Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 3, Number 3, 2020
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

TECHNICAL EFFICIENCY OF RICE PRODUCTION IN SOUTHERN TARABA STATE, NIGERIA

[1]Aboki, E., [2]Luka, P., [1]Jonathan, R. and [3]Rukwe, D. T.
[1]Department of Agricultural Economics and Extension,
Taraba State University, Jalingo, Nigeria
[2]Taraba State College of Agriculture, Jalingo, Nigeria
[3]National Agricultural Extension and Research Liaison Services,
Ahmadu Bello University, Zaria, Nigeria
Corresponding Authors' E-mail: rukwedaniel@gmail.com **Tel.:** 08085455661

ABSTRACT
The study evaluated technical efficiency of rice production in Southern Taraba State, Nigeria. Multi stage sampling procedure was employed in selecting 133 respondents for the study. Primary data used in the study were collected using structured questionnaire administered to respondents. Data collected were analyzed using descriptive statistics and stochastic frontier production function. Result of the study indicated that majority (80.45%) of the respondents was male; the average age of the farmers was 39 years, majority (67%) of the respondents was married. The average household size was five (5) people per household. The average farming experience of the farmers was 15 years; majority (76%) of the respondents had formal education. The average farm size of the farmers was 2 hectare, 69.17% of the rice farmers do not have access to credit, and most (75.94%) of the respondents did participate in any cooperative association. Majority (95.49%) of the respondents did not have access to extension contacts. The maximum likelihood estimate of stochastic frontier production function for rice farmers were all positive, that is, farm size, seed used, fertilizer and labor except for herbicide and cost of ploughing which were negative. It was concluded that rice farmers were efficient in their production with mean efficiency index of 87%. It was recommended that, farmers should use the available resources efficiently to attain maximum output.

Keywords: Likelyhood estimate, production function, rice production, stochastic frontier, Technical efficiency.

INTRODUCTION
Agriculture is the mainstay of the majority of Nigerian rural people (Ayoola *et al.*, 2011). They further pointed that the rural farmers are the key players in terms of the food crops production in Nigeria. Food produced in Nigeria is mostly at subsistent level and is always inadequate to meet the demand of the populace due to low crop yield and the use of sub-standard technology (Olasunkanmi and Janet, 2013).

Rice is one of the most important food crops grown in Southern Taraba State and Nigeria at large. The country has suitable ecologies that are suitable and significant for rice production (Ministry of Agriculture and Rural Development, 2010). Despite the suitable environment the country has for rice production its demand is still very high due to increase in population over the years. The domestic production has not been able to meet the demand of the population due to the use of poor production techniques (Polycarp and Shall, 2004).

Existing low level of rice production reflect low level of technical, allocative and economic efficiencies. Therefore, increasing Agricultural growth is an indication of appreciable growth in Agricultural production that is linked to farm profit (Olasunkanmi and Janet, 2013).

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 3, Number 3, 2020
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

Hence, farm productivity and efficiency is no longer arguable but a necessity in view of food deficit being experienced in the country judged by the over reliance on food importation in recent time (Central Bank of Nigeria, 2003). Thus, this condition calls for improving yields of rice crop for better food security.

One way to bring about increase in rice production and productivity is the introduction of improved technology and agricultural research (Asfaw and Bekele, 2010). Asefa (2012), observed that if existing inputs and technologies are not efficiently utilized, to introduce new technologies will not be cost-effective. Consequently, a technical-efficiency analysis is essential to find out if farmers are efficient in the use of the existing resources and to decide when to introduce new technologies. It was on this premi that the study was carried out to examine the technical efficiency of rice production in Southern Taraba State, Nigeria. The study was designed to address the following specific objectives to describe the socio-economic characteristics of rice farmers; estimate the level of technical efficiency in the rice production and evaluate the socio-economic factors of rice farmers influencing technical efficiency.

MATERIALS AND METHODS

The Study Area

The study was carried out in Southern part of Taraba State, Nigeria. The Southern part is made up of five (5) Local Government Areas (LGAS), thet is, Takum, Wukari, Donga, Ussa and Ibi; and Yangtu been the special development area (Figure 1). It lies between latitude 8º 30”N and 9º 30”N of the equator and longitude 8º 30”E and 10º 30”E of the Greenwich meridian. The area covers an area of 14,099km^2 landmass with a population of about 704,900 people as at 2006 (National Population Commission [NPC], 2006). The National Population Commission has projected an annual growth rate of 3.5% which brought the population figure to 1,036,183 people as at 2017.

