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Original Research Article

Technical Efficiency of Pig Production in Enugu North Agricultural Zone of Enugu State, Nigeria

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ABSTRACT

Technical efficiency of pig production in Enugu North Agricultural Zone of Enugu State, Nigeria was studied. The specific objectives of the study are to estimate the technical efficiency in pig production in Enugu North Agricultural zone of Enugu State and access the determinants of technical efficiency in the study area. Purposive and multi-stage sampling techniques were used to select 60 pig farmers. A structured questionnaire and oral interview were used to collected information based on farmers' socioeconomics and other related information necessary for the study. The Cobb-Douglas frontier production function was used to address the objectives of the study. The result shows that feed intake, water and labour input affected pig farmers' output at different risk levels respectively. Drugs and medication was negative but significant. The result furthermore shows that the estimated farm level technical efficiency of pig farmers ranged from 23% and 96% with a mean of 75%. Also, household size, educational level, membership organization and rearing experience were the socio-economic determinants of technical efficiency of pig farmers in the study area. There is need to enhance farmers' access to adult education, encouraged farmers to form cooperative society and ease of accessibility to productive inputs.

Key word: Technical Efficiency, pig Production, Stochastic frontier, Production function.

INTRODUCTION

The important of animal protein and its inadequacy in the dietary of most households in developing countries of Africa and South East Asia are variously documented (Okolo, 2011; Ume, *et al*; 2016). For instance, Food Agriculture Organization, (FAO), (2008) reported that animal protein origin is capable of predisposing victims to low productivity, high infant mortality, malnutrition and related diseases. This animal protein origin could be acquired in Nigeria through mainly cattle, pig, poultry, goat and sheep (Ajala, *et al;* 2007). However, among these animals, pig is becoming very popular because of among others fast growth rate, large litter size, good convert of feed to meat, high carcass dressing percentage, the pork is tender and nutritive in relation to high protein and B-vitamins than any other livestock (Adeschinwa, *et al*; 2003; John, 2007; Ume, *et al*; 2018). However, in Nigeria and other developing countries, piggery industry is confronted with myriads of problems resulting in its low productivity and inefficiency in resource use. Piggery industry has features of having high production costs, low profit margins and high feed bills (Adeschinwa, *et al*; 2003,

Holness, 2007; Ume, *et al*; 2018). This situation is more pronounced especially with the economic recessions that the country is experiencing now. However, one of the surest way of liberating the farmers especially the small scale farmers that constitutes the bulk of the farming population from low productivity is through enhancing their efficiency of resource use (Onyenweaku and Effiong, 2000; Ewuziem, *et al*;2009).

The efficiency is the ease of transforming given inputs into outputs in a production process (Coelli, 1994; Ume, et al;2016). Efficiency according to Farrel, (1957) and Heady and Olayide, (1982) could be in form of technical, allocative and economic efficiency. Technical efficiency refers to the ability of firms to achieve maximum output at minimal waste at given technology (Jondrow, *et al* 1982; Coelli, 1994) Allocative efficiency refers to the choice of optimum combination of inputs consistent with the relative factor prices (Meeusen and Vander, 1977; Effiong and Idiong; 2008; Ume, *et al*; 2016).While, economic efficiency is the ability of a farm to maximize profit (Onyenweaku *et al*, 2010; Ume, *et al*;2012). It is imperative to state that information on measuring technical efficiency of pig farmers using stochastic frontier method is dearth in the study area, therefore, the need to abridge this research gap is mandatory. This could help in making available information for making sound management decision as relates to resource allocation by policy makers and programme planners. Furthermore, this study could serve as a guide for scholars interested in the subject area and for students' teaching purpose.

The specific objectives of the study are to estimate the technical efficiency in pig production and estimate the determinants of technical efficiency in Enugu North Agricultural zone of Enugu State.

