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Technical Efficiency and Profitability of Rice Production in Anambra State, Nigeria

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ABSTRACT

The study examined the technical efficiency and profitability of rice production in Anambra State, Nigeria. Multistage, purposive and random sampling techniques were used to select 120 rice farmers for the study. Data collection was achieved through the administration of structured questionnaires to the farmers using personal interview. Data analysis was attained using descriptive and parametric statistics involving Cobb-Douglas stochastic frontier production function, enterprise budgeting, multiple regression analysis and relative important index technique. Results indicated that mean age of the farmers was 48 years, and rice farming was dominated by male farmers (64.17%). The mean technical efficiency score was 0.93. Rice production in the area was profitable with gross margin, net production income and return per naira invested of N18,551,200, N16,939,669.9 and 0.71 respectively. Age of the farmer, household size, farm size, farming experience and cost of production significantly determined net production income. Farming experience, educational level and extension visits positively and significantly influenced efficiency of rice production. Furthermore, rice production in the area was majorly constrained by pests, diseases and weed infestations, high cost of labour and high cost of inputs. Technical efficiency and profitability of rice production could be increased if government and non-governmental bodies make farm inputs available to farmers at subsidized rates to enable them produce more efficiently and profitably.

Keywords: rice production, technical efficiency, profitability, Anambra State, Nigeria.

INTRODUCTION

The agricultural sector has been performing very noteworthy roles in providing food and income to majority of people in the rural areas of Sub-Saharan Africa, including Nigeria. It is the mainstay of the economy of most countries in the region hence it contributes substantially to export earnings and employs majority of total labour force (Food and Agriculture Organization (FAO), 2008). The Nigerian economy has about 70% of its people dependent on agriculture (National Bureau of Statistics (NBS), 2011). The agricultural sector, according to the Central Bank of Nigeria (CBN), 2017, contributed 0.84 percent to economic growth in 2017. In terms of sectoral growth rates of Gross Domestic Product (GDP) in 2017, the agricultural sector recorded the fastest growth rate of 3.45% compared to 4.11% recorded in 2016.

Within the sector, crop production remained the fastest growing subsector at 3.64% followed by forestry, livestock and fishery which grew by 3.31%, 1.61% and 1.34% respectively. Furthermore, agriculture contributed 25.1% to the real GDP in 2017 and the aggregate index of agricultural production rose by 3.5% in 2017 (CBN, 2017). The improved performance of the agricultural sector was attributed to increase in output in all the subsectors except fishery. The continued commitment of the Federal Government to diversification; improved implementation of various agricultural programmes and policies; and the prevalence of relatively favourable weather conditions were the main drivers of growth in the sector (CBN, 2017).

Rice is the staple food for about half of the human race. It is the leading cereal crop which can be grown in the standing water of areas of flat, low-lying tropical soils. It is grown in over 100 countries of the world (Oko, Ubi and Efisue, 2012). Over 95% of the global rice production comes from the developing countries (Food and Agriculture Organization Statistics (FAOSTAT), 2008a) and Nigeria is the leading producer of the commodity in the West African sub region (FAOSTAT, 2008b).

Rice is a preferred food in the urban centres of many countries including Nigeria because of the relative ease of preparation in catering for large numbers of people (Amaechina and Eboh, 2017). In Nigeria, its importance is seen in the fact that it is accepted amongst all cultures (Onimawo, 2012) and is normally preferably prepared in social functions. As noted earlier the ease in preparation and its wide usage in festivities have made rice a popular meal in most households in Nigeria, with almost similar recipes for preparation across cultures. It is estimated that the per capita consumption of rice is about 24.8kg (Adeyeye, Navesero, Ariyo and Adeyeye, 2010). The other uses of rice as asserted by Ume, Ezeano, Eluwa and Ebe (2016) are industrial uses (beverages, roofing materials, flour and starch), livestock feed, medium for growing tropical mushroom and compost.