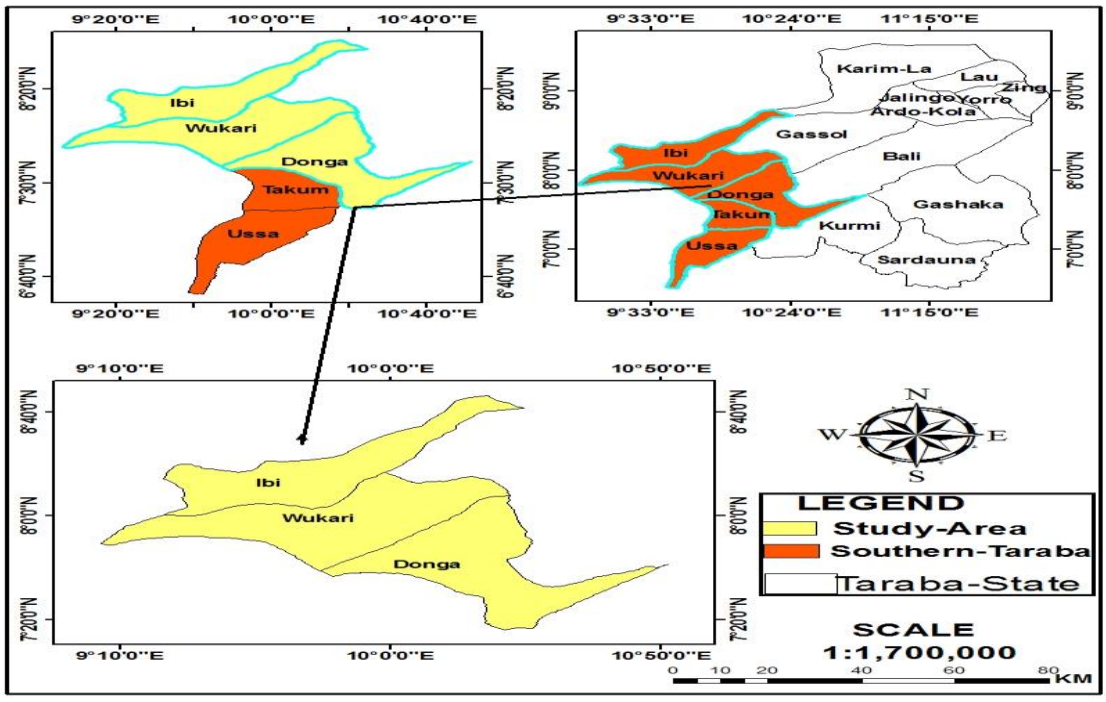

Figure 1: *Map of the study area*
Source: Department of Geography, Taraba State University, Jalingo, 2017

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 3, Number 3, 2020
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

The area shares a common boundary with Gassol, Bali, Kurmi, and Karim-lamido LGAs to the North, Nassarawa and Plateau state to the North-west, Benue State to the South-west and Republic of Cameroun to the Southeast (Taraba Agricultural Development Programme [TADP], 2004). The zone has a tropical climate marked by dry and rainy seasons. The rainy season starts in April and ends in October. The wettest months are August and September. The dry season starts in November and ends in April. The mean annual rainfall ranges from 800mm to over 1800mm in the south. The mean minimum daily temperature recorded is 14.8º c and the mean maximum daily temperature recorded is 34.4º c (TADP, 2004). The vegetation of the zone is Guinea savannah type. The study area is predominantly agrarian with about 80% of its inhabitants depending on subsistence agriculture practices mainly in food and cash crops like rice, cassava, yams, benni seed and maize (TADP, 2004).

Sampling Techniques

A multi-stage sampling procedure was used to select rice farmers for the study. Firstly, the purposive sampling technique was used to select three (3) LGAs from the area that is, Wukari, Ibi and Donga LGAs Taraba State based on their relative importance in Rice production.

