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PROFIT EFFICIENCY AMONG SHEEP FATTENING ENTERPRISES IN KEBBI STATE, NIGERIA.

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ABSTRACT

Livestock fattening means procuring feeder animal, putting the animal on concentrate feeds for a few months and disposing for slaughter after which it might have added weight (Moses, 2017) Profit efficiency refers to the extent at which a firm makes not only profit but its ability to maximize profit. The study examined the Profit efficiency and its determinants among sheep fattening enterprises in Kebbi state, Nigeria. Data were collected from a sample of 160 fatteners using the multistage sampling technique. A translog stochastic frontier profit function model was employed for the analysis in which profit efficiency effects are specified to be a function of socioeconomic variables estimated using the maximum likelihood method. The results of the analysis revealed that labour, fattening animals, depreciation, and water are the dominant variables that influenced profit efficiency in sheep fattening with coefficient values of (8.849, -0.629, -0.003, and 3.132), respectively. Analyzed results revealed a wide variation in the estimated profit efficiencies, ranging between 0.10 and 0.66 with a mean of 0.23 suggesting that the best profit maximizing fattener operated barely above average frontier. The result also showed that increase in age reduces profit efficiency among sheep fatteners at 1% while increase in fattening experience, herd size, credit access and membership of cooperative influenced the level of profit efficiency at 1% levels. For sheep fatteners to increase profit efficiency, it is recommended that they should increase herd size, have access to credit and they should form cooperatives in order to attract financial support.

KEYWORDS: Profit efficiency, Sheep, fattening, Kebbi State, Nigeria

1. Introduction

The production of animal protein in the developing countries has remained insufficient to meet nutritional requirements of the low income households. There is no doubt that the animal protein requirements of the geometrically growing population will continue to increase. The need to increase animal production aggressively is an understatement if the already shortfall in protein intake of the average Nigerian and the continuous increase in the nations populations are considered (Akpodiete, 2007).

As the population density increases farmers must produce even more food than before. With the population increases today, people are being pushed to develop new technologies of raising more animals hence more meat. One of the enormous challenges in the drive to increase food to feed the growing population will be to raise productivity and efficiency in the agricultural sector (Ajibefun, 2002). Given the various agricultural programs and policies implemented over the years to raise farmers efficiency and productivity, it has become imperative to quantitatively measure the current level of and determinants of profit efficiency so as to raise the present level of efficiency, given the fact that efficiency of production is directly related to the overall productivity of the agricultural sector (Ajibefun, 2002). In view of the inherent constraints posed by the traditional animal husbandry system practiced by the nomadic animal rearers, with increased demand- supply gaps, Oni (2006) and Kolo (2013) asserted that concerted efforts must be made to develop new technologies that will enhance meat production as a shorter term approach and consequently increase protein availability. It is recognized that one of the major bottlenecks to meat production in the nation are the problems of animal nutrition and system of management (Oyediji and Akinfolarin, 2013). Oyediji and Akinfolarin (2013), Inwuanyanwu (2001) and Alawa *et al.* (2008) have advocated that a shorter-term approach than range management to increase meat output under the prevailing socio-ecological conditions is the development and use of feedlot techniques.

Inwuanyanwu (2001) and Alawa *et al.* (2008) asserted that introduction of industrial feedlots through livestock fattening on sufficiently large scale will make the beef industry more efficient due to higher daily weight gains, better feed conversion, short period involved and higher dressing percentage. Other advantages according to them include, possibility of utilizing agro industrial by-products, ensuring greater homogeneity of finished product, conflict free

production, easier marketing of finished animal, reduced assembling costs, and rapid money turn over that will make the venture lucrative to private and external financing. Thus, the physical and economic relationships between feed inputs and livestock output within the system, becomes highly important area to be studied.

Profit efficiency is defined as the ability of farmers to achieve highest possible profit given the prices and levels of fixed factors of that farm or ability of a firm to achieve potential maximum profit, given the level of fixed factors and prices faced by the firm.

Profit inefficiency is defined as the losses of profit from not operating on the frontier (Ali and Flinn, 1989).