MATERIALS AND METHODS

The study is conducted in Enugu North agricultural zone of Enugu State, Nigeria. It is one of the agricultural zones in Enugu State. The zone is located between latitudes 6^o 31' and 7^o 6' North of Equator and longitude 6^o 54' and 7^o 54' North East of Greenwich Meridian. The population of Enugu North agricultural zone is 1,190,908 persons which comprise 678,015 males and 700,403 females (National Population Commission (NPC), 2006). The land area is about 3,404km^2 and about 11,000 households. The inhabitants apart from farming are also engage in petty trading, commercial driving, mechanics and tailoring.

Enugu North consists of six (6) Local Government Areas (LGAs) namely; Igbo-etiti, Igbo-eze South, Igbo-eze North, Nsukka, Udenu and Uzo-uwani LGAs. Enugu North agricultural zone is made up of eight (8) blocks comprising Igbo- Etiti, Igbo-Eze South, Igbo-Eze North, Uzo-Uwani block I, Uzo-Uwani block II, Nsukka block I, Nsukka block II and Udenu . Purposive and multistage random stage sampling techniques were used to blocks, communities and farmers. In the first stage, two (2) blocks namely; Nsukka 1 and Udenu were purposively selected for the study. This was as a result of many piggery farms found in those places. In stage two, in each of the blocks selected, three communities were randomly chosen for the study. In the third stage, ten (10) pig farmers were randomly selected from each of the communities. This brought to a total of sixty (60) respondents for the detailed study. A structured questionnaire and oral interview were used to gather information as relates to primary data. Cobb- Douglas - technical efficiency and the determinant models were used to address the objectives of the study.

Theoretical Framework.

A stochastic production function is given by

$Yi = f(Xij\ \beta)\ \exp\ (Vi\text{-}Uj),\ = 1, 2, \ldots\ldots\ldots\ldots n\ldots\ldots\ldots\ldots\ldots (1)$

where Yi is output of the i-th farm, Xi is the vector of input quantities used by the i-th

farm, β is vector of unknown parameters to be estimated; *f*( ) represents an appropriate function (e.g. Cobb Douglas, translog, etc). The term Vi is a symmetric error which accounts for random variation in output due to factors beyond the control of the farmer, while the term Uj is a non negative random variable representing inefficiency in production relative to the stochastic frontier. The random error Vi is assumed to be independent and identically distributed as N(0, 0u2) random variables independent of the Uis which are assumed to be non-negative truncation of the N(0, 6u 2) distribution (i.e. half-normal distribution) or have exponential distribution(Forsund, *et al*; 1980; Aigner, Lovell and Schmidt, 1977).The stochastic frontier was independently proposed by (Bravo- Ureta and Vander, 1997). Technical efficiency according to Heady and Olayide (1982) is a measure of firm's success in producing maximum output from a given set of input.Bravo – Ureta and Pinheiro, (1997) described technical efficiency as attainment of production goal without wastage.

Technical efficiency (TE) = Yi/Yi

+

= *f*(Xi, β) exp (Vi-Ui)/ *f*(Xi, β) exp (Vi) = (exp) (-Ui) .....(2)

Where Yi = observed Output

Yi = Frontier Output

The parameters of the stochastic frontier production function are estimated using the maximum likelihood method. For this study, the production technology of pig farmers in Enugu North Agricultural zone of Enugu State is assumed to be specified by the Cobb Douglas frontier production function defined as follows:

In Q = b0 + b_1InZ_1 + b_2InZ_2 +b_3InZ_3 +b_4InZ_4 + b_5InZ_5 + ……+ bnInZn……V_i-U_i ……..(3)

Where Q = Value of pigs produced per farm (N)

Z_1 = Flock size (No.)