In the second stage, two (2) faming communities were randomly selected from each of these LGAs to form a total of six (6) faming communities. In the third stage, farmers were selected in proportion to their population, that is 10% of the rice farmers were randomly selected from six (6) of the faming communities. Finally, a total of 133 respondents form the sample size for the study from which analysis was done.

Method of Data collection

Primary data were used for this study. The primary data were collected using structured questionnairiare. Data were collected on information needed to address the specific objectives.

Analytical Techniques

Mean frequency distribution, percentage and Cobb-Douglas production functional form of the stochastic frontier production model was employed to estimate the technical efficiency of rice farmers and the socio-economic factors influencing technical efficiency of rice farmers in the study area.

The stochastic frontier production function has the advantage of allowing simultaneous estimation of individual technical efficiency of the farmers as well as identifying determinants of technical efficiency (Battese and Coelli, 1977). The Cobb-Douglas stochastic frontier production function was specified in its log form as:

$$LnY_i = lna_0 + a_1 lnX_1 + a_2 lnX_2 + a_3 lnX_3 + a_4 lnX_4 + a_5 lnX_5 + a_6 lnX_6 + V_i - U_i \quad \ldots (1)$$

where;

Ln = the natural logarithm
Y_i = Output (kg)/ha
X_1 = farm size (ha)
X_2 = Seed (kg)/ha
X_3 = Fertilizer (kg)/ha
X_4 = Herbicides (litre)/ha
X_5 = other capital such as cost of ploughing (₦)/ha
X_6 = Labour (man-hour)/ha
V_i = Error term not under the control of farmers
U_i = Error term under the control of farmers' (technical inefficiency)
a_0 = Intercept (constant term)

The model to identify determinants of inefficiency, U_i, is expressed as:

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 3, Number 3, 2020
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

$U_i = b_0 + b_1Z_1 + b_2Z_2 + b_3Z_3 + b_4Z_4 + b_5Z_5 + b_6Z_6 + b_7Z_7$ … (2)

where;
Z_1 = age (years)
Z_2 = family size (number)
Z_3 = farming experience (years)
Z_4 = education (years)
Z_5 = Access to credit (₦)
Z_6 = Extension contact (no of times each farmer had extension contact in a year)
Z_7 = Membership of cooperative (years)
Z_8 = Sex (male or female)
b_0 = Constant
$b_1 – b_8$ = regression coefficient
U_i = inefficiency model.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Rice Farmers

Table 1 revealed that 80% of the farmers were males, meaning that males dominated the business of rice farming in the study area. Thus, agreeing with the findings by Odoemenem and Inakwu (2011) who reported that men constitute 65% of rice farmer in Cross River State. However, this disagreed with the findings of Abuh and Mohammed (2017) which observed that women occupy a Central position and play a vital role in the society and suggested that they should be encourage to participate fully in agriculture.

The results reveals that majority (62%) of the farmers were young with a mean age of 39 years. This is an indication that most of the farmers were relatively young and physically active. The younger farmers are more agile, energetic and have the stamina to be more productive in agriculture production than their older ones. This finding agrees with Mohammed (2011) who revealed that majority of the rice farmers were aged and this could mean high labor cost as most of them will result to live labours in the absence of availability of family labour.

The result also shows that majority (67%) of the farmers were married, meaning that there are more married farmers in the rice enterprise than the single counterparts. The findings agree with Ahmadu and Erhabor (2012) who opined that majority (77%) of the respondents were married with high family sizes.

The results indicates that 58% of the farmers had 1-20 years of farming experience, the mean farming experience was 15 years while the mode 10 indicating that majority of the farmers have been long in the rice farming and are therefore conversant with the problems of the area. This implies that with the long years of farming experiences the farmers are expected to be conversant with the new technologies and methods of production. This findings support the view of Onu and Edon (2009) who reported a positive and significant relationship between farming experience and technical efficiency.

The study revealed that majority (75.94%) of the farmers in the study area was literate implying that farmers in the study area have acquired one form of formal education or the other. The result from this work is inline with Ogundari *et al.* (2006) whose findings further agree with Osuji (2000) that education is considered as an important factor in the acceptance of new farming practice.

