FACTORS AFFECTING PROFITABILITY OF AGRIBUSINESS ACTIVITIES AMONG SMALLHOLDER PIG FARMING IN ENUGU STATE, NIGERIA

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ABSTRACT

Concerted efforts have been made to commercialize the pig sub-sector to make it more profitable for farmers, especially smallholders. Despite development, the profitability of the sector has not been consistent among smallholder farmers. Smallholder farmers have made variable and dismal profits. The causes of the variation in profits have not been established empirically, as the influence of institutional arrangements from a transaction cost perspective and the management factors contributing to this inconsistency are not fully established. The study investigated the influence of institutional arrangements and management factors on the profitability of small-scale pig farming in Enugu State, Nigeria. A two-stage sampling technique was used for the selection of 80 smallholder pig farmers. Semi-structured interview guides were administered and data were analyzed using descriptive statistics and a stochastic frontier production function. The study revealed that the majority of male respondents (75%) were of working age and had 6 years of pig farming experience with basic education. The stochastic frontier production results revealed that feed costs (p<0.01) and breed type (p<0.05) negatively reduced the respondents' profit efficiency while the size of the herd (p<0.01) positively influenced profit efficiency. Inefficiency was increased by gender (p<0.1) and debt ratio (p<0.01) while trust in information (p<0.05) and experience decreased. The average profit efficiency was 0.40, which shows low profit efficiency in the study area, the efficiency level could be increased by 60% through better utilization of available resources, adoption of modern technologies and reduction of transaction costs. This would be achieved if good management practices and marketing channels were adopted. The gamma parameter (γ) was 0.63, which means that 63% of the variation in net revenues is due to profit inefficiencies. The study contributes to the field of agribusiness and would improve policies associated with the development of agribusiness in Kenya.

Keywords: smallholder farmers; institutional arrangements; management factors; stochastic frontier analysis; profit inefficiency.

INTRODUCTION

Population growth and urbanization have pushed the demand for animal protein to a new high. There is already a disparity between the rate of food production and demand in Nigeria. This has led Nigeria to import pork worth USD 700,000 since the country produces around 12,000 tonnes of pork worth N1.2 billion. Over the past five years, the number of pigs slaughtered in Nigeria has increased by about 12%, from 560,000 to 588,200 [ILRI, 2019]. Failure to provide the required amount of animal protein in the diet of the population is one of the main causes of dietary disparity [FAO, 2012]. In Nigeria, the livestock sector contributes 25% of employment and 9% of Nigeria's Gross Domestic Product (GDP). This sector mainly includes dairy products, milk, meat, eggs, wool, hides and skins. Meat consumption has increased rapidly over the past decade and is expected to reach 13.3 million tonnes by 2025 [Shibia *et al*, 2018]. As most urban areas continue to grow, meat consumption (beef, chicken, mutton, goat, pork, and camel) is expected to continue to increase from the current average of 19 kg per capita per year [USAID, 2017]. Pork could play an important role in effectively reducing the inadequacy of animal protein in diets through pig farming. Unfortunately, in Nigeria, smallholder farmers are not well organized and lack good agricultural practices, resulting in low yields, even very low yields. Over the years, the number of pigs slaughtered in Nigeria has steadily increased. With the level of poverty in Nigeria, pig farming plays an important role in risk diversification and livelihood security for smallholders and households as they present an important asset useful in generating income for purchase. Agricultural inputs, payment of school fees and emergency cash coverage. [ILRI,2019]. The small-scale pig farming business has proven to be very profitable when better husbandry practices and better management skills are applied [FAO, 2012]. Appropriate breeding stock selection as well as organized breeding programs are needed to facilitate genetic improvement to improve pig productivity in Nigeria (Mutua *et al*, 2010 Maitima *et al*, 2010). However, small-scale pig farmers in Enugu derive variable and dismal profits from their enterprise due to a number of productivity and market constraints, such as disease, poor nutrition and poorly organized markets. With good management skills and effective institutional arrangements, pig production improves,