Z_2 = Quantity of feeds and feed supplements (kg)

Z_3 = Labour input (mandays)

Z4 = Value of drugs and medicine (N)

Z_5 = Other costs (Depreciation costs on fixed inputs) (N)

V_i = Random error

U_i = Technical inefficiency

Determinants of Technical Efficiency:

In order to determine factors contributing to the observed technical efficiency, the following model was formulated and estimated jointly with the stochastic frontier model in a single stage maximum likelihood estimation procedure using the computer software frontier version 4.1 (Coelli, 1994) as follows:

TE = a_0 + $a_1\beta_1$ + $a_2\beta_2$ + $a_3\beta_3$ +$a_4\beta_4$ + ……$a_9\beta_9$ ……(4)

Where TE = Technical efficiency of the i-th farmer

β_1 = Age of farmers (Years)

β_2 = Educational Level (Years)

β_3 = Household size (No)

β_4 = Membership of farmers association/cooperatives(Member; 0 and otherwise; 0)

β_5 = Access to Extension services (Access; 1, otherwise; 0)

β_6 = Rearing Experience (Years)

β_7 = Access to credit (Access; 1 and otherwise ;o)

While a_0, a_1 a_2 ……a_9 are the parameters to be estimated.

RESULTS AND DISCUSSION

The mean socio-economic characteristics of the pig farmers are presented in Table 1.

Table 1: Mean Socio-economic Characteristics of PigFarmers in Enugu North Agricultural Zone of Enugu State, Nigeria.

Socio-economic Variable	Mean Value
Age of farmers	36
Educational level	6.5
Farming experience	6.2
Flock Size	25
Household size	6

Source; Field Survey; 2017

The Table indicates that the mean age of the pig farmers was 36 years. The implies that most of the sampled farmers were youthful, motivating, adoptive individuals and energetic to handle pig management that are often labour and

capital intensives (Okolo, 2011; Ume, *et al*,2018). Table 1 also, reveals that a typical pig farmer had 6.5 years of education. The educational status of the farmer influences his managerial ability, receptive to technology adoption, and in evaluating different production technologies options (Adesehinwa, *et al*; 2003; Eze and Akpa, 2010).In addition, the mean of the farmers' farming experience was 6.2 years. Experience in farming helps farmers to maximize their output through efficient input utilization. (Ezeano, *et al*;2017). The findings of Onyenweaku, *et al;* (2010) and Ume, *et al;* (2012*)* concurred to the assertion. They were of the opinion that farmers through long years of farming experience could be able to set realistic plan aimed at boosting their farm output at minimal costs. The mean flock size of the pig farmers was 25 pigs. This implies that majority of the respondents were small scale in their productions. Small scale farmers are often limited in access to productive inputs, leading to reduced production (Tewe, *et al*; 2009).The mean household size of the pig farmers was 6 persons. Studies show that household members that are of labour age could be proxy to labour to household head especially during peak farming when hired labour is costly and scarce, particularly at sustenance level (Ume, *et al*; 2016). Nevertheless, where the household members are more of dependent population, they will be more of consumers, hence a burden to the household head (Onyenweaku, *et al*; 2010).

The Maximum Likelihood Estimates (MLE) of the stochastic frontier production parameters for pig farmers is presented in Table 2.

Table 2: Estimated Stochastic Frontier Production Function for Pig Farmers in Enugu North Agricultural Zone of Enugu State, Nigeria.

Variable	Parameter	Coefficient Standard	T-value	Error
Constant term	β0	5.564	1.209	4.602***
Flock size	β1	0.067	0.078	0.859
Feed intake	β2	3.903	0.873	4.471***
Labour input	B3	1.760	0.865	2.035**
Water	β4	2.521	1.069	2.528**
Drug and Medication	β5	-1.168	0.118	-9.764***
Depreciation	β6	-0. 202	0.231	-0.875

***, **, * Significant at 1%, 5% and 10% respectively
Source; Field Survey; 2017

The table revealed that feed intake, water and labour input were positive and significant at different probability levels. These influence significantly the value of output of pig.