The distribution of farmers according to their access to credit is presented in Table 1. Majority (69.17%) of the farmers had no access to credit. This implies that the farmers used their personal saving to purchase farm inputs and adopt farm innovations. This agreed with the

findings of Sa'aodor (2013) who found that the farmers used their personal saving to purchase farm inputs and adopt farm innovations.

Table 1: Socio-economic Characteristics of the Respondents

Variables	Frequency	Percentage	Max.	Min.	Mean
Sex	107	80.45			
Male					
Female	26	19.55			
Age					
20-30	9	6.7	65	20	39
31-40	27	20.80			
41-50	47	35.34			
51-60	39	29.32			
>61	11	8.27			
Marital Status					
Married	89	67			
Single	44	33			
Years of farming experience					
1-10	53	39.85	31	5	15
11-20	37	27.82			
21-30	29	21.80			
>31	14	10.53			
Level of education					
No formal education	32	24.06			
Adult/Quaranic education	15	11.28			
Primary education	29	21.80			
Secondary education	41	30.83			
Tertiary education	16	12.03			
Access to Credit (₦)					
Zero credit	92	69.17			
1000- 50,000	15	11.28			
51,000- 100,000	11	8.27			
101,000 – 150,000	8	6.26			
151,000 – 200,000	7	5.26			

Source: Field Survey, 2017

Technical Efficiency of Rice Farmers

Result in Table 2 indicated that the estimate sigma square (σ^2) was (0.103) and statistically significant at 5%. This shows a good fit and the correctness of the specific distributional assumption of the composite error term (Tadesse *et al.,* 2016). The estimate of the variance parameter gamma (γ) was significant at 1% level of significance with a coefficient of 0.58 which explained that 58% of total variation in technical efficiency of rice output while 42% was due to technical inefficiency of the farmers in the study area. This implies that the inefficiency effects were significant in determining the level and variability of output of rice farmer in the study area. The likelihood estimates (0.736) of the stochastic frontier production revealed that output was significantly influenced by farm size, seed, fertilizer and labor.

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 3, Number 3, 2020
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

The elasticity of output with respect to farm size was positive and statistically significant at 1%, implying that farm size was a significant factor that influences changes in the output of rice. This agreed with the finding of David and Terwase (2011) reported that farm size was statistically significant and have the tendency to increase rice output in Benue State. The coefficient of seed was positive (0.4469) and statistically significant at 5 percent. This implies that a unit increase in the quantity of rice seed cause an increase in output of rice by 45%. Similarly elasticity of output with respect to the use of fertilizer was positive (0.2591) and statistically significant at 5%. This finding is in agreement with the result of Rahman and Umar (2009) who reported that fertilizer was positive and statistically significant to increase rice output. The coefficient of labour (0.2988) was positive and statistically significant at 5%. This implies that additional unit of labour will lead to increase in the output of rice. This conformed with the result of Goni *et al.* (2007) which observed that labour was positively related to the output of rice in the Lake Chad area of Borno state.

Table 2: Maximum Likelihood Estimate of Parameter of Stochastic Frontier Production Function for Rice Farmers

Variables	Parameter	Coefficient	Standard Error	t-value
Constant	$\beta 0$	0.1062	0.6306	5.9360
Farm size	X_1	0.2298***	0.8304	3.6119
Seed	X_2	0.4469**	0.9512	2.1282
Fertilizer	X_3	0.2591**	0.7403	2.8570
Herbicide	X_4	-0.3363	0.1193	-0.3548
Cost of ploughing	X_5	0.7289	0.4831	0.6627
Labor	X_6	0.2988**	0.8304	2.7795
Inefficiency factors				
Constant	$\alpha 0$	-0.2100	0.9689	-4.6134
Age	z_1	0.3625**	0.9037	2.4919
Family size	z_2	-0.2369***	0.8566	-3.6150
Farming experience	z_3	-0.1399***	0.4346	-3.1063
Education	z_4	-0.2228***	0.9229	-4.1507
Access to credit	z_5	-0.6279	0.7794	-1.2412
Extension contact	Z_6	-0.2392***	0.8164	-3.4139
Membership of the Cooperative	Z_7	-0.2007***	0.8715	-4.3436
Diagnostic statistic				
Sigma squared	σ^2	0.10317	0.049001	2.10546
Gamma	Γ	0.58872	0.067342	8.7445
Log likelihood		0.73603	0.068503	10.7444
LR test		0.88941		