Objectives of the Study

In view of the above, this study was designed to evaluate the profit efficiency of sheep fattening enterprises in Kebbi State, Nigeria. The specific objectives of the study are to:

1 determine the profit efficiency of sheep fattening enterprises.
2 examine the determinants of profit efficiency among sheep fattening enterprises in the study area.

2 Materials and Methods

Sampling Procedure

The study was conducted in Kebbi State of Nigeria. This was purposively selected due to its importance in livestock fattening. The sampling method used was the multi-stage sampling technique. The State was divided in to four according to Kebbi State Agricultural Development Project (ADP) zones, namely Argungu, Bunza, Yauri and Zuru Zones. In the first stage, two Local Government Areas (LGAs) were randomly selected in each zone through lottery method (drawing lots), making a total of eight LGAs in the study. These include Argungu and Dandi LGAs in Argungu zone, Jega and Bunza LGAs in Bunza zone, Yauri and Ngaski LGAs in Yauri zone and Danko-Wasagu and Zuru LGAs in Zuru zone. Secondly, from each of the LGAs, two leading villages noted for sheep fattening were purposively selected giving a total of sixteen villages and from each village ten sheep fatteners were randomly selected through snow ball technique giving a total of 160 fatteners that were interviewed for the study.

Data Collection

Data were collected at fortnight intervals so as to get comprehensive data using the cost route approach. Information on primary data collected includes input – output data on fattening enterprises. The weight of sheep fattened was obtained using a bathroom scale. The body weight was measured by measuring the weight of a research assistant alone and then while carrying the animal in his hands using bathroom scale. The difference in the human weight from the total

weight for each weighing was recorded as the individual animals' weight. The difference between the initial body weight and the final body weight gives the weight gain.

Data Analysis

The tool of analysis used for analyzing the data is the stochastic frontier profit function model to determine the profit efficiency and its determinants among sheep fattening enterprises.

The empirical model

$$\text{Ln } \pi^{*} = \beta_o + \beta_1 \text{LnX}_1 + \beta_2 \text{LnX}_2 + \beta_3 \text{Ln X}_3 + \beta_4 \text{Ln X}_4 + \beta_5 \text{LnX}_5 + \beta_6 \text{Ln X}_6 + \beta_7 \text{LnX}_7 + \tfrac{1}{2} \beta_{11} \text{Ln X}_1^2 + \tfrac{1}{2} \beta_{22} \text{LnX}_2^2 + \tfrac{1}{2} \beta_{33} \text{LnX}_3^2 + \tfrac{1}{2} \beta_{44} \text{Ln X}_4^2 + \tfrac{1}{2} \beta_{55} \text{Ln X}_5^2 + \tfrac{1}{2} \beta_{66} \text{Ln X}_6^2 + \tfrac{1}{2} \beta_{77} \text{LnX}_7^2 + \beta_{12}\text{LnX}_1\text{LnX}_2 + \beta_{13}\text{LnX}_1\text{InX}_3 + B_{14}\text{LnX}_1\text{LnX}_4 + \beta_{15}\text{LnX}_1\text{LnX}_5 + \beta_{16}\text{LnX}_1\text{LnX}_6 + \beta_{17}\text{LnX}_1\text{LnX}_7 + \beta_{23}\text{LnX}_2\text{LnX}_3 + \beta_{24}\text{LnX}_2\text{LnX}_4 + \beta_{25}\text{LnX}_2\text{LnX}_5 + \beta_{26}\text{LnX}_2\text{LnX}_6 + \beta_{27}\text{LnX}_2\text{LnX}_7 + \beta_{34}\text{LnX}_3\text{LnX}_4 + \beta_{35}\text{LnX}_3\text{LnX}_5 + \beta_{36}\text{LnX}_3\text{LnX}_6 + \beta_{37}\text{LnX}_3\text{LnX}_7 + \beta_{45}\text{LnX}_4\text{nX}_5 + \beta_{46}\text{LnX}_4\text{LnX}_6 + \beta_{47}\text{LnX}_4\text{LnX}_7 + \beta_{56}\text{LnX}_5\text{LnX}_6 + \beta_{57}\text{LnX}_5\text{LnX}_7 + \beta_{67}\text{LnX}_6\text{LnX}_7 + \text{Vi} - \text{Ui} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where,

Ln = Logarithm to base e

π^{*} = Normalized profit in Naira of the farm defined as gross revenue less variable cost normalized by price of livestock output per farmer.

