Journal of Agriculture and Environment Vol. 14 No. 1, 2018: 1-9
ISSN 1595-465X

DETERMINANTS OF TECHNICAL EFFICIENCY IN RICE PRODUCTION UNDER THE NATIONAL PROGRAMME FOR FOOD SECURITY (NPFS) IN THE FEDERAL CAPITAL TERRITORY, NIGERIA

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ABSTRACT

This study evaluates the technical efficiency of rice production under the National Programme for Food Security (NPFS) in the Federal Capital Territory, Nigeria. One hundred and forty-five (145) farmers were sampled using multi-stage sampling technique and data collected with the aid of questionnaire. The results revealed that respondents were of the mean age of 39.21 years and had mean farm land holding of 1.63 ha. Technical efficiency was estimated to be 82% as the farmers level of education and access to credit were the statistically significant variables negatively influencing the technical inefficiencies of the rice farmers. In other words, these two significant variables aided technical efficiency. Inputs like farm size, seeds and fertilizers were the major inputs observed to also influence the output of rice production in the study area. Agricultural policies that will improve the capacity of farmers to apply the available technologies more efficiently, particularly by raising the educational level of farmers were therefore recommended. Inputs distribution should be strengthened to support timely supply at affordable prices, while land use and accessibility reforms should also be looked into to make land available to counter the prevalent rice production-constraining access by inheritance.

Keywords: Rice Production; Technical Efficiency; National Programme for Food Security (NPFS)

INTRODUCTION

Rice can undoubtedly be one of the most important cash crops playing vital role in uplifting a country's economy. It has the potential of significant contribution to world food needs and become an important source of employment and income generation for rural farmers in the rice cultivation zone. It can also contribute significantly to a country’s foreign exchange earnings through export, owing to the economic relevance the cereal is currently gaining. This is because rice has been identified as a major staple food in many developing countries (Hauser, 2003). In the daily diet of an average farm family, rice serving and ration is growing, taking a large portion in their consumption and expenditure pattern (Ojeleye, 2015).

Moreover, the Food and Agriculture Organization FAO (2017) have noted that Nigeria is Africa’s leading consumer of rice, one of the largest producers and simultaneously one of the largest rice importers in the world. FAO (2017), added that rice, being an important food security crop, is an essential cash crop for the mainly small-scale producers who commonly sell 80% of total production and consume only 20%. Rice has been noted to generate more income for Nigerian farmers than any other cash crop in the country (FAO, 2017).

Food insecurity is a problem affecting many nations, Nigeria inclusive. The Nigerian Government initiated food security programmes in year 2002 to bring about self - sufficiency and poverty reduction. The government's interventions in the rice sub – sector, over the past few decades, have been through the International Institute of Tropical Agriculture (IITA) and West African Rice Development Association (WARDA), in an attempt to address the nation's rice demand – supply gap. One other of such efforts is the National Programme for Food Security (NPFS), a national programme whose broad objective is to attain food security and alleviate rural poverty in Nigeria (Federal Ministry of Agriculture and Water Resources/ Food and Agriculture Organization, FMAWR/FAO, 2004). One of its specific objectives however, is to assist farmers in achieving their potential for increased output and productivity and, consequently increased incomes on a sustainable basis. The Programme involves some 23,000 to 25,000 farm families per site in 109 project sites across the country (Oyebanji, 2005). The NPFS runs a rice production programme in the Federal Capital Territory as one of its sites.

Several recent studies on the technical and economic efficiencies of crop production, particularly for wheat and rice, have pointed out the existence of a 'yield gap'. This 'gap' refers to the difference in productivity on 'best practice' and on other farms operating with comparable resource endowments under similar circumstances (Kebede, 2001; Wadud, 1999; Villano, 2005; Abedullah, and Khalid, 2007). The difference between actual and technically feasible output for most crops implies great potential for increasing food and agriculture production through improvements in productivity, even without further advancement in technology and employment of additional resources (land, labour and water etc.). It is generally believed that, resources in the agricultural sector, especially in developing countries, are being utilized inefficiently. Farmers are mainly concerned with profitability of farming business which directly or indirectly depends on resource use efficiency. However, little work or none has been done along these lines in the rice sector particularly under the NPFS rice production programme, and the present study is attempting to fill this gap.