***P<0.01, **P<0.05, *P<0.1
Source: Field survey, 2017

The signs of the coefficient in the inefficiency model are interpreted in the opposite way such that a negative sign means that the variable increase efficiency a positive signs means that it decrease efficiency. The result of the inefficiency shows that the coefficient of all the variables except age had negative signs. Age was statistically significant at 5% with coefficient of 0.3625. This means that age was not critical a factor of inefficiency among rice farmers in the study area. The coefficient (-0.2369) of family size was negative and statistically significant at 1% level. This means that farmers with large family size were more efficient than those with small family size. A plausible reason for this is that some members of the family might be

useful as family labour, thereby reducing the cost on hired labor. The coefficient (-0.1399) of farming experience was negative and statistically significant at 1% level. This implies that, rice farmers with more farming experience were more technically efficient than those with less farming experience. This finding is inline with the study of Ifeanyichukwu *et al.* (2016). In the same vein the coefficient of education was negative (-0.2228) and statistically significant at 1%. This means that farmers with a level of education are more efficient than those without formal education. This agreed with the findings of Njeru (2010) who reported that the main factors that influenced the degree of inefficiency were education levels and access to credit. The coefficient of access to credit was negative (-0.6279) and not statistically significant. This shows that rice farmers that have no access to credit facilities were not efficient compared to those with credit facilities. This means that farmers with access to credit will be able to buy farm input as well as paid for hired labour. Extension contact (-0.2391) had negative coefficient and statistically significant at 1%.

Technical Efficiency Indices

The technical efficiency indices presented on Table 3 reveals that the individual technical efficiency indices range between 77% and 99% with mean technical efficiency of 87%. The mean technical efficiency of 87% implies that on the averages the farmers were able to achieve 87% of optimal output of rice from the set of inputs and technology available to them. Thus, the rice output could be increased by 13% with the existing level of resources. This suggests that there are opportunities for the farmers to increase their current resource efficiency in the study area. This concord with the findings of Njeru (2010) who reported that the magnitude of technical efficiency varied from one farmer to another and range from 48.9% to 95.1% with a mean TE index of 87.2%. This implied that farmer's loss close to 13% of the potential output to technical inefficiencies.

Table 3: Technical Efficiency of the Rice Farmers

Class	Frequency	Percentage
0.7-0.79	5	3.76
0.80-0.89	90	67.67
0.90-0.99	38	28.57
Total	133	100
Minimum	0.74	
Maximum	0.99	
Mean	0.87	

Sources: Field survey, 2017

CONCLUSION AND RECOMMENDATIONS

The major determinants of technical efficiency in rice production in the study area were family size, farming experience, education, access to credit, extension contact and membership of corporative. It was recommended that:

1. The farmers should use the available resources efficiently. This could lead to increase in output through more efficient use of available resources (farm size, seed used, fertilizer, labor and other inputs) given the current state of technology.
2. The attainment of the average technical efficiency of 87% indicated that the technical efficiency of the farmers could be increased by 13% through efficient use of inputs.

REFERENCES

Abuh, S. and Mohammed, G. (2017). Analysis on Women Farmers of Rice Production in Donga Local Government Area of Taraba State, Nigeria. *Journal of Sustainable Development in Agriculture and Environment,* **3**: 31-37.

Ahmadu, J. and Erhabor, P. O. (2012). Determinants of Technical Efficiency of Rice Farmers in Taraba State, Nigeria. *Journal of Agriculture, Food and Environment,* **8**(3): 78-84.

Asefa, S. (2012). *Analysis of technical efficiency of crop producing smallholder farmers in Tigray, Ethiopia.* 'Munich Personal RePEc Archive (MPRA), Paper, (40461).

Asfaw, S. and Bekele, S. (2010). *Agricultural technology adoption and rural poverty: Application of an endogenous switching regression for selected east African countries.* Poster presented at the joint 3rd African Association of Agricultural Economists (AAAE), 19-23.