Rice cultivation is the principal activity and source of income for millions of households around the globe. Several countries of Asia and Africa are highly dependent on rice as a source of foreign exchange earnings and government revenue (Kadiri and Eze, 2015). It is relatively easy to produce and it is grown for sale and home consumption. Rice is primarily consumed in its parboiled form which adds value to rice in the production and consumption chain. Rice extract from the bran is rich in nutrients such as vitamin E and would not cause high blood cholesterol levels (Odomenem and Inakwu, 2011).

Efficiency is a very important aspect of productivity growth especially in our developing agriculture where resources are scrimpy and opportunities for developing and adopting better technologies have lately started dwindling (Onyenweaku and Effiong, 2005). Efficiency is achieved either by maximizing output from given resources or by minimizing the resources required for producing a given output (Varian, 2014). Nevertheless, to improve the farmers' productivity requires that their resources must be used more efficiently with attention paid on attaining production goal without waste (Ume and Nwaobiala, 2012).

Technical efficiency as noted by Farrell (1957) is the ability of a firm to produce as much output as possible with specified level of inputs given the existing technology. Technical efficiency also measures the differences in technical efficiency which may exist between firms and the variations in technical efficiency of producers may also be due to management decisions and farm specific characteristics that may affect the ability of the producer to use the existing technology adequately (Abba and Abu, 2015). Therefore, the study broadly examined the technical efficiency and profitability of rice production in Anambra State, Nigeria. Specifically, the study described the socio-economic characteristics of rice farmers; determined the technical efficiency levels of the rice farmers; estimated the profitability of rice production; established the effects of socio-economic characteristics of rice farmers on net production income; ascertained socio-economic factors of farmers that affect technical efficiency, and identified constraints to rice production in the area.

MATERIALS AND METHODS

The study was carried out in Anambra State. The State has twenty one Local Government Areas (LGAs) spread across the four agricultural zones namely Awka, Anambra, Aguata and Onitsha. Anambra State is located between longitude 6°36'E and 7°21'E and latitude 5°38'N and 6°47'N. It has an estimated population of 4,182,032 with male population of 50.9% and female 49.1% (National Population Commission, (NPC) 2006). The State is bounded in the North by Kogi State, in the West by Delta State, in the South by Imo State and in the East by Enugu State. It occupies an area of about 4,416km^2, 70% of which is arable land (Ugwumba and Oko, 2010).

Multistage, purposive and random sampling techniques were employed to select 120 rice farmers for the study. Three Agricultural zones were purposively selected from the four zones in the state at stage I. Stage II witnessed the purposive selection of one LGA from each of the selected zones to arrive at three LGAs. These selections were based on the LGAs and zones with largest areas of land suitable for rice cultivation. At stage III, four communities were randomly selected from each of the selected LGAs to arrive at 12 communities. This selection was informed by the number of communities

identified to be active in rice production by the LGA Agricultural officers. Finally, 10 rice farmers were randomly selected from the 12 communities to give a total of 120 farmers.
Data were collected from primary source using structured questionnaires administered to the farmers by personal interview. The collected data were analyzed using descriptive and inferential statistical tools. The budgetary method used to assess enterprise profitability is given as:
GM = TR – TVC
NPI =GM – TFC or TR – TC
MNPI = NPI/n
NROI = NPI/TC
Where,
GM = Gross margin
TR = Total revenue
TVC = Total variable cost
TFC = Total fixed cost
TC = Total cost
NPI = Net production income
MNPI = Mean net production income
NROI= Net return on investment
The stochastic frontier production function used to measure the technical efficiency levels of rice farmers and ascertain the determinants of technical efficiency is explicitly specified as:

$$\ln Yi = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + V_i - U_i$$

Where:
i = ith farmer in the sample
In = Natural logarithm
Yi = Output of rice (kg)
X_1= Seed (kg)
X_2= Farm size (hectares)
X_3= Total labour (man hours)
X_4= Chemical fertilizer (kg)
X_5= Capital input (number of capital items)
V_i= Random error
U_i= Technical inefficiency effects

The model for technical inefficiency effects (U_i) is defined as:

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + ei$$

Where:
U_i= Technical inefficiency effect
Z_1 = Age of the farmer
Z_2 = Years of farming experience
Z_3 = Education status of the farmer
Z_4 = Extension contact
Z_5 = Household size
αi = Parameters to be estimated
e_i = Error term