This study is attempting to evaluate the technical efficiency in rice production in the NPFS rice production programme. It is expected to guide the policy managers to decide where future resources should be allocated to improve rice productivity. The key objective of present study is to estimate technical inefficiency of rice farmers that could contribute in explaining the yield gap and to determine the role of the programme in improving technical efficiency and rice productivity.

MATERIALS AND METHODS

The study was conducted in the Federal Capital Territory. Politically, FCT has the status of a state but headed by a minister. At present it has six area councils (Abaji, Bwari, Gwagwalada, Kuje, Kwali and the Municipal). As at 2006, the population figure for FCT was put at 1.4 million (NPC, 2006), and amounts to a projected 3.94 million people in 2018 at 9% growth rate. The rainfall is bimodal in some years but a monomodal pattern may occur in the northern parts of the territory. Temperature ranges from 26^0C to 32^0C with maximum and minimum temperatures occurring in March and December respectively. The crops grown include rice, maize, garden egg, yams, maize and the livestock kept include goat, sheep and cattle (Adejoh, 2014).

A multistage sampling technique was adopted for this study. The first stage involved purposive selection of villages that are participating in the NPFS rice production programme in the Federal Capital Territory (FCT), which include Pandagi site, Kawu site, Kilankwa site I, and Kilankwa site II. The second stage involved a 100% selection of all the farmers participating in the rice production scheme from each of the NPFS sites, giving a sample size of 145 respondents. Primary data were collected through personal interview with the rice farmers under the NPFS, using structured questionnaires, while descriptive statistics and stochastic frontier production function were used in the analysis of data obtained.

The Stochastic Frontier production function model is given by;

$$Y_i = f(Xi;\, \beta) + e_i^{vi-ui} \text{……………......................................(1)}$$

Where: Y_1 is the quantity of agricultural output in kilogramme, Xi is the vector of input quantities, β is the vector of production function or unknown parameters to be estimated, *f is* a notation for the functional form of the model. The production function $f(Xi;\beta)$ is a measure of maximum potential output for any particular input vector Xi. e_i is the error term and is the farm specific composite residual term comprising of a random error term ***Vi*** and an inefficiency component ***Ui.*** Such that $0 \leq TEi \leq 1$

The stochastic production frontier model is specified as;

$$InY_{ij} = \alpha_0 + \alpha_1 In\alpha X_{1ij} + \alpha_2 In\alpha X_{2ij} + \alpha_3 In\alpha X_{3ij} + \ldots + \alpha_5 In\alpha X_{5ij} + V_{ij} - U_{ij} \text{ ....(2)}$$

Where: The subscription *i* and *j* refers to i^{th} farmers and j^{th} farm, respectively while: Y is the total farm output of paddy rice (Kg), X_1 is the cultivated land area for rice (ha), X_2 is the quantity of seeds planted (kg), X_3 is labour (man days), X_4 is the quantity of fertilizer used (kg), X_5 represents chemicals (litres), V_{ij} is a random error term with normal distribution $N(0, \delta^2)$. U_{ij} is a non - negative random variable called technical inefficiency effects associated with the technical inefficiency of production of farmers involved. *In* is the natural logarithm (to base e), while α_o - α_6 are the parameters to be estimated.

The technical inefficiency effects *Ui* is given by;

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 \text{…………..(3)}$$

Where; Z_1 is the age of the farmer (years), Z_2 represents the education level (years), Z_3 is household size (number), Z_4 is the years of farming experience in rice production (years), Z_5 denotes membership of cooperative (years of membership), Z_6 is the amount of credit accessed (₦), Z_7 represents number of contact with extension agents per cropping season (number of contacts), and $\delta_1 - \delta_7$ are the scalar parameters to be estimated.

RESULTS AND DISCUSSION

The distribution of the respondents' socio-economic characteristics is presented in Table 1. The respondents' age distribution showed that 53.79% were between 21-40 years, as the average age was found to be 39.21 years. The results obtained imply that farmers in the study area are still in their active age group. Age is very important in agricultural production because it determines the physical strength of the farmer. In addition, the younger people tend to withstand more stress and put more time in various farming operations, which will likely result in an increase in rice production.