Ayoola, J. B., Dangbegnon, C., Daudu, C. K., Mando, A., Kudi, T. M., Amapu, I. Y., Adeosun, J. O. and Ezui, K. S. (2011). Socio-economic factors influencing rice production among male and female farmers in Northern Guinea Savanna Nigeria: lessons for promoting gender equity in action research. *Agriculture and Biology Journal of North America,* **2**(6): 1010-1014. doi:10.5251/abjna.2011.2.6.1010.1014.

Battese, G. E. and Coelli, T. J. (1977). A model for Technical Inefficiency Effect in Stochastic Frontier Production Function for Panel Data. *Empirical Economics,* **20**: 325-332.

Central Bank of Nigeria [CBN] (2003). *Central Bank of Nigeria Annual Report and Statement of Account for the year ended 31st December 2002*.

David, T. A. and Terwase, S. (2011). Efficiency of Resource Use in Rice Farming Enterprise in Kwande Local Government Area of Benue State, Nigeria. *International Journal of Humanities and Social Science,* **1**(3): 215-220.

Department of geography (2017). *Map of Taraba State showing the study area.*

Federal Ministry of Agriculture and Rural Development (2010). *State of Nigerian Agriculture at Maizube Farms, Niger State.* Ministerial Press Briefing by Minister of Agriculture and Rural Development.

Goni, M., Mohammed, S. and Baba, B. A. (2007). Analysis of Resource Use Efficiency in the Lake Chad Area of Borno State, Nigeria. *Journal of Sustainable Development in Agriculture and Environment,* **3**:31-37.

Ifeanyichukwu, U. S., 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,* **55**(2): 1-12.

Mohammed, S. (2011). Economics of Rain-fed and irrigated Rice production under upper Benue River Basin Development Authority Scheme Dadinkowa, Gombe State, Nigeria.*Continental Journal of Agricultural Economics,* **5**(1): 14-22.

National Population Commission [NPC] (2006). *Population and Housing Census Enumerators Manual.* Federal Republic of Nigeria, National Population Commission, Nigeria, 1-16.

Njeru, J. (2010). *Factors Influencing Technical Efficiencies among Selected Wheat farmers in Uasin Gishu district, Kenya*. African Economic Research Consortium Nairobi, Pp.1-20.

Odoemenem, I. U. and Inakwu, J. A. (2011). Economic Analysis of Rice Production In Cross River State, Nigeria. *Journal of Development and Agricultural Economic,* **3**(9): 469-474.

Ogundari, K., Ojo, S. O. and Ajibefun, I. A. (2006). Economics of Scale and Cost Efficiency in Small Scale Production: Empirical evidences from Nigeria. *Journal of Social Sciences*, **13**(2): 131-136.

Olasunkanmi, M. B. and Janet, O. A. (2013). Technical Efficiency in Swamp and Upland Rice Production in Osun State, Nigeria. *Scholarly Journal of Agricultural Science*, **3**(1): 31-37. Available online at http:// www.scholarly-journals.com/SJAS.

Onu, J. I. and Edon, A. (2009). Comparative Economic Analysis of Improved and Local Cassava varieties in Selected Local Government Area of Taraba State Nigeria. *Journal of Social* Science, **19**(3)213-217.

Osuji, L. O. (2000). Institutional Factors Associated with Adoption of new Farm Technology among Farmers in Eastern Nigeria. *Journal of Agricultural Extension.1 (2) 43-53*

Polycarp, I. M. and Shall, D. J. (2004). *Perspectives on the Agricultural Sector in Adamawa State.* Publishers Loud Books Ibadan. 85Pp.

Rahman, S. A. and Umar, H. S. (2009). Measurement of Technical Efficiency and its Determinants in Crop Production in Lafia Local Government Area of Nasarawa State, Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension*, **8** (2): 90-96.

Sa'aodor, P. A. (2013). Crop that Feed the World: Rice. Food security, *Review of Technology Adoption Theories, Measurement and Analysis in Agricultural Extension*, **2**(4): 7-15.

Tadesse, Z. L., Solomon, A. T. and Fentahum, A. A. (2016). Technical efficiency in paddy farms of Tamil Nadu: An analysis based on farm size and ecological zone. *Journal of Agricultural Economics*, **16**: 185-192.

Taraba Agricultural Development Programme [TADP] (2004*). Crop Production Recommendations for Taraba State.* Taraba press Ltd. Nigeria. Pp.31-39.