontier Production Function of the Poultry Feed Firms

Variable	Coefficient	Standard Error	T-value
Constant	0.0268	0.0052	5.1737***
Maize	0.3791	0.1201	3.1591***
Groundnut Cake	0.0742	0.0479	1.5510
Soya beans	0.3513	0.0830	4.2341***
Palm Kernel Cake	0.0221	0.0120	1.8358*
Wheat Bran	0.0717	0.4596	0.1559
Maize Bran	-0.3742	0.5311	-0.7046
Fish Meal	0.1932	0.0198	9.7477***
Bone Meal	0.2002	0.1446	1.3845
Limestone	0.0770	0.0424	1.8183*
Vitamin	0.0124	0.0839	0.1484
Salt	0.0344	0.2797	0.1230
Enzyme	-0.7469	0.6084	-1.2276
Methionine	-0.3768	0.3731	-1.0099
Lysine	0.0203	0.0432	0.4696
Diesel	0.3206	0.0975	3.2890***
Electricity	-0.4341	0.4009	-1.0828
Labour	0.6927	0.3353	2.0661**
Mill size	0.0545	0.0501	1.0879
Sigma Squared	0.2187	0.1120	1.9598*
Gamma	0.53	0.1377	3.8286***
Log likelihood	154.6208		
Observations	51		

***<0.01, **<0.05, *<0.10

Technical efficiency level of the Poultry feed firms

Table 4 below showed the distribution distributions of technical efficiency indices. The level of technical efficiency of feed mill firms ranged from 0.21 to 0.90 with a mean of 0.67. The least technically efficient firm produced about 28 percent of the maximum output with the available inputs, that is, 72 percent of the potential output was lost due to technical inefficiency. The most efficient feed firms produced about 90 percent of the maximum output with the available inputs, meaning that, 10 percent of the potential output was lost due to technical inefficiency. The average feed mill firm, on the other hand, could still produce 67 percent of the maximum output with the available inputs, that is, 33 percent of the potential output was lost due to technical inefficiency. These findings indicate that there is still great potential for the feed mill firms to increase their current level of production using the available resources. This supports findings from similar study by Sani *et al* (2017) in estimating the profitability and technical inefficiency among toll feed mills in Nigeria and

reported a technical inefficiency mean of 0.82 which is below frontier.

Table 4: Frequency Distribution of Technical Efficiency of The Poultry Feed Firms

Class	Frequency	Percent
0.21- 0.30	3	6
0.31- 0.40	5	10
0.41- 0.50	4	8
0.51- 0.60	10	20
0.61- 0.70	10	20
0.71- 0.80	12	24
0.81- 0.90	7	14
Total	**51**	**100**
Mean	**0.67**	
Min	**0.28**	
Max	**0.90**	

Determinants of Technical Efficiency among the Poultry Feed Firms

The factors which influence the technical efficiency of the sampled poultry feed firms were operating capacity, distance to output market, number of employees, months ingredients are available and type of ownership of mill (Table 5). However, access to credit, years of milling experience, membership of association, and level of education of employees were found to have the expected negative coefficients, though insignificant. This implies that these factors do not contribute to poultry feed firms' inefficiency. Operating capacity as expected is having negative coefficient and significant at 5%. The implication of the finding is that technical inefficiency decreased with increased operating capacity i.e., the bigger or larger the operating capacity, the more efficient a firm could be. Poultry feed firms with higher operating capacity were expected to be more efficient than their counterparts. This result is in line with the findings of Sani (2015), who found that operating capacity of on-farm feed mills had a negative and significant effect on the level of technical inefficiency.

Distance to output market had a positive coefficient and significant at 1%. The implication is that nearness to output market increases inefficiency. i.e., the closer the distance of the toll mill to output market, the less efficient the mill will be. The firms don't normally move out to seek for more customers through advertisement, they rely on their usual customers or a referrals who might require their services. Moreover, firms that were closer to output market could be less efficient than their counterparts, holding other variables constant. This finding is contrary to Sani *et al* (2017), who found distance to output market had negative and significant effect on technical inefficiency of toll mill firms in Nigeria.

Number of employees is also having a positive coefficient and significant at 10% level. The implication of the finding is that increase in the number of employees by a firm increased technical inefficiency i.e. will reduce efficiency, holding other variables constant. The higher the number of employees the more important human resource management becomes difficult. Partly, the inefficiency gap between firms with more employees and those with fewer employees could be attributed to the education gap among the employees which has the ability to increase efficiency. This is also in line with Sani (2015), who found number of employees to have positive and significant effect on the level of technical inefficiency in on-farm mills.

Months during which ingredients are available in required quantity is having a negative coefficient and significant at 10%. This implies that the more the number of months ingredients are available at required quantity, the more efficient poultry feed firms will be. Firms who have fewer months of ingredients availability will therefore be less efficient compared to those with higher number of months ingredients are available especially during production in off season. This finding conform to that of Sani *et al* (2017), who found that number of months ingredients are available in required quantity to feed mills had negative and significant effect on technical inefficiency of toll millers.