The multiple regression model adopted to establish the effects of socio-economic characteristics of farmers on net production income is specified implicitly as:
Y = f (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})

Where:
Y = Net production income (₦)
X_1 = Age (years)
X_2 = Gender (dummy: male = 1; female = 0)

X_3 = Household size
X_4 = Marital status (dummy: married = 1; otherwise = 0)
X_5 = Farm size (ha)
X_6 = Educational level (years)
X_7 = Farming experience (years)
X_8 = Cost of production (₦)
X_9 = Amount of credit obtained (₦)
X_{10} = Extension visits (number of times per production season)
The production function was fitted with four functional forms of the regression model namely linear, exponential, semi-log and double-log. The explicit expressions of the models are:

Linear:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + e_i$$

Exponential:

$$\ln Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + e_i$$

Semi - log:

$$Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + e_i$$

Double-log:

$$\ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + e_i$$

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The ordinary and transformed values of the dependent and independent variables were fitted into the respective models and analyzed using the MINITAB statistical package. The regression output which produced the best result in terms of number of significant parameters, values of t-statistic, F-statistic and coefficient of multiple determination (R^2) was chosen as the lead equation.
The constraints to rice production in the study area was identified and ranked using the relative important index technique. The formula is specified as:

$$RII = \frac{\sum W}{A \times N}$$

Where:
W= Weighting given to each factor by the respondents (ranging from 1 to 4)
A= Highest weight (i.e 4 in this case)
N= Total number of respondents
The responses from the respondents were ranked or disaggregated along a continuum. The response indicating the most serious constraint was given the highest score. Response on constraints to rice production was disaggregated as follows: very serious (4), serious (3), moderately serious (2) and not serious (1).

RESULTS AND DISCUSSION

Socio-economic characteristics of rice farmers

The distribution of rice farmers according to their socio-economic characteristics is shown in Table 1. The results showed that majority (64.17%) of the farmers were males, average age was 48.03 years, mean household size was 6 persons, most of the farmers were literates, while average farming experience was 12 years. Majority (79.17%) had farm size of 0.1-1.5ha indicating the dominance of small scale farmers. Personal savings constituted the source of fund for most (73.33%) for most of the farmers while a greater proportion (51%) were visited by extension agents1-2 times within the production year.

Table 1: Socio-economic characteristics of the rice farmers

Variable	Frequency	Percentage (%)	Mean/Mode
Gender:			
Male	77	64.17	**Male**
Female	43	35.83	
Age:			
25-36	18	15	
37-48	47	39.17	
49-60	37	30.83	**48.03 years**
Above 60	18	15	
Marital Status:			
Single	8	6.67	
Married	112	93.33	**Married**
Household Size:			
1-5	37	30.83	
6-10	83	69.17	**6 persons**
Educational Level:			
Less than 1	24	20	
1-6	57	47.5	
7-12	33	27.5	**7years**
13-18	6	5	
Farming Experience:			
Less than1	7	14.17	
1-10	41	34.17	
11-20	47	39.17	**12 years**
21-30	13	10.83	
Above	2	1.66	
Farm size:			
0.1-1.5	95	79.17	
1.6-3.0	23	19.17	**1.1 ha**
3.1-4.5	2	1.66	
Source of Fund:			
Personal savings	88	73.33	**Personal**
Friends and relatives	12	10	
Cooperatives	20	16.67	
Extension Visit:			
No visit	23	19.17	
1-2	61	50.83	**2 visits**
3-4	36	30	

Source: Field survey, 2019.

Technical efficiency levels of the rice farmers

The distribution of technical efficiency scores among rice farmers is shown in Table 2. Majority (80%) of the farmers recorded technical efficiency scores within the range of 0.91-1.0. This implied that most of the sampled rice farmers were operating very close to the frontier. The mean, minimum and maximum technical efficiency scores were 0.93, 0.76 and 0.98 respectively. This finding is in concurrence with Djomo *et al*. (2016) who reported mean technical efficiency of 82% for rice farmers in the West Region of Cameroon.