increasing incomes and eventually increasing profit levels for farmers. This can only be achieved if the pig sub-sector is run as a business [Levy *et al*, 2014]. The development of the pig value chain is important because it has an effect on the profits of the farmers, because all the key actors in the chain support each other to improve efficiency and competitiveness [Kit *et al* 2006]. The county's subsector is largely informal with poorly organized markets and limited technology, information and services. Additionally, the lack of feed quality control measures and disease risks that wipe out pig herds during epidemic times lead to stunted growth that reduces market value. The exchange of good product market information is also affected by the lack of farmer organizations in the pig sector. This results in high transaction costs due to weak binding relationships between smallholder farmers and traders [Key *et al*, 2000]. Therefore, to minimize these high transaction costs, smallholder farmers need to establish effective institutional arrangements. A few studies have determined the influence of management factors and institutional arrangements on the profitability of smallholder pig producers. Most have examined the effect of farm and farmer conditions, marketing, social, cultural, technological and institutional factors on farm-level profit efficiency [Abdulai and Huffman, 1998, Rahma, 2003 , Ogundari, 2006, Hyuha, 2006, Coastales *et al* 2006, Ogunniyi, 2011, Maganga, 2012, Kadurumba *et al* 2014]. However, it is not only management factors and institutional arrangements that influence the effectiveness of smallholder pig farmers' benefits and the extent of influence, but also the identification of critical factors that influence the effectiveness of benefits is an important research priority. Thus, research is needed to determine what management factors and institutional arrangements need to be targeted for smallholder pig farmers to be profitable. This study also attempted to fill this knowledge gap.

METHODOLOGY
Study area, sampling procedure and data collection instruments
The study was conducted in Enugu State, Nigeria. A descriptive research design was used. A multistage sampling technique was used. Enugu State has been stratified into three zones according to the agricultural areas of the state. In the second step, two blocks were selected in each area by a simple random sampling (EAS) procedure. In the third step, the circles of each chosen block have been delimited and the list constitutes the sampling frame from which one circle has been chosen per block by the SRS procedure. A total of 8 circles were chosen. With the help of the village chiefs and the extension agents of the Enugu State agricultural development program in charge of the selected circles, the census of the smallholder pig farmers in the selected circle was done. A total of 80 small pig farmers, composed of 10 farmers per circle

were chosen. Primary data was collected through semi-structured interview schedules through personal interviews with farmers and the data obtained was analyzed using descriptive statistics and a stochastic frontier production function.

Specification of the empirical model
The stochastic frontier production function (SFPF) was applied in the data analysis. To determine which factors led to earnings inefficiency, the stochastic frontier approach was used. It takes into account the random error and the inefficiency component [Jacobs, 2000]. Following [Rahman, 2002], this study uses the model [Battese and Coelli, 1995] by postulating a profit function, which is assumed to behave in a manner consistent with the concept of stochastic frontier. The functional form of the stochastic profit frontier was determined by testing the sufficiency of the Cobb-Douglas which is very restrictive by adjusting it with the less restrictive translog, this is consistent with the work of [Nganga *et al* 2010].

The stochastic profit model used is the one shown in Equation 3 which is basically an input-output and transaction cost transformation model [NIIC, 1990] which is the linearized Cobb-Douglas production function while the equation 4 is the inefficiency model. The econometric model was generally defined as follows:

$Y_i = x_i \beta + e_i$ ………. (1)

$Y_i = \beta_0 + \sum_{i=1} \beta_i X_i + V_i - U_i$ (Cobb-Douglas function) (2)

$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + V_i - U_i$ (Translog function) (3)

Where:

$\ln Y_1$ = Normalized profit (net revenue per kilogram of output sold); X_1= Feed cost (kg); X_2=Wage rate (include wage rate for both hired and family labor) (man-days); X_3 = Breed type; X_4= Herd size; X_5= Search costs and X_6= Drug/Veterinary costs (N); B_0, $\beta_1,,,\beta_5$= Parameters to be estimated;

U_i = Degree of inefficiency which is half-normal distributed (iid N|) (0, σu_2). U_i is closely related to the profit inefficiency which may arise from management factors and institutional arrangements.

V_i = statistical disturbance term that is caused by factors outside the scope of the farmers which is assumed to be identically and normally distributed with a mean of zero (iid) and constant variance of $V \sim N$ ((o, $\sigma_2 v$) and independent of U.

The coefficient of the variables X_1, X_2, X_3, X_4, and X_5 are the estimates from profit function maximum likelihood and are interpreted as the elasticities of the variables. The coefficients are all correctly signed. Stochastic frontier model was used to determine the relationship between the pig Net Revenue and the inputs used by the selected smallholder pig farmers.