The feed intake estimated coefficient is positive (4.471***), implying that every one percent increase in feed intake, could lead to 4.471 percent increase in the value of pig produced. This finding is consistent to Ume, *et al*,(2018), who reported that quality feed intake by animal had direct relationship to animal production with all things being equal. The coefficient of labour input was positive and significant at 2% alpha level. Studies inferred that pig farming is labour intensive and if properly enhanced, could reduce inefficiency in the animal production (Adesehinwa, *et al*; 2003). This finding contradicted Ajala, *et al* (2007),who reported that unavailability and high cost of hired labour have made pig production less profitable as result of urban drift of able bodied youths. Drug and medication coefficient had indirect relationship to the dependent variable at 95% confidence level. The sign identity could be linked to sub standard and adulterated drugs that flood markets in Nigeria and other developing countries of the world as result of their poor drug auditing and inspection mechanisms. This scenario dwarfs significantly livestock development in these countries, as farmers' livestock are predispose to considerable annihilate by any slight disease attack as they resort to use of indigenous Knowledge Technologies (IKT), which are often less

efficacy (Ajala, *et al;* 2001). As expect, the coefficient of water was positive in enhancing pig production through facilitating body metabolism and cooling effect during heat condition (Tewe, *et al*;2009). Ewuziem, *et al*,(2007), John, (2011) and Ume, *et al*, (2018) made similar finding.

The coefficient of farmer's age as shown in Table 3 was inversely related to technical efficiency and statistically significant at 5% probability level.

Table 3: Maximum Likelihood Estimation of the Cobb Douglas Stochastic Production Function

Production Factor	Parameter	Coefficient	Standard Error	t-value
Constant	a_0	0.778	0.041	18.976***
Age	a_{01}	-0.054	0. 026	-2.077**
Educational Level	a_0	0.826	0.259	3.189***
Household size		0.7534	0.281	2.996**
Membership of Organisation		0.367	0.220	2.996**
Access to extension Services		0.042	0.045	0.933
Rearing Experience		0.486	0.592	0.821
Access to Credit access		- 0.460	0.251	-1.833*
Diagnostic Statistics Total variance	(a^2)	1.6628	0.3065	5.425***
Variance ratio		32.9641	0.0421	782.9951***
Likelihood ratio test		285.1765		
Log-likelihood	376.78			

Source: Computed from Frontier 4.1 MLE/Field Survey, 2017

Note: ***, **, * indicate statistically significant at 1.0, 5.0, and 10.0 percent respectively.

The implication is that as the age of the farmer increases, their technical efficiency decreases. This could be ascribed to mental and physical strengths which correlate with advances in age. Several studies (Aarnik, 2007; Ewuziem, *et al;* 2008,) concurred to this assertion. Moreover, in line with a *priori* expectation, the coefficient of household size in the efficiency model is positive and significantly different from zero at 5%. Household with large numbers of members that is of labour age, helps to curtail maximally money spent on hiring labour and such saving is use in taking care of other family welfare. This result is in consonance with Onyenweaku, *et al* 2010, Eze and Akpa, 2010, and Ume, *et al, 2016). They reported that* use of family labour by household is capable of reducing his/her labour cost and facilitates benchmark for enhanced technical efficiency to ensue. However, this result did not concur with the findings of Edet and Effiong,(2005), Effiong, and Idiong, (2008) and Ume, *et al.(2018),* who opined that in household where the members are dependent ones, there is every likelihood that pig farm productivity will be in jeopardy as much of household's income is used for family consumption, while meager mount is left for farming business.

More so, as expected, the coefficient of cooperative society had direct relationship to pig farmers' technical efficiency at 90% confidence level. This implies that farmers who members of cooperative societies, tend to maximize their profits through among others proper management of resources, access to credit and subsidized inputs by government (Ezeano, *et al*; 2017). Contrarily, Effiong, (2007) and Ume, *et al,(2016)* were of the view that cooperative may not be an incentive to farmers especially where cooperative activities become source of distractions to their vocation, as much of their time are spent on cooperative matters rather than in their farming work. Furthermore, the coefficient of level of education had a positive sway on technical efficiency in pig farming and significant at 1% risk level in the study area. This indicates that household's level of technical efficiency increases with increase in his/ her level of education. This finding agrees with the work of Onyenweaku and Effiong (2000) and Ume, *et al* (2012) but is inconsistent with the findings of Onyenweaku and Effiong (2000) and

Ewuziem, *et al. (2008),* who found a negative relationship between household's level of education and technical efficiency among pig farmers. They were of the view that educated people often have flair for 'white collar job' in preference to farming.