Table 2: Distribution of the rice farmers' technical efficiency scores

Technical efficiency range	Frequency	Percentage (%)
0.71 - 0.80	3	2.5
0.81 - 0.90	21	17.5
0.91 - 1.0	96	80
Total	120	100
Mean	0.93	
Minimum	0.76	
Maximum	0.98	

Profitability of rice production in the area

Enterprise budgeting method was used to determine the profitability of rice production. Result of the analysis (Table 3) showed a gross margin of ₦18,551.200, net production income of ₦16,939,669.9, mean net production income of ₦141,163.92 and net return on investment of 0.71. The net return on investment value of 0.71 implied a return of 71 Kobo for every 100Kobo investment in the business. This result conforms to the findings of Nwike and Ugwumba (2015); Ben-Chendo *et al.,* (2017); Madu and Aniobi (2018), which commonly noted that rice production was profitable in the study area.

Table 3: Estimated profitability of rice production

Variable	Amount (₦)	Percentage of TC
Total Revenue (TR)	**40,891,050**	
Variable input		
Rice seeds	2,513,350	10.49
Fertilizer	4,651,000	19.42
Agrochemicals	1,404,110	5.86
Labour	13,162,250	5.50
Transportation	609,140	2.54
Total Variable Cost (TVC)	**22,339,850**	**93.27**
Fixed input		
Dep. On matchete	125,123.33	0.52
Dep. On hoe	90,415.82	0.38
Dep. On wheel barrow	117,490.95	0.49
Rent on land	972,000	4.06
Interest on loan	306,500	1.28
Total Fixed Cost (TFC)	**1,611,530.1**	**6.73**
Total Cost (TC=TVC + TFC)	**23,951,380.1**	**100**
Gross Margin (GM=TR-TVC)	**18,551,200**	
Net Production Income (NPI=TR-TC)	**16,939,669.9**	
Mean Net Production Income (MNPI=NPI/n)	**141,163.92**	
Net Return on Investment (NROI=NPI/TC)	**0.71**	

Source: Field survey, 2019. Note: Dep. – depreciation

Determinants of net production income realized by the rice farmers

Table 4 shows the results of the multiple regression analysis on the determinants of net production income realized by rice farmers in Anambra State, Nigeria. Based on the magnitude of the coefficient of multiple determination (R^2), t-ratios, F- statistic, Durbin-Watson statistic, the signs and appropriateness of signs of the parameter estimates, as well as number of significant variables, output of the linear function was chosen as the lead equation.

The coefficients of multiple determination (R^2) of 99.6% implied that 99.6% variations in the net production income was accounted for by the production variable; hence the remaining 0.4% was due to random disturbance. The F-statistic value of 2762.85 was significant, an indication of overall significance of the regression.

A total of ten regressors were included in the model. Five of them (age, household size, farm size, farming experience and cost of production) were statistically significant while the other five were not significant. Among the statistically not significant variables, gender, marital status, educational level and extension visits exerted positive effect on net production income while the impact of amount of credit obtained was negative.

The coefficient of age was negative and statistically significant at 1% level of probability. This implied that the younger farmers were likely to produce more and realize more net production income and vice versa. This could be attributed to the fact that younger farmers would be more energetic to work than ageing farmers, hence leading to higher productivity and increase in net production income. This finding disagrees with Osanyinlusi and Adenegan (2016) who reported that older rice farmers were more productive than the younger ones. The coefficient of household size of the rice farmers was positive and statistically significant at 1% probability level, meaning that larger the farmers' household size higher would be the expected net production income. This can be as a result of minimal use of hired labour which lowers the cost of production thereby increasing the net production income. This is in discord with the findings of Ume *et al*. (2016) and Osanyinlusi and Adenegan (2016) which reported a positive relationship between household size and production income.

Furthermore, the result showed positive and significant relationship between net production income and farm size at 1% level of probability *a priori*. This means that higher output and net production income would be realized if the numbers of hectares of farm land cultivated by the farmers are increased. This concurs with the findings of Djomo *et al*. (2016) that farm size had a positive and significant relationship with rice output. The coefficient of farming experience had a positive and statistically significant influence on net production income at 1% probability level. This conforms to *a priori* expectations that more experienced farmers are expected to have higher output and net production income than farmers with lesser or no farming experience. This result contradicts the findings of Osanyinlusi and Adenegan (2016) who reported that farming experience was negatively related to productivity. Also, result of the analysis indicated a positive and significant relationship between cost of production and net production income. This means that increase in the quantities of inputs would lead to increase in net production income.