β_o = Intercept/constant term

β_1-β_{67} = Parameters to be estimated

X_1 = Daily wage rate (₦) normalized by price of fattened livestock output per farmer.

X_2 = Cost of medication and veterinary services in naira (₦) normalized by price of fattened livestock output per farmer.

X_3 = Price of feeds and feed supplements in naira (₦) normalized by price of fattened livestock output per farmer

X_4 = Price of fattening animals purchased in naira (₦) normalized by price of fattened livestock output per farmer

X_5 = Capital inputs measured in naira (₦) these include; depreciation charges on Implements/ equipment's, repairs and operating expenses, interest charges on borrowed capital, depreciation on housing, drinkers, ropes.

X_6 = Volume of water utilized in liters

X_7 = Cost of transportation in naira (₦) normalized by price of fattened livestock output per farmer

Vi = Normal random errors which are assumed to be independently and identically distributed having zero mean and constant variance

Ui = Profit inefficiency effects, are independently distributed and arise by truncation (at zero) the normal distribution with mean Ui and Variance δ^2, where Ui is specified as:

Ui = $\delta_o + \delta_1 z_1 i + \delta_2 z_2 i + \delta_3 z_3 i + \delta_4 z_4 i + \delta_5 z_5 i + \delta_6 z_6 i$ ……..…. (2)

Z_1 = Age of the livestock fattener in years

Z_2 = Level of education in number of years spent in school

Z_3 = Fattening experience in years

Z_4 = Household size

Z_5 = Herd size

Z_6 = Dummy variable for credit access (1 for access to credit, 0 otherwise).

$\delta - \delta_6$ = Unknown parameters estimated

The parameters of the stochastic frontier profit function were estimated by the method of maximum likelihood using computer program FRONTIER version 4:1 (Coelli, 1994).

The effect of technical inefficiency in the variation of output was determined following Jondrow *et al* (1982) drawing a relationship for the inefficiency index to that of general error as follows:

٢ = (λ^2/1+λ^2). ……..…. (3)

2. Results and Discussion

Parameter Estimates of the Stochastic Frontier Profit Function

Results in Table 1 indicate the sigma squared value of 0.007 and variance ratio of 0.998 and are significant at 1% level, respectively.

Table 1: Translog parameter estimates for profit efficiency in sheep fattening enterprises, Kebbi State, Nigeria

Production factor	Parameter	Coefficient	Standard error	t-ratio
Constant term/intercept	β_0	1.687	0.199	8.480***
Labour	β_1	8.849	1.519	5.827***
Medication	β_2	0.274	0.515	0.532
Feeds	β_3	-0.182	0.272	-0.668
Fattening Animals	β_4	-0.629	0.157	-3.992***
Depreciation	β_5	-0.003	0.001	-4.729***
Water	β_6	3.132	1.142	2.743***
Transportation	β_7	-0.062	1.016	-0.061
Squared terms				
Labour x Labour	β_{11}	57.965	1.000	57.965***
Medication x Medication	β_{12}	1.724	1.000	1.724*
Feeds x Feeds	β_{33}	1.832	1.000	1.832*
Fattening Animals x Fattening Animals	β_{44}	0.181	1.000	0.181
Depreciation x Depreciation	β_{55}	0.001	1.000	0.000
Water x Water	β_{66}	9.269	1.000	9.269***
Transportation x Transportation	β_{77}	6.409	1.000	6.409***
Interaction among inputs				
Labour x Medication	β_{12}	-532.752	1.758	-302.993***
Labour x Feeds	β_{13}	54.433	2.216	24.565***
Labour x Fattening Animals	β_{14}	-19.058	0.884	-21.568***
Labour x Depreciation	β_{15}	0.064	0.012	5.499***
Labour x Water	β_{16}	-172.885	3.607	-47.926***
Labour x Transportation	β_{17}	29.793	1.959	15.202***
Medication x Feeds	β_{23}	-62.886	1.210	-51.959***
Medication x Fattening Animals	β_{24}	47.791	1.318	36.253***
Medication x Depreciation	β_{25}	-0.029	0.005	-5.637***
Medication x Water	β_{26}	242.550	0.974	249.040***
Medication x Transportation	β_{27}	-34.417	0.547	-62.896***
Feeds x Fattening Animals	β_{34}	3.893	1.094	3.559***
Feeds x Depreciation	β_{35}	0.001	0.003	-0.338
Feeds x Water	β_{36}	16.818	12.742	1.319
Feeds x Transportation	β_{37}	-124.933	39.159	-3.190***
Fattening Animals x Depreciation	β_{45}	-0.006	0.002	-3.306***
Fattening Animals x Water	β_{46}	-27.483	9.059	3.033***
Fattening Animals x Transportation	β_{47}	27.698	12.546	2.208**
Depreciation x Water	β_{56}	0.050	0.012	4.156***
Depreciation x Transportation	β_{57}	0.047	0.019	2.476**
Water x Transportation	β_{67}	305.366	159.511	1.914*
Diagnostic statistics				
Log likelihood function		190.964		
Sigma square (δ^2)		0.007	0.001	10.56***
Gamma		0.998	0.001	3193***
LR test		142.198		