Table 1: Socio-economic variables of respondents

Socio-Economic Variables	Frequency	Percentage	Average (Mean)	Min/Maximum
Age (Years)				
21-40	78	53.79	39.21	20/68
>41	67	46.21		
Gender				
Male	127	87.59		
Female	18	12.41		
Household Size				
1-5	60	41.38	6	1/14
6-10	73	50.34		
>10	12	8.28		
Level of Education				
No formal education	66	45.52		
Primary education	46	31.72		
Secondary education	26	17.93		
Tertiary education	7	4.83		
Farm Size (Ha)				
0.1-1.0	66	45.52	1.63	0.4/4.5
1.1-2.0	47	32.41		
2.1-3.0	19	13.10		
> 3	13	8.97		
Mode of land acquisition				
Inheritance	121	83.44		
Lease	17	11.72		
Gift	6	4.14		
Purchased	1	0.69		
Total (n)	145	100		

Source: Field Survey

Table 1 also presents an average household size of 6 members per household. This implies that the farmers in the study area have advantage of family labour for farm work, thereby reducing the cost of hired labour. However, large household size may increase household food consumption expenditure which could reduce the money that could be used for production purposes, in this case rice production. Furthermore, respondents' distribution by their educational level presented in Table 1 shows that 46% of the respondents had no formal education, 31.72% had primary education and 17.93% had secondary education and 4.83% had tertiary education. Education is one of the key variables needed to foster productivity in any profession. Ogundari (2006) noted that education is needed to enhance productivity among farming households in Nigeria. It is likely that good education propels farmers to adopt innovations and technologies that are vital to enhancing productivity. Njoku (1991) opines that the more educated a farmer is, the more the chances that he/she will utilize available opportunities and adopt innovations. Moreover, the results presented further show the respondents' mode of land acquisition. The results revealed that about 83% obtained their land through inheritance, and only 0.69% through purchase. This implies that the predominant mode of land acquisition in the study area is through inheritance. Olukosi and Erhabor (1988) stated that in some subsistence farming communities, pieces of land are acquired through inheritance, passed from one generation to another while others are either bought or rented. The mode of land acquisition can affect the farmer's decision about the use of farm land. For example, inheritance as a means of land acquisition may restrain farmers from planning a large-scale agricultural production since other members of the family also have right of ownership. Inheritance, on the order hand, may enhance the accessibility of resource - poor farmers to farm land since land is secured without paying for it.

Technical Efficiency of Rice Production under the NPFS in the Study Area

Maximum Likelihood Estimates (MLEs) for the production frontier are presented in Table 2. The sigma square (δ^2) and gama (γ) were estimated to be 0.36 and 0.99 respectively and were significant at 10% and 1% levels of probability respectively. The value obtained for sigma square was significantly different from zero at 1%, indicating a good fit and the correctness of the specified distributional assumption. The value of gamma (0.99) implies that about 99% of the variation of output from the frontier was due to technical inefficiency of the farmers, Thus, it can be inferred that rice production under the NPFS is not technically efficient. The coefficient obtained for farm size (0.702) was positive and significant at 1%, implying that increase in farm size would lead to an increase in output of rice. This result is similar to result obtained by Muhammad-Lawal *et al,* (2009) in their study on technical efficiency of youths participating in agricultural programme in Ondo State. They reported that farm size was positive and significant at 1% level of probability. Furthermore, the parameter estimate for seed was positive and significant at 1%, implying that an increase in quantity of seed would increase the output of farmers. This finding agrees with the report of Okoruwa and Ogundele (2006) in their work on technical efficiency differentials in rice production technologies in Nigeria. They reported that the coefficient of seed was positive and significant at 5% level of probability for traditional technology. Also, the coefficient obtained for labour was also positive and significant at 1% level of probability. This agrees with the findings of Amaza and Maurice (2005) who reported that labour was positive and significant at 1% level of probability.

The estimated coefficient obtained for fertilizers was positive and significant at 1%. This result is in line with the findings of Adejoh (2009) who reported that coefficient of agro-chemicals, particularly fertilizer was positive and significant among yam farmers in Kogi State. Amaza and Maurice (2005) reported from their work on the identification of factors that influence technical efficiency in rice-based production system in Nigeria that the positive coefficient of fertilizer usage would result in increase in output level of rice farmers. Oladebo and Fajuyigbe (2007) also reported in their work on technical efficiency of women upland rice farmers in Osun State of Nigeria that fertilizers significantly increased output in upland rice cultivation.