In addition, credit had a negative and significant effect on efficiency, which did not agree with a priori expectation at 1.0% level of probability. This implies that increasing access to credit by farmers would lead to increased technical inefficiency. The negative sign of the coefficient of the variable could be associated to poor access to credit from formal lending institution by the farmers (Effiong, 2005) and diversion of agricultural credit to non- farm activities (Ume, *et al*; 2013). However, studies by Edet, and Effiong, (2006), Gekara, *et al*; (2008) and Ezeano, *et al;* (2017) found a positive relationship between the coefficient of the variable and technical efficiency. They were of the opinion that credit accessibility helps farmers to overcome the limitation of labour availability and in procurement of productive inputs that would help to boost their technical efficiency. Besides, Table 2 shows that the coefficient for rearing experience was positive and significant at 1% risk level, indicating an direct relationship between rearing experience and technical efficiency. The implication is that farmer who have more years in the pig farming are more technically efficient in the business compares with the less experienced ones. Empirical studies reveal that experienced pig farmers to be specific have technical know-how and could embrace easier innovations disseminated to them (Ewuziem, *et al*.2007). This assertion is in consistent with Onyenweaku, and Effiong, (2000) and Ume, *et al. (2018),* who opined that experienced farmers have ability to overcome intricacies in their farming businesses for high technical efficiency to ensue.

The diagnostic statistic of the technical efficiency as contain in Table 3 indicates that the total variance and ratio of the variance were both positive and significantly different from zero at 1% level of probability respectively. The total variance sign identity indicates that the model is good fit and assumes the correctness of the specified distribution assumption of the composite error term. Hence, the use of the stochastic frontier function estimated by the Maximum Likelihood Estimates procedure is suitable for the data. On the ratio of the variance with value of 782, implies that 78.2% of the variations in output among the pig farmers were as result of the disparities in technical efficiency.

Table 4 reveals that 87% of the sampled pig farmers in the study areas operated within technical efficiency range of between 0.61 and 1.00.

Table 4: Distribution of Technical Efficiency in Pig production in Enugu North Agricultural Zone OF Enugu State, Nigeria

Technical Efficiency Range	Frequency	Percentage (%)
0.00-0.20	8	3.33
0.21-0.40	0	0
0.41-0.60	0	0
0.61-0.80	6	10
0.81-100	46	76.67
Total	60	100

MaximumTechnical Efficiency 0.96
Minimum Technical Efficiency 0.28
Mean Technical Efficiency 0.54
Mean of the best 10 47.91
Mean of the worst 10 75
Source: Computed from Field Survey, 2017

The estimates are skewed to the right, meaning high level of efficiency the farmers operated. Furthermore, the pig farmers had mean efficiency of 0.54%, which inferred that there was a large scope for increasing pig production by 46%, by adopting the practices and innovation engaged or used by the best practice pig farmers. Also, the minimum efficiency is 0.28, which indicates that pig farmers grossly underutilized their resources used in production. Studies show that farmers who have efficiency values above the mean score were frontier farmers, while those below were non-frontier farmers. Therefore, the pig frontier farmers was 58.66 %, while non-frontier ones was 38.39 %. This implies that an average pig farmers required 47.91% $(1\text{-}0.54/0.96)^{100}$ cost saving to attain the

status of the most efficient farmer as sampled best ten category, while the least performing ones needed 75% (1-0.28/0.96)^{100} cost saving to become the most efficient pig farmers among the worst 10 respondents.