The objective of this study was analyzed using the inefficiency model where profit inefficiency (u) was the dependent variable and the inefficiency factors were the independent variables.

The expression of inefficiency model is specified below:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9 + \delta_{10} Z_{10} \ldots (4)$$

U_i – the inefficiency of the ith farm; $\delta_0,,\delta_9$= Are parameters to be estimated; Z_1 =Age; Z_2 = Gender ; Z_3 =Schooling years; Z_4 = Group membership; Z_5=Management type; Z_6=Trust (price); Z_7= Trust (Information); Z_8 = Debt Asset Ratio; Z_9= Experience; Z_{10} =Record Keeping. A half normal distribution of the inefficiency variance was used in the estimation.

The variance of the random errors, σv_2 and that of the profit inefficiency effect σu_2 and the overall variance of the model $\sigma2$ are related thus: $\sigma_2 = \sigma v_2 + \sigma u_2$, measure the total variation of profit from the frontier which can be attributed to profit inefficiency [Battese and Corra, 1977]. [Battese and Coelli, 1995] provided log likelihood function after replacing σv_2 and σu_2 with $\sigma_2 = \sigma v_2 + \sigma u_2$ and thus estimating gamma (γ) as: $\gamma = \sigma u_2 /\sigma v_2 + \sigma u_2$. The parameter γ represents the share of inefficiency in the overall residual variance with values in interval 0 and 1. A value of 1 suggests the existence of a deterministic frontier, whereas a value of 0 can be seen as evidence in the favor of OLS estimation [Kumbhakar and Lovell, 2000,Greene, 2008]. Lambda (λ) that is (σu /σv) was also computed to assess the goodness of fit and correctness of the specified normal/ half-normal distribution assumption. It was also used to explain the disparities of pork output among smallholder pig farmers.

The study will use the county average wage rate as an indicator of family worker wages. Average salary is the average salary of workers hired in pig farms in TharakaNithi County. This is calculated by the rule that a worker would spend 2 hours a day on the pig farm only.

RESULTS AND DISCUSSION
Pig management practices and institutional arrangements
The management practices and institutional arrangements of the sampled smallholder pig farmers are presented in Table 1. The table shows that the average age is 44 years, ranging from 24 to 76 years. This implies that most farmers were middle-aged; therefore, they possessed capacities for risk taking and innovation. At this age, farmers have a great mental capacity to deal with the daily challenges and demands of the farming business. The average number of years spent in school was 10 years, implying that pig farmers were educated and had a positive influence on the adoption of improved technologies and the exploitation of opportunities in pig production.

The majority (77.5%) of the farmers were men, while 22.5% were women, indicating that men are more involved in production than women in the study area. In the African context, men, as heads of households and owners of resources, make important production decisions and increase profit efficiency as they decide on the purchase and use of production inputs. Women in this study area contributed labour in light agricultural operations such as serving food, water, and cleaning the pigsty.

Farmers had a higher preference for large white breeds (60%) than for other breeds due to their wide availability and high fecundity. Moreover, the average herd size of 4 pigs implied that pig production was on a small scale, which could be due to the economic condition of the breeder. The study revealed that the majority of pig farmers practiced the pen (70%) which was a semi-intensive system, and 39% practiced the barn (an intensive system) in which the pigs were confined to a clean barn and fed balanced feed. Smallholder pig farmers in the study area sold pigs directly to traders (60%) who offered exploitable prices compared to local consumers at 40%, where high prices were offered with search and contract costs students. The study showed that the majority (56.3%) of smallholder pig farmers were not members of any farmers' group, while 41% were members of the farmers' group. Members of farmer groups have benefited from various trainings that have enabled them to adopt new technologies and follow management practices recommended by extension workers and other trainers.

Profitability of pork producers in the study area
The maximum likelihood (MLE) estimates of the stochastic frontier model parameters are presented in Table 2.