Table 2: Maximum likelihood parameter estimates of stochastic frontier production function

Variable	Coefficient	Std. Error	t-ratio
Constant (β_0)	2.515***	0.159	15.79
Farm size (β_1)	0.702***	0.059	11.985
Seed (β_2)	0.154***	0.026	5.924
Labour (β_3)	0.128**	0.044	2.900
Fertilizer (β_4)	0.085***	0.035	2.428
Agro-Chemicals (β_5)	0.053	0.055	0.961
Sigma (δ^2)	0.362**	0.211	1.716
Gamma	0.998***	0.012	83.14

Source: Computer Data Analysis *** P<0.01 and ** P<0.05.

Distribution of Technical Efficiency of Rice Production under the NPFS

The results in Table 3 show the distribution of technical efficiency of rice farmers in the study area. The mean technical efficiency was estimated to be 0.82, implying that the shortfall in the output of rice is 18% to achieve the maximum technical efficiency. Thus, opportunity still exists for increasing farmers' productivity through increasing efficiency in the use of existing resources. The minimum and maximum technical efficiencies were 32 and 99% respectively. About 88 percent of the farmers had technical efficiency index of 70 percent and above. The results also indicate that for the average farmer in the study area to achieve technical efficiency of his most efficient counterpart, they would have to realize about 18% [1-(82.8/99) x 100] cost savings while the least technically efficient farmer will have 68% [1-(0.319/0.99) x100] cost savings to become the most efficient farmer. Muhammed-Lawal *et al.* (2009) reported the minimum and maximum technical efficiency of 32.62 and 96.25% respectively and the mean technical efficiency of 85.23%. They said that if efficiency of input usage is increased by 14.77%, the farmers would be operating in the production frontier.

Table 3: Frequency distribution of technical rice production under NPFS farmers

Efficiency	Frequency	Percentage
0.30-0.39	3	2.07
0.40-0.49	3	2.07
0.50-0.59	4	2.76
0.60-0.69	8	5.52
0.70-0.79	30	20.69
0.80-0.89	39	26.90
0.90-0.99	58	40.00
Total	145	100.00
Mean technical efficiency = 0.824	Minimum technical efficiency = 0.319	
Max technical efficiency = 0.990		

Source: Computer Data Analysis

Determinants of Technical Inefficiency in Rice Production under the NPFS

Table 4 shows the determinants of technical inefficiency in rice production under NPFS in the study area. The coefficient of age was found to be negative but not significant. The negative sign only denotes that as age of the farmer increases, the technical inefficiency decreases. The coefficient obtained for education was negative and showed a significant relationship with technical inefficiency at 5% level. The negative coefficient of education reveals that a high level of education results in a reduction in technical inefficiency of rice farmers. Kalirajan and Shard (1985) noted that education sharpens managerial input and leads to a better assessment of the importance and complexities of good decisions in farming.

The coefficient of household size was negative but not significant. The estimated parameter for the amount of credit received was negative and significant at 1%. The negative sign of this variable indicates that an increase in the amount of credit received decreases the technical inefficiency. This is in line with the findings of Ogunyinka and Ajibefun (2003) in their study on determinants of technical inefficiency of farm production among farmers in Ondo state. They found that farmers' access to credit had a coefficient of -0.037 and is statistically significant at 1%. Farmers' access to credit enhances the timely acquisition of production inputs that would enhance productivity.

Table 4: Estimated determinants of technical inefficiency

Variable	Coefficient	Std. Error	t-ratio
Constant	1.066**	0.478	2.230
Age	-0.045	0.028	-1.644
Education	-0.129**	0.075	-1.739
Household size	-0.026	0.025	-1.036
Farming experience	0.014	0.011	1.297
Membership of cooperative	0.018	0.022	0.796
Access to credit	-0.088***	0.027	-3.259
Extension contact	0.0016	0.0049	0.339

*** P<0.01 and ** P<0.05.

CONCLUSION

Based on the findings of this study, it is revealed that there is room for improvement in the technical efficiency by adopting the techniques and technologies used by the most efficient farmers in the study area. This is because the mean technical efficiency was estimated to be 82% implying that farmers were not on the production frontier. Education, and access to credit were the socio-economic characteristics of farmers influencing the technical inefficiencies of the farmers. Agricultural policies that will improve the capacity of farmers to apply the available technologies more efficiently could be implemented particularly by raising the educational level of farmers. Inputs like seeds and fertilizers were some of the major inputs influencing the output of rice production in the study area. Thus, farm inputs such as improved rice seeds and fertilizers distribution should be strengthened to support timely supply at affordable prices to the farmers. Land use and accessibility reforms should also be looked into to make land available to counter the prevalent rice production-constraining access by inheritance.