Elasticity of production (E_P) and return to scale is shown in Table 5.

Table 5: Elasticity of Production and Return to Scale

Inputs	Elasticity
Flock size	0.067
Feed intake	3.903
Labour	1.760
Water	2.521
Drug and Meditation	-1.168
Sum of elasticity	6.881

Source: Computed from Table 4.

The elasticity of production is a concept that measures the degree of responsiveness of output to changes in input. It measures the proportionate change in output as result of a unit change in input. The estimates for the parameters of the stochastic frontier production are the direct elasticity's of production for the various inputs, given the Cobb Douglas specification of the model (Schmidt, 1980; Hazarika and Subramanian, 1999). The return to scale was 6.881, which implies that pig farmers in Enugu North Agricultural zone of Enugu State, Nigeria were in stage II of the production phase. Therefore, the pig farmers in the study area under-utilized their farm inputs. The implication is that the farmers needed an overall increase in the level of their current input employment to achieve technical efficiency.

CONCLUSION AND RECOMMENDATION

The following conclusion was deduced; The pig farmers have minimum and maximum efficiencies of 23% and 96% respectively with a mean efficiency of 75%. The socio-economic determinants of technical efficiency of pig farmers in the study area were household size, educational level, membership organization and rearing experience

Based on the findings, the following recommendations were proffered;

(i) Farmers' level of education should be enhanced through adult education, workshops and seminars.

(ii) Also, new and old farmers could be encouraged to stay in pig business through provision of improved breeds of pigs and credits for payment of labour.. This would help to absorb the available labour in order to reduce poverty and unemployment.

(iii) In addition, pig farmers should be encouraged to form cooperatives for ease of access to credit and other productive inputs at reduced costs from government and non- governmental organizations.

(iv) Households with large family size are encouraged to use them as source of labour in order to enhanced their efficiency for higher output to accrue

REFERENCES

- Aarnink, A.J.A., (2007). Ammonia emissionwould help in from houses for growing pigs as affected by pen design, indoor climate and behavior. PhD thesis, Wageningen, The Netherlands, 175 pp.
- Adeschinwa, A.O.K, Aribido, S.O., Oyediji, G.O. and Obiniyi, A.A. (2003). Production strategies for coping with the demand and supply of pork in some peri-urban areas of Southwestern Nigeria. *Livestock Research for Rural Development* 15/10 2003.
- Adeschinwa, A.O.K, Makinde, G.E.O and Oladele, I.O. (2003). Demographic characteristics of pig farmers as determinant of pig feeding pattern in Oyo State, Nigeria. Proceeding 8th Annual Conference of Animal Science Association (ASAN), September 16-18 at Federal University of Technology (FUTO). Pp: 127-129.
- Ajala, M.K., Adesehinwa, A.0.K. and Mohammed, A.K. (2007). Characteristics of small holder pig production in Southern Kaduna Area of Kaduna State, Nigeria. *American-Eurasian Journal of Agricultural and Environmental Science*, 2(2), 182-188, 2007.
- Amaza, P. S. and Olayemi, J. K. (2001). Technical efficiency in food crop production in Gombe State, Nigeria. *The Nigeria Agricultural Journal 32(2): 140-151.*
- Battese, G.E. and Coelli, J.J. (1977): A model for technical efficiency effect in stochastic

frontier productions function for panel data. *Journal of Empirical economics*; 20:325-332.