The production function results showed that most of the inputs used were statistically significant at different levels, with the exception of labor costs and research costs. The feed cost coefficient was correctly signed and statistically significant ($p<0.01$) with a coefficient of -0.255, meaning that a 1% increase in feed price would decrease the net income level of the company by 25%, which was in line with the conclusions, [Kadurumba et al, 2014]. The pig breed type coefficient was negative and statistically significant ($p<0.05$) with a coefficient of -0.100 indicating that a 1% increase in the use of poor breeds would reduce the net income level of the pig. 10% business. Herd size was positive and statistically significant at the level ($p<0.05$) with a coefficient of 0.080 although inelastic indicating that a 1% increase in the number of pigs will increase net income by 8%, which was consistent with the study by [Aminu and Akhigbe, 2017]. Finally, veterinary and pharmaceutical costs were positive and statistically significant at ($p<0.01$). The coefficient, which was elastic in nature, appeared to be a major determinant of the profit level of the pig enterprise in the study area. However, this implied that a 1% increase in the price of veterinary drugs would increase the company's net income by 50%, which was in line with the findings of [Angkana et al, 2019] who found that the service system veterinarians was strengthened for quality animal health information and potential alternative interventions to the use of antibiotics,

including improved livestock management, vaccines and immune modulators.

The labour cost coefficient was 0.444 and was not statistically significant. It therefore did not appear to be a major determinant of profit efficiency of pig enterprises in the study area, but had a direct relationship. A unit increase in labour cost increased the net income level by 0.444. This was in agreement with the findings of [Dagar *et al*, 2020] where labour was not statistically significant but had an inverse relationship with mustard yield. The search cost coefficient was -0.052, which was inelastic in nature and did not appear to be a major determinant of the profit efficiency of pig enterprises in the study area. Therefore, a unit increase in research costs reduced the net income level by 0.052.

Determinants of profit inefficiency in pig production

The result of the ineffectiveness model in Table 2 shows that gender was positive and significant at p<0.10. This implies that profit inefficiency increases with gender, suggesting that female-headed households are more profit-efficient than male-headed households since they were more involved in agricultural operations, consistent with the study by [Mutua *et al*, 2010]. Trust in market information was negative and significant at p<0.05, implying that profit ineffectiveness decreased with a lack of trust in market information. Transaction costs resulting from information asymmetry where farmers had to incur more costs to seek better customers and prices and these costs include; personal time, travel costs and communication costs. This was corroborated by the findings of [Holloway *et al*, 2000] who found that information asymmetry leads to opportunism leading to distrust between actors in the milk value chain. The result was also in line with the study by [Kit, *et al*, 2006] which concluded that the higher the level of trust between trading partners in the marketing channel, the better the conditions for good business performance. [Dagar *et al*, 2020] in their study that sources of information were safe in flooded agriculture.

The debt ratio was positive and statistically significant at p<0.01. This implied that earnings inefficiency increased with a higher debt ratio. The higher ratio indicated that farm business liabilities were greater than assets and therefore needed to be balanced. The high ratio made agricultural businesses insolvent and

prevented them from attracting more credit [. Kaase *et al*, 2003]. [Carroll *et al*, 2006] estimated in their own study that dairy farms with a low debt ratio in the UK were more efficient.

The results of the pig farming experiment were found to be negative and significant at the 5% level in Table 2. This suggests that specialization developed over time, leading to improved production methods and greater profit efficiency. This conclusion was in line with those of [Etim and Udoh, 2014], according to which increased experience in agricultural production improves the critical evaluation of the relevance of better production decisions, including the efficient use of productive resources.

The age variable had a positive sign with a coefficient of 0.119 but was not statistically significant. These results were consistent with the conclusions of [Kadurumba *et al*, 2014]. They revealed that older farmers are less willing to adopt new practices and modern inputs. In addition, young farmers were likely to have formal education and therefore might be more successful in collecting information and understanding new practices which in turn will improve profit efficiency through higher levels of efficiency. Formal education commonly measured in years of schooling did not have a statistically significant relationship between the two variables. This is consistent with the study by [Weir, 1999] which concluded that farmers with some form of formal education did not display higher levels of profit efficiency in the study area.

Breakdown of profit efficiency

Table 3 presents the individual efficiencies of sampled pig farmers using the estimated stochastic frontier model. The predicted profit efficiencies differed significantly between farmers, ranging from 0.094 to 1. The estimates are biased to the left and the average profit efficiency was estimated at 0.40.