Table 4: Estimated determinants of net production income realized by the rice farmers

Predictor	Linear	Exponential	Semi-log	Double-log
Constant	-49898	4.79346	5978578	2.9739
	(-4.52)	(93.92)	(10.80)	(10.55)
AGE	-624.6	-0.0003289	-101442	0.11016
	(-2.93)***	(-0.33)	(-1.23)	(-2.62)**
GEN	4668	0.00635	9742	0.02551
	(1.54)	(0.45)	(0.24)	(1.25)
HHS	2427	0.000506	45662	0.05340
	(2.18)**	(0.10)	(0.71)	(1.63)
MAS	10990	0.01416	15485	0.016334
	(1.62)	(0.45)	(1.64)	(3.39)***
FAS	190368	-0.26023	1758125	0.60213
	(25.76)***	(-7.62)***	(16.53)***	(11.12)***
EDL	509.0	-0.000748	3229	0.002354
	(1.45)	(-0.46)	(0.84)	(0.234)
FAE	679.3	0.000099	11394	0.010517
	(2.72)***	(0.09)	(2.54)**	(4.61)***
COP	0.86516	0.00000499	-1047181	0.50319
	(15.61)***	(19.49)***	(-9.87)***	(9.31)***
ACO	-0.01072	-0.00000041	3521	0.0014041
	(-0.38)	(-3.17)***	(2.03)**	(1.59)
EXV	1536	-0.000631	1127	-0.003243
	(1.06)	(-0.09)	(0.23)	(-1.28)
R^2	99.6%	95.7%	93.9%	99.2%
R^2 adjusted	99.6%	95.3%	93.3%	99.1%
F- statistic	2762.85	240.95	166.76	1317.43
D- Wat. Stat.	1.38	1.74	1.93	1.57

Source: computed from survey data, 2019. Note: **, * means significant at 5% and 1% levels of probability. D- Wat. Stat. = Durbin-Watson Statistic. Figures in ( ) are t-ratios. AGE, GEN, HHS, MAS, FAS, EDL, FAE, COP, ACO, EXV are as earlier defined**

Determinants of technical efficiency of rice production

The maximum likelihood estimates for parameters of the stochastic frontier production model for determinants of technical efficiency of the rice farmers are presented in Table 5. The result indicated that two (fertilizer and capital) out of the five production variables had significant effects on production output. While seed, farm size and labour were not significant. This implies that a 1% increase in the quantities of fertilizer and capital used by rice farmers would lead to 0.16% and 0.42% of output respectively. This finding is in agreement with Ume *et al.* (2016) who posited that fertilizer and capital inputs had a positive and significant relationship with output.

With regards to the inefficiency factors (Table 5), the coefficients of farming experience, educational level and extension visits were negatively signed and significant. This implies that the higher farmers' farming experience, educational level and extension visits the lower the level of technical inefficiency in rice production in the area. This conforms to *a priori* expectations and the findings of Oumaruo and Zhou (2016) and Djomo *et al.* (2016) that technical inefficiency in rice production decreases with higher levels of education, experience and extension visits obtained by farmers.

The estimate of the sigma-squared ($\sigma 2$) parameter, 0.07 was statistically significant, indicating a good fit and correctness of the distribution assumption of composite error term. The estimate of the gamma parameter (0.86) indicated that only 0.14 of the total variations in rice output was due to technical inefficiency. The log likelihood function was estimated to be 161.63.