Source: Computer printout of Frontier 4.1

Asterisk ***, ** and * implying significant at 1, 5 and 10% levels respectively

This parameter estimate ascertains the goodness-of-fit and the correctness of the specified distributional assumptions of the composite error term. The variance ratio/the gamma (r = 0.998) which signifies that, the unexplained influences by the profit function are the major sources of the random errors, indicate also that, 99.8% of the variation in sheep fattening is attributed to profit inefficiency. This confirms the presence of one sided error component in the model that makes the average function inadequate in representing the data. The coefficient of the first order terms for costs of labour (8.849) and water (3.132) are positive and significant at 1% level respectively. On the other hand, fattening animals (-0.629) and depreciation (-0.003) had negative and significant relationship with profit at 1% level of probability. However, elasticity of fattening animals and depreciation are negative and significantly related to profit efficiency. The negative signs recorded against the slope coefficients of these variables indicated that these variables reduces profit inefficiency (increases profit efficiency). This is a sign that these resources were not being efficiently allocated or the enterprise is experiencing increasing returns that is increasing these variables will lead to a corresponding increase in profit efficiency. The findings is in disagreement with that of Cevger (2003) who found that profit decreases with cost of feed and purchase price. Results from the table also indicate that coefficients of labour cost and water utilized were the largest, signifying their importance in influencing profit efficiency in sheep fattening enterprise in the study area. This indicates that a 1% increase in labour and water, will lead to 8.85 and 3.13% decrease in profit efficiency, respectively. This is an indication that these variables are experiencing a diminishing returns. This finding is in disagreement with that of Nganga *et al* (2010) whose result showed cost of feeds as most important variable determining profit efficiency in their study.

Most of the interaction terms (2^{nd} order coefficients) were statistically significant at the conventional significance levels (1. 5 and 10%), implying the suitability of the Translog function (Okoye and Onyenweaku, 2007). Among the second order terms, the coefficients of the square term for labour, water utilized and transportation were significant at 1% probability level respectively. However, coefficients of labour, medication, feeds and water had positive values and their t-ratios suggesting that these squared resources need to be increased in order to operate at an economic level of efficiency at profit maximization level. The implication is that these

squared variables have not been utilized up to their optimal economic efficiency levels. Coefficients of interaction between labour x medication, labour x feeds, labour x fattening animals, labour x depreciation, labour x water, labour x transportation, medication x feeds, medication x fattening animals, feeds x transportation, fattening animals x depreciation, fattening animals x water and depreciation x water showed a strong relationship at 1% level of probability and fattening animals x transportation and depreciation x transportation showed significance at 5% levels while water utilized x transportation is significant at 10% levels. This means that increasing a unit of these interaction terms for positive coefficients would lead to a corresponding increase in weight gain while increasing a unit of these interaction terms for negative coefficients would lead to a corresponding decrease in economic efficiency.