- Bravo-Ureta, T. and Pinheiro, C. (1997): Technical, economic and allocative efficiencies of peasant farming. Evidence from Dominic Republic: *Development Economics xxxv(1)*: 48 – 67.
- Bravo-Ureta, T. and Vander, B. (1997). Technical economics and allocative efficiency in peasant farming evidence from the Dominican Republic. *The Development Economics 35:48-50.*
- Coelli, L.J. (1994): A guide to frontier 4.1. A computer program for stochastic frontier production and cost function estimation. Department of Econometrics, University of New England Armidale, Australia.
- Coelli, L.J. Prasada, R. and Battese A. (1998): An introduction to efficiency and productivity analysis. Kluwer Academic Press, Boston.
- Edet, J.U. and Effiong E.O (2006). "Technical efficiency in pig production in Akwa Ibom State of Nigeria". A paper presented at the conference of the agricultural society of Nigeria held at National Root crop Research Institute (NRCRI) Umudike
- Effiong, E. O. (2005). Efficiency of production in selected livestock enterprise in Akwa Ibom State, Nigeria. *Ph.D Dissertation, Department of Agricultural Economics, Michael Okpara University of Agriculture Umudike, Abia State*.
- Effiong, E.O. and Idiong, C.I. (2008): Measurement and sources of economic efficiency in rabbit production in Akwa Ibom State, Nigeria. A stochastic frontier profit function approach. *Nigeria Agricultural Journal* 4(1):5-8.
- Eze, C. T. and Akpa, C. E. (2010). Analysis of technical efficiency of National Fadama II facility on arable crop farmers in Imo State, Nigeria. Nigeria *Agricultural Journal, 41(1): 109-115.*
- Ezeano, C.I, Ume, S.I, Okeke, C. C and Gbughemobi, B O (2017);Socio economic determinant factors to youths participation in broilers production in Imo State of Nigeria. *International Journal of Research & Review; 136 4;(1); 136 - 142. www.ijrrjournal.com*
- Ezeano C. I. Okeke,C C N. J. Obiekwe, N J and A. I. Onwusika, A I (2017)Adoption and profitability of cassava in Enugu South Local Government Area of Enugu State, Nigeria. Indo–Asian Journal of Multidisciplinary Research (IAJMR) 3; (3); 1125-1134
- Ewuziem, J.E., Onyenobi, V.O. and Dionkwe, A. G. (2008). Piggery waste management and profitability of pig farming in Imo State, Nigeria. Nigeria *Agric. Journal 40(1)*: 29-36.
- Ewuziem, J.E., Onyenobi, V.O. and Dionkwe, A. G. (2009). Technical Efficiency of farmers in Imo State, Nigeria. A trans log stochastic frontier production approach. *Nigeria Agric. Journal* 40(1): 137-143.
- Farrel, M. (1957): The measurement of productive efficiency. *Journal of Royal Statistical;* ACXX; 3: 25 – 90.
- F.A.O. (2008): FAOSTAT Statistics Division of the food and agriculture organ. http://FAO.Stat:FAC.org.
- Forsund, F.R, Lovel, C.A.R. and Schmidit, L.T. (1980): A survey of frontier production function and their relationship to efficiency measurement. *Journal of Economics*, 5:15-17.
- Gekara, O., Garner, J.O.O and Dunbar, T.V (2009). Evaluating production techniques to improve efficiency and profitability of hog farms in South East Arkansas. University of Arkansas Press.Pp: 321-324.
- Hazairka, C. and Subramanian, S. R. (1999). *Estimation of technical efficiency in the frontier production model - an application.*
- Heady, E. O. and Olayide, S. O. (1982). *Introduction to Agricultural Production Economies.* University Press, Ibadan.
- Holness, D.H. (2007). Pigs for Profit. London: Macmillan Education Ltd. Pp 36-42.
- John, G. (2011). Modern pig production technology. Nottingham: Nottinghom University of Press. Pp. 137-139.
- John, R.M. (2007). Swine production: A global perspective. U.S.A: Alltech Incorporation.
- Jondrow, J, Lowell, C.A.K. and Schmidt, P. (1982): Estimation of technical efficiency in the stochastic frontier production function model. *Journal of Econometrics;* pp. 233 – 238.
- Meeusen, N. and Vander, B. K. (1997). Efficiency estimation from Cobb Douglas production function with composite error. *International Economic Review 18(2):123-134.*
- National Population Commission (NPC, 2006). National Population Census Figure, Abuja, Nigeria.
- Okolo, C.I. (2011). Tropical Tips on Intensive Pig Production: Animal Management and Health Issues. Technical Notes: Tapas Institute of Scientific Research and Development. Pp 240-246.
- Onyenweaku, C. E., Okoye, B. C. and Okorie, K. C. (2010). Determinants of fertilizer

adoption by rice farmers in Bende Local Government Area of Abia State, Nigeria. *Nigeria Agricultural Journal, 41(2): 1-6.*