Table 5: Maximum likelihood estimate of stochastic production function of rice farmers

Variable	Parameter	Coefficient	t-ratio
Production factors			
Constant	β_0	-0.33	-0.40
Seed	β_1	0.32	1.51
Farm size	β_2	-1.57	-1.21
Labour	β_3	1.76	1.44
Fertilizer	β_4	0.16	3.63***
Capital	β_5	0.42	7.67***
Inefficiency effects			
Constant	δ_0	0.02	0.16
AGE	δ_1	0.01	1.33
FAE	δ_2	-0.01	-1.70*
EDU	δ_3	-0.00	-4.73***
EXV	δ_4	-0.02	-1.82*
HHS	δ_5	-0.02	-1.23
Diagnostic statistic			
Sigma-squared (σ^2)		0.07	1.76*
Gamma (γ)		0.86	8.20***
Log likelihood		161.63	

Source: computed from survey data, 2019. Note: * and * means significant at 1% and 10% level of probability respectively. AGE, FAE, EDU, EXV and HHS as defined earlier.**

Constraints to Rice Production in the Area

The calculated Relative Important Indices (RII) of the identified problems of rice production in the area were ranked in descending order of seriousness, and the results are shown in Table 6. Pests, diseases and weed attacks were indicated by the respondents as the most serious constraint to rice production in the area with RII value of 0.898. This result corroborates Osanyinlusi and Adenegan (2016) that pest infestation is the most serious constraint affecting rice production in Ekiti State, Nigeria. High cost of labour was ranked second with RII value of 0.823. This result agrees with the findings of Nwike and Ugwumba (2015) that high cost of labour was a major problem encountered by rice farmers. High cost of inputs was ranked third with RII value of 0.75. This result agrees with the findings of Madu and Aniobi (2018) that cost of farm inputs is also a major problem encountered by rice farmers. Lack of capital was ranked fourth with RII value of 0.694. High cost of fertilizer and agrochemicals was ranked fifth with RII value of 0.656. Other problems were flooding (0.596), scarcity of improved seeds (0.569), inadequate extension services (0.396) and poor storage facilities (0.285).

Table 6 : Constraints to rice production in the area

Factor	Relative Important Indicies (RII)	Rank
Pests, diseases and weed infestation	0.898	1st
High cost of labour	0.823	2nd
High cost of inputs	0.75	3rd
Lack of capital	0.694	4th
High cost of fertilizer and agrochemicals	0.656	5th
Flooding	0.596	6th
Scarcity of improved seeds	0.569	7th
Inadequate extension services	0.396	8th
Poor storage facilities	0.285	9th

Field survey, 2019.

The results showed that majority (64.17%) of the farmers were males, average age was 48.03 years, mean household size was 6 persons, most of the farmers were literates, while average farming experience was 12 years. Majority (79.17%) had farm size of 0.1-1.5ha indicating the dominance of small scale farmers. Personal savings constituted the source of fund for most (73.33%) for most of the farmers while a greater proportion (51%) were visited by extension agents1-2 times within the production year.

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The estimate of the sigma-squared ($\sigma 2$) parameter, 0.07 was statistically significant, indicating a good fit and correctness of the distribution assumption of composite error term. The estimate of the gamma parameter (0.86) indicated that only 0.14 of the total variations in rice output was due to technical inefficiency. The log likelihood function was estimated to be 161.63.

CONCLUSIONS

Rice production in Anambra State, Nigeria was technically efficient and profitable. Slight inefficiency gap still exist among the farmers due to influence of significant socio-economic determinants and serious constraints to production. Technical efficiency and profitability of rice production in the study area would improve if farmers could get improved varieties of rice seeds, fertilizers and capital at subsidized rates from government and Non- governmental institutions.

REFERENCES

Abba, M.W. & Abu, H.M.I., (2015). Technical efficiency of small scale rice production in Adamawa State, Nigeria. International Conference on Chemical, Food and Environment Engineering (ICCFEE'15), Jan. 11-12, 2015 Dubai (UAE).

Amaechina, E.C. & Eboh, E.C. (2017). Resource use efficiency in rice production in the lower Anambra irrigation project, Nigeria. Journal of Development and Agricultural Economics, 9(8), 234-242.

Ben-chendo, G.N., Lawal, N. &Osuji, M.N. (2017). Costs and returns of paddy rice production in kaduna State, Nigeria. European Journal of Agriculture and Forestry Research, 5(3), 41-48.