Profit Efficiency Estimates

Table 2 shows the predicted profit efficiency of sheep fatteners ranging between 0.10 and 0. 66 with a mean of 0.23. The minimum efficiency of 0.10 shows gross under-utilization of resources while the best economically efficient fattener operated barely above average frontier. There is a wide gap between the economic efficiency level of best and the worst fatteners. To bridge the gap, the average fattener needs a cost saving of 65.15 percent that is (1-0.23/0.66%) to attain the frontier level of the most economically efficient fattener in the study.

Table 2: Distribution of sheep fatteners according to profit efficiency indices, Kebbi State, Nigeria

Technical Efficiency index	Frequency	Percentage (%)
< 0.20	86	53.75
0.21-0.30	40	25.00
0.31-0.40	18	11.25
0.41-0.50	12	7.50
0.51-0.60	3	1.87
0.61 and above	1	0.63
Total	160	100.00
Mean Economic efficiency	0.23	
Standard Deviation	0.12	
Minimum Economic efficiency	0.10	
Maximum Economic efficiency	0.66	

Source: Computer printout of Frontier 4.1

The least economically efficient fattener will however, experience efficiency gain of about 84.85 percent that is (1-10/0.66%) to be able to attain the level of the most economically efficient fattener in the study. Given the fact that none of the sheep fatteners operated on the frontier (efficiency ratio is less than one), it depicts that more than the profit maximizing level of the input was employed (Onyenweaku and Fabiyi 1991; Ohajianya and Onyenweaku, 2000).

Determinants of Profit Efficiency

The result in Table 3 indicates that the coefficient of age (0.006) is positive and statistically significant at 5% level. This is in consonance with the apriori expectation that the older a fattener becomes, the more his efficiency drops. This tally's with the findings of Idiong *et al* (2009) as well as Tanko and Jirgi (2008) in their various investigations.

Table 3: Maximum likelihood estimates of the determinants of profit efficiency in sheep fattening enterprise, Kebbi State, Nigeria.

Variable	**Parameter**	**Coefficient**	**Standard error**	**t-ratio**
Intercept	Z_0	-0.246	0.054	-4.594***
Age	Z_1	0.006	0.003	2.040**
Level of education	Z_2	0.002	0.004	0.443
Fattening experience	Z_3	-0.004	0.003	-2.602***
Household size	Z_4	-0.010	0.002	-1.019
Herd size	Z_5	-0.113	0.017	-6.756***
Credit access	Z_6	-0.047	0.053	-2.896***
Membership of cooperative	Z_7	-0.060	0.036	-2.047**

Source: Computer printout of Frontier 4.1

***, **, * are significant levels at 1, 5 and 10% respectively.

Fattening experience (-0.004) has a negative coefficient but statistically significant at 10% level. The implication is that sheep fatteners with more years of experience achieve higher level of profit efficiency than the less experienced fatteners. This is in agreement with studies from Umar

et al. (2014) while in disagreement with studies by Moses (2017) who obtained positive and significant coefficients of years of experience in his different studies.

The coefficient of membership of cooperative (0.060) is negative and significant at 1% level of probability as expected. The result is in consonance with that of Umar *et al.* (2014) while it disagrees with studies by Moses (2017) who found positive coefficient for membership of cooperative. Farmers' membership of associations or cooperatives affords them the opportunity of interacting with others and thereby exchanging information on improved technology in sheep fattening. Results also revealed that the coefficient of herd size and credit access were negative implying that provision of credit and increasing herd size increase the level of profit efficiency. This agrees with the study by Umar *et al*. (2014) while in disagreement with studies by Moses (2017).

4. Conclusion

Based on the revealed results of the study it can be concluded that the fatteners were not maximizing profit. An estimated mean profit efficiency of 23% suggests that the best profit maximizing fattener operated barely above average frontier. The results suggested that profit will be enhanced with increase in fattening experience, herd size, credit access and membership of cooperative.

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