REFERENCES

Abedullah, S.K. and Khalid, M. (2007). Analysis of technical efficiency of rice production in Punjab (Pakistan): Implications for future investment strategies. *Pakistan Economic and Social Review*, 45(2): 231-244

Adejoh, S.D. (2009). Analysis of production efficiency and profitability of yam production in Ijumu local government area of Kogi state, Nigeria. B.Sc. Project Report, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University Zaria, Nigeria.

Adejoh, E.U. (2014). Economic evaluation of rice production under the National Programme for Food Security (NPFS) in the Federal Capital Territory, Abuja, Nigeria. An MSc Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Amaza, P.S. and Maurice, D.C. (2005) Identification of factors that influence technical efficiency in rice-based production systems in Nigeria. A paper presented at workshop on policies and strategies for promoting rice production and food security in Sub-Sahara Africa, Cotonou (Benin).

Federal Ministry of Agriculture and Water Resources/Food and Agricultural Organization (2004). *National Special Programme for Food Security (NSPFS). The Journey So Far.* Produced by projects coordinating unit, Federal Ministry of Agriculture and Water Resources, Abuja and Food and Agricultural Organization, the United Nations, Abuja.

Food and Agriculture Organization FAO (2017). Nigeria at a glance. Online document Accessed at: http://www.fao.org/nigeria/fao-in-nigeria/nigeria-at-a-glance/en/. Visited on 18/10/2017

Hauser, E. (2003). *The WTO Food Security and Poverty Reduction: A Contradiction in Term*? 2nd Edition. Agriculture and Rural Development, pp 8 - 11.

Kalirajan, K.P. and Shard, R.T. (1985). Types of education and agricultural productivity. A quantitative analysis of Jamil Nadu rice farming. *Journal International Development Studies*, (21): 232–243.

Kebede, T.A. (2001). Farm household technical efficiency: Stochastic frontier analysis, study of rice producers in Mardi watershed in the Western Development Region of Nepal. Master's thesis, Department of Economics and Social Sciences, Agricultural University of Norway.

National Population Commission, NPC (2006). *Provisional Census Results, Abuja, Nigeria.*

Njoku, J.E. (1991). Factors influencing adoption of improved oil palm production technologies by small holders in Imo state of Nigeria. *In*: Olukosi, J.O., Ogungbile, A.O. and Kalu, B.A. (eds.) (1991) *Appropriate Agricultural Technologies for Resource Poor Farmers, National Farming Systems Research Network.* PP 207-208.

Muhammad-Lawal, A. Omotesho, O. A. and Falola, A. (2009). Technical efficiency of youth participation in agriculture programmes in Ondo state, Nigeria. *Nigeria Journal of Agriculture Food and Environment* 5(1): 20-26

Ogundari, K. (2006). An examination of technical, economic and allocative efficiency of small farms. The case study of cassava farmers in Osun state of Nigeria. *Journal of Central European Agriculture*, **7**(3): 430-432

Ogunyinka, E.O. and I.A. Ajibefun (2003). Determinants of technical inefficiency of farm production: Tobit Analysis approach to the NDE farmers in Ondo state, Nigeria. *International Journal of Agriculture and Biology*, 6 (2): 355-358.

Ojeleye, O.A. (2015). Analysis of farm household and community food security in Kaduna state, Nigeria. PhD Dissertation, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria.

Okoruwa, V. O. and Ogundele, O. O. (2006) Technical efficiency differentials in rice production technologies in Nigeria. *African Economic Research Consortium, Research Paper N*o. 154.

Oladebo, J.O. and Fajuyigbe, A.A. (2007). Technical efficiency of women upland rice farmers in Osun state, Nigeria. *Journal of Human Ecology*, 22(2):93-100

Olukosi, J.O. and Erhabor, P.O. (1988). *Introduction to Farm Management Economics: Principles and Applications*, Agitab Publishers Limited, Zaria.

Oyebanji, O.O. (2005). *Food Security Situation in Nigeria.* Held at Cafston – Durbar Hotel Kano 26th to 27th May.

Villano, A. R. (2005), Technical efficiency of rainfed rice farms in the Philippines: A stochastic frontier production function approach. Working Paper, School of Economics, University of New England, Armidale, NSW, 2351.

Wadud, M.A. (1999), Farm efficiency in Bangladesh. Ph.D. Thesis, Department of Agricultural Economics and Food Marketing, University of Newcastle Upon Tyne, UK.