Central Bank of Nigeria (CBN) (2017). Annual report published by CBN, ISSN 1597-2976.

Coelli, T.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.

Djomo, C.R.F., Odoemenem, U.I. &Biam, C. (2016). Analysis of technical efficiency of small scale rice farmers in the West Region of Cameroon: a stochastic frontier approach. International Journal of African and Asian Studies, 21, 2409-6938.

Egbodion, J. &Ahmadu, J. (2015). Production cost efficiency and profitability of Abakaliki rice in Ihiala Local Government Area of Anambra State, Nigeria. Journal of Applied Science and Environmental Management, 19(2), 327-333.

Farrell, M.J. (1957). The measurement of production efficiency.Journal of Royal Statistical Society, Series A, 120, 253-290.

Food and Agriculture Organization (FAO) (2008). FAO Statistics Division of the Food and Agriculture, Rome.

Food and Agriculture Organization Statistics (FAOSTAT) (2008a). Calorie supply intake, FAO statistics division. Retrieved from: http://beta.irri.org/statistics/index.php?

Food and Agriculture Organization Statistics (FAOSTAT) (2008b). Trends in the rice economy: paddy rice production area, FAO statistics Division. Retrieved from: http://beta.irri.org/statistics/images/stories/wrs/wrs-novo8-tables

Kadiri, F.A. &Eze, C. (2015). Effects of paddy rice production on the welfare of farmers and the determinants of achievements of paddy rice farmers in Niger Delta Region of Nigeria. Journal of Economics and Sustainable Development, 6(4), xx-xx.

Madu, A.B., &Aniobi, U.J. (2018). Profitability analysis of paddy production: a case of agricultural zone 1, Niger State, Nigeria. Journal of Bangladesh Agricultural University, 16(1), 88-92.

National Bureau of Statistics (NBS) (2011). Facts and figures about Nigeria.

Nwike, M.C. &Ugwumba, C.O.A. (2015). Profitability of rice production in Aguata Agricultural Zone of Anambra State, Nigeria: A Profit Function Approach. American Journal of Agricultural Science, 2(2), 24-28.

Odoemenem, I.U. &Inakwu, J.A. (2011).Economic analysis of rice production in Cross River State, Nigeria. Journal of Development and Agricultural Economics, 3(9), 469-474.

Oko, A.O., Ubi, B.E. &Efisue, A.A. (2012). A comparative study on local and newly introduced rice varieties in Ebonyi State of Nigeria based on selected agronomic characteristics. International Journal of Agriculture and forestry, 2(1), 11-17.

Onimawo, I. (2012). Traditional food systems in assuring food security in Nigeria. In Burlingame & B. Demini, S. (eds) sustainable diets for biodiversity. Directions and solutions for policy, research and action.Proceedings of the international scientific symposium on biodiversity and Sustainable Diets United against hunger. 3-5 november 2010, FAO Rome.

Onyenweaku, I.C.E. &Effiong, E.O. (2006).Technical efficiency in pig production in Akwa-Ibom State, Nigeria. International Journal of Agricultural Rural Development, 6, 51-57.

Osanyinlusi, O.I. &Adenegan, K.O. (2016).The determinants of rice farmers' productivity in Ekiti State, Nigeria. Greener Journal of Agricultural Sciences, 6(2), 049-058.

Oumarou, B. & Zhou, H. (2016). Technical efficiency of rice farming in South-western Niger: a stochastic frontier approach. Journal of Economics and Sustainable Development, 7(24), 2222-2855.

Ume, S.I., Ezeano, C.I., Eluwa, A.N. &Ebe, F. (2016).Analysis of technical inefficiency in rice production among farmers in Ezza South Local Government Area of Ebonyi State, Nigeria (application of stochastic frontier production). Archives of Current Research International 5(2), 1-2.

Ume, S.I. &Nwaobiala, C.U. (2012).Economic efficiency of upland rice farmers across gender in Anambra agricultural zone of Anambra State, Nigeria. Agricultural Journal, 41(2), 37-45.

Varian, H.R. (2014). Big data: new tricks for econometrics. Journal of Economic Perspective, 28(2), 3-8.