Type of ownership also had a positive and significant effect on the level of technical inefficiency at 5% level. This implies that poultry feed mills owned and managed by a sole proprietor increases inefficiency than otherwise. On the other hand, mills that are operating not by their owners (sole proprietor) such as partnership, limited liability, etc. were found to be more efficient in the use of all production inputs than the sole proprietorship. This perhaps, could be as a result of poor personnel and financial management associated with sole proprietorship. Moreover, other types of ownerships usually have board of directors and other managerial carder for effective supervision and oversight functions, which will ultimately increase efficiency.

Table 5: Socio-economic Determinants of Technical Efficiency among the Poultry Feed Firms

Variable	Coef	Std error	t-value
Operating capacity	-6.3E-08	2.58E-08	-2.43**
Amount of credit accessed	-1.90E-08	7.74E-08	-0.25
Proprietor's experience in feed milling	-0.01	0.02	-0.36
Average distance to major sources of ingredients	0.001	0.0007	1.28
Source of power	0.18	0.2	0.89
Number of competitors in your area	0.01	0.02	0.34
Distance to major market	0.46	0.18	2.61***
Membership of millers association	-0.001	0.03	-0.06
Number of employees	0.05	0.02	1.92*
Availability of ingredients in required qty	-0.09	0.05	-1.7*
Level of education of employees	-0.02	0.01	-1.54
Ownership type	0.51	0.17	2.92***
Constant	0.23	0.44	0.52
BC Average technical efficiency	0.62		
JLMS Average technical efficiency	0.61		

***<0.01; **<0.05 and 0.1; BC=Battese and Coelli; JLMS= Jondrow, Lovell, Materov and Schmidt.

Constraints Faced by the Poultry Feed Firms

Result in Table 6 presented the major constraints faced by poultry feed mills in the study area. Constraints identified were high cost of ingredients (1st), low quality or adulterated ingredients (2nd), low patronage (3rd), high competition from larger firms (4th), unstable electric power (5th) and security challenges (6th). Specifically, the findings shows that all (100%) the poultry feed firms were facing the problem of high cost of ingredients which has significantly increase production costs and ultimately reduce the net return to the mills. This constraint remains the bottleneck in the industry over the years as Sani (2015), also found that 100% of the commercial mills, toll mills and on-farm mills reported to have being constrained by high cost of ingredients. A similar work on small scale animal feed production by Oluwafemi *et al.* (2017), also identified that 24% of feed mills were constraint by high cost of feed ingredients. Adulterated ingredients was second and found to be 94%. This has affected their quality standard as well as limit their market penetration and competition especially with the larger mills. This is also reported by Sani (2015). Also, low patronage was third and found to be 88% of the toll mills' constraint. Toll millers reported that poultry farmers only patronize them during inflation of commercial feeds, because of their relatively low-price charge per 25 kg. Furthermore, unstable power supply was reported to be 63% of the mills' challenge. This corresponds with the findings of Oluwafemi *et al*. (2017) and Akerele *et al*. (2019), whom reported unstable supply of electricity as a major constraint to poultry feed production in Ogun state, Nigeria. Security challenges (53%) was also other constraints found to limit efficiency and productivity of the feed mills. Insecurity in this sense not only affected the feed mills operation, but also poultry farmers who buy feeds from them. It also, affect the availability of raw materials with multiplier effects on the costs of production.

Table 6: Constraints Faced by the Poultry Feed Firms

Constraints	Frequency	Percent (%)	Rank
High cost of ingredients	51	100	1st
Adulterated Ingredient	48	94	2nd
Low patronage	45	88	3rd
High competition from larger firms	39	76	4th
Unstable supply of electricity	32	63	5th
Security challenges	27	53	6th

*Multiple response allowed

CONCLUSION AND RECOMMENDATIONS

The study revealed that some characteristics of the poultry feed firms, such as distance to output market, number of employees, and type of ownership are positive and significant, implying that an increase in any of them will increase technical inefficiency and consequently affect the output of the poultry feed firms negatively. Also characteristics of mills such as milling capacity, access to credit and availability of ingredients in required quantity, have the tendency to reduce technical inefficiency there by affect the output of the poultry feed firms positively. The technical efficiency levels of the sampled feed mills ranged from 0.21 to 0.90 with a mean of 0.67. This implies that, on average, the mills have to increase output at current level of input usage by 33% to attain full efficiency. This further implies that poultry feed firms in the study area did not achieve absolute efficiency in the use of variable inputs.

Based on the findings of this study, the following recommendations are advanced

a. Labour has significant influence on the output of poultry feed firms, yet underutilized. This implies that labourers are less in quantity, overworked as well as under paid. Therefore, the firms should improve on the employment of labour as well as in their wages.
b. The study revealed that most of the major ingredients like maize, soybeans and groundnut cake were all underutilized. It is therefore recommended that the firms should buy ingredients in bulk and store them when they are cheap for future use.
c. It was revealed that diesel as fuel for generator was underutilized owing to its skyrocketing price, at the same time the unstable electricity power increase inefficiency. It is therefore recommended that feed millers should either relocate to places where electric power from National grid is relatively stable or source for other cheaper power sources such as solar and/or other renewable energy.
d. The study also revealed that distance to major market had a positive and significant effect on the level of technical inefficiency. It is to the advantage of the firms to establish themselves in the aspect of marketing their output before moving them to far places where they might have more competition.

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