The study showed that pig farmers in the study area were producing at about 40% of the potential production level, indicating that the production level was about 60% below the border. According to a study by [Kaase *et al*, 2003], this was an indication of product wastage due to the inefficiency of the resources used by the farmers. The result also suggested that profit efficiency in pig production in the study area could be increased by 60% through better use of available resources and the use of more variable inputs to boost production.

Table 1. Percentage distribution of selected management and institutional arrangements factors of respondents (N=80)

Parameter	Frequency	Percentage	Mean	Std. dev
Age (Years)			44	12
School Years			10	4
Experience			6	5
Gender				
Man	62	77.5		
Woman	18	22.5		
Total	**80**	**100**		

Type of Pig Breed				
Cross breeds	26	32.5		
Hampshire	4	5.0		
Landrace	2	2.5		
Large white	48	60		
Total	**80**	**100**		
Herd size			4	2.56
Trainings attended			2	0.690
Management type				
Penning	56	70		
Stall feeding	24	30		
Total	**80**	**100**		
Buyer type				
Local consumer	32	40		
Trader	48	60		
Total	**80**	**100**		
Trust (price, Inform)				
Yes	38	47.5		
No	42	52.5		
Total	**80**	**100**		
Group membership				
Yes	35	43.7		
No	45	56.3		
Total	**80**	**100**		

Source: Source field survey, 2022

Table 2. Maximum likelihood estimates for the parameters of the stochastic frontier production for pig production

Variables	Parameter	Coefficients	P>|Z|
Constant	β_0	-4.647	
Feed costs	B_1	-0.255	0.000***
Labour costs	B_2	0.444	0.256
Breed type	B_3	-0.100	0.004**
Herd size	B_4	0.080	0.001**
Search Costs	B_5	-0.052	0.254
Vet/ Drug Costs	B_6	0.505	0.000***
Inefficiency Model			
Constant	δ_0	-0.811	0.000***
Age	δ_1	0.119	0.458
Gender	δ_2	0.067	0.054*
Schooling years	δ_3	0.068	0.205
Group membership	δ_4	-0.291	0.477
Management type	δ_5	-0.003	0.993
Trust (Price)	δ_6	-0.059	0.909
Trust (information)	δ_7	-0.814	0.008**
Debt Asset Ratio	δ_8	5.007	0.000***
Pig rearing Experience	δ_9	-0.003	0.009**
Records	δ_{10}	0.237	0.685
Sigma-squared	δ^2	4.320	0.000***
Gamma	$\sigma u/\sigma s$	0.630	0.000***
Log-Likelihood function			-95.954
Wald chi2(8)		66.70	0.000***

Source Field Survey, 2022; ***Significant at 1%, **5%, *10%

Table 3. Deciles frequency of profit efficiencies of smallholder pig farmers

Efficiency level	Frequency	Relative percentage
< 0.25	27	33.75
0.26-0.50	28	35
0.51-0.60	11	13.75
0.61-0.70	2	2.5
0.71-0.80	2	2.5
0.81-0.90	3	3.75
0.91-1.00	7	8.75
Total	80	100
Minimum		0.094
Maximum		1
Mean		0.402

Source: Field data Survey, 2022

CONCLUSION
The study was conducted to assess the factors that affect the profitability of smallholder pig farmers in Enugu state, Nigeria. From the above study, it can be concluded that the trust in market information as well as the experience of the household head have a negative influence on the profit inefficiency of pigs. The debt ratio also positively influenced profit inefficiency in farms in the study area. The study indicated that pig farmers were not fully profitable, however, there is considerable potential for improved profitability.

RECOMMENDATIONS
Based on the findings of the study, the following policy recommendations are made:

1. Pig farmers should be organized into groups such as producer organizations or cooperative societies which are means to achieve the necessary economies of scale and thus reduce information asymmetries and create countervailing market power.

2. Adequate training program on pig production (to familiarize them with innovations) and basic financial management skills such as optimal level of debt-to-asset ratio and debt utilization.

3. Pig production is predominantly dominated by men in the study area. However, women's empowerment programs should be initiated through pig farming as they offer significant opportunities for financial access. Women should also be encouraged to participate in pig production to increase their income and improve their livelihoods.

The major key players in the sector are expected to come up with a cohesive and integrated response to address the key challenges faced by smallholder pig farmers. The government can work in partnership with other stakeholders to ensure coordination and cooperation between different national institutions and agencies, at central and local levels, private sector organizations, producer organizations and development partners

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