- Onyenweaku, C. E. and Effiong, C. O. (2000). Technical efficiency in pig production in Akwa Ibom State, Nigeria. *A paper presented at the 40th Conference of the Agricultural Society of Nigeria held at National Root Crop Research Institute, Umudike, Abia State*.
- Onyenweaku, C. E. and Effiong, C. O. (2000). Technical efficiency in pig production in Akwa Ibom State, Nigeria. *A paper presented at the 40th Conference of the Agricultural Society of Nigeria held at National Root Crop Research Institute, Umudike, Abia State*.
- Schmidt, P. (1980): On the statistics estimation of parametric frontier production functions. *Rev. Economics Statistics*, 58: 238 – 239.
- Tewe O, O, Ogodgo, M.W and Adesehinwa, A.O.K., (2009). Resources requirements for profitability pig farming in Nigeria. In: National. Pig prod. Training Manual, NAERLS/ABU. Pp 16-26.
- Ume S. I., Kadrumba C. and Anozie R. O. (2012). Gender and Relative Economic Efficiency of cocoyam production in Enugu State of Nigeria (using stochastic frontier approach).Journal of Science, 12 (1) 48-55 Agriculture food technology and environment. Faculty of Agriculture Ebonyi State University Abakaliki
- Ume S.I, Jiwuba, P.D and Ede, NO (2013) Technical efficiency of Enugu Urban broiler farmers in Enugu State of Nigeria. Agro Science of Tropical Agriculture, Food, Environment and Extension, 2 (1) 37-42. Faculty of Agriculture, University of Nigeria Nsukka.
- Ume, SI, Ezeano, CI, Gbughemobi, BO (2018) Analysis of the Environmental Effect of Pig Production in Okigwe Local Government Area of Imo State, Nigeria. International Journal of Environmental & Agriculture Research (IJOEAR) ISSN: [2454-1850] [Vol-4, Issue-6, June- 2018].
- Ume SI, Ezeano CI, Chukwuigwe O, Gbughemobi BO (2018)Resource use and technical efficiency of okra production among female headed household: Implication for poverty alleviation in the rural areas of south east, Nigeria. International Journal of Advanced Research and Development. 3; (2); 1028-1040 . www.advancedjournal.com
- Ume S.I, Ezeano, C I, Dauda, E and Okeke C C (2016)Technical Efficiency of Rabbit Production among Small Holder Farmers in Ivo Local Government Area of Ebonyi State, Nigeria. Impact Factor 3.582 Case Studies Journal ISSN (2305-509X) 5(11); 69 – 81.
- Ume S.I, Ezeano C.I, Eluwa .A.N. and Ebe .F. (2016). Analysis of Technical Inefficiency in Rice Production among Farmers in Ezza South LGA of Ebonyi State of Nigeria (Application of Stochastic Frontier Production). *Archives of Current Research International, 4(3): 261-269.*
- Ume SI, Ezeano CI, Chukwuigwe O, Gbughemobi BO(2018). Effect of climate change on pig production and choice of adaptation strategies by farmers in southeast, Nigeria. International Journal of Academic Research and Development 3; (2); 858-868. www.academicsjournal.com
- Ume. S I and Ochiaka J.S .(2016)Technical efficiency OF Catfish Production among small holder Farmers in Anambra State of Nigeria Impact Factor 3.582 Case Studies Journal ISSN (2305-509X) – Volume 5, Issue 9–Sep-2016http://www.casestudiesjournal.com Page 147

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