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FACTOR PRODUCTIVITY AND TECHNICAL EFFICIENCY IN SWAMP RICE PRODUCTION SYSTEM IN EBONYI STATE: *A STOCHASTIC FRONTIER APPROACH*

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ABSTRACT

The study examined factor productivity and technical efficiency of swamp rice farmers in Ohaukwu Local Government Area of Ebonyi State. A purposive random technique was employed in selecting 180 rice farmers. A stochastic frontier production function was used to estimate technical efficiency. The study further assessed the factors that affect technical efficiency of the rice farmers. All the coefficients were found to have positively influenced swamp rice productivity. However, the swamp rice farmers were technically inefficient in the use of their productive resources. The mean level of efficiency of rice farmers was found to be 0.731, whereas the analysis of factor productivity of swamp rice farms revealed a mean estimate of 2.42. The study further found that farming experience, educational level and household size were important determinants of technical efficiency. Furthermore, it was found that swamp rice production was dominated. Swamp rice production was also found to be profitable as revealed by the gross margin and net farm income per hectare of ₦184,674.00 and ₦161,469.50 respectively. The major constraints to swamp rice production in the study area included lack of access to farm credit, poor road networks, land tenure problems, poor marketing system, inadequate supply of inputs, pest and disease infestations. The study therefore recommended policies that will encourage the Local Council Authorities to tackle the issue of rural infrastructures especially the feeder roads and market structures. There is need for farmers groups and related associations to liaise with relevant government agencies and financial

ISSN: 2455-6939

Volume:02, Isuue:03

institutions on ways and means of finding lasting solution to the issues of farm credit and input supply.

Keywords: Factor Productivity, Technical Efficiency, Stochastic Frontier Approach, Swamp Rice

INTRODUCTION

Rice is the seed of the monocot plant *Oryza sativa* of the grass family Gramineae (Kuldeep, 2006). It is possibly the world's most vital food crop being the staple food of over 2.6 billion people in the world (FAO, 2006). Rice cultivation is the primary activity and cradle of income for millions of households around the world. Several countries of Asia and Africa are extremely reliant on rice as foundation of foreign exchange earnings and government revenue (Rice Trade, 2011).

In Nigeria, rice is the fourth major cereal crop after sorghum, millet and maize, in terms of output and cultivated land area (Babafada, 2003). It is a key staple and most prevalent cereal crop of abundant nutritional value grown and consumed in all ecological zone of the country (Ohaka et al., 2013; Omotesho et al., 2010; Raufu, 2014; Ohajianya and Onyenweaku, 2003; Ajah and Ajah, 2014 and Abdullahi, 2012). Rain-fed lowland rice is the most predominant rice production system in Nigeria, accounting for nearly 50% of the total rice – growing area in Nigeria; 30% of production is rain-fed upland rice, while just 16% is high yielding irrigated system (Rice Data System in Nigeria, 2012).

The demand for parboiled rice forced the government to commit N600 million in foreign exchange to milled rice imports in 1985 and the imposition of a ban on rice imports in order to facilitate and increase local production on the precious grain and to meet the high demand for the product (Moses, 2012). However, in 1995, the import ban was lifted as the local supplies, although showing improvement could not meet the demand for the commodity. Therefore, the lifting of the ban resulted in incessant importations and not being affected by duty hikes (Osagie, 2014; FMARD, 2013).

According to Olayide, et. al., (1982) agricultural productivity is an index of the ratio of farm output to the value of the total inputs used in producing the output. Thus optimal productivity of resources implies an efficient utilization of resources in production process, while Odii (1998) opined that technical efficiency is a ratio of total output to total input. It is the ability to achieve a higher level of physical output given a small level of production input.

ISSN: 2455-6939

Volume:02, Isuue:03

Despite the place of rice in contributing to the food supply in Nigeria, Its production is still put at 3.2 million tonnes (Babafada, 2003; Ohaka et al., 2013). This has shown to be far below the national requirement as over 600 million dollars' worth of rice is imported annually into the country (Adeoye, 2003; Ohaka et al., 2013; Raufu, 2014; Abdullahi 2012, Omofesho, 2010).

However, several studies have been conducted on rice such as Shehu et al.(2007); Tashikalma(2011) and Moses(2012) considered rain-fed and irrigated rice production and not Swamp rice production. It is believed that the productivity of the farmers in general and swamp rice farmers in particular could be enhanced through enhancing their technical and allocative efficiency, assessing their level of profitability visa-vis their socio-economic characteristics in response to better information and education (Idiong, 2006). Hence the need to investigate the technical efficiency of the swamp rice farmers using stochastic frontier approach and also to estimate the factor productivity. Moreover, the recommendations made will go a long way in helping the farmers and the government take decisions and make policies beneficial to the production of swampy rice in Ohaukwu Local Government Area of Ebonyi State and Nigeria as a whole.

Objectives of the study

Specifically, this study was designed to examine the socio economic characteristics of the swamp rice farmers; determine the costs and returns associated with swampy rice production; identify the determinants of technical efficiency, estimate the technical efficiency and factor productivity in swamp rice production system in Ohaukwu LGA. of Ebonyi State- Nigeria.

Hypothesis Tested

H_{01}: Rice farmers in the study area are technically inefficient.

Methodology

The study was conducted in Ohaukwu Local government area (L.G.A) of Ebonyi State. The L.G.A is made up of ten communities namely; Izhia, Emezaka, Amoffia, Ekwashi, Ukwagba, Okposi-Eheku, Okposhi-Eshi, Umuogudu-Akpu, Umuogudu-Ishia and Effium. The study area has an approximated population of about 196,337 people (NPC, 2006). Its boundaries are formed by Abakaliki L.G.A on the North East, Benue State on the North West and Ishielu L.G.A on the West. The soil type is a well-drained sandy soil, which supports the growing of cassava, yam and few other arable crops like; groundnut, rice, tomatoes, melon, potatoes as well as tree crops like oil palm, oranges, mangoes, etc.

ISSN: 2455-6939

Volume:02, Isuue:03

Method of Data Collection

Data used for the study were sourced mainly from primarydata. Primary data were collected using structured questionnaire administered to the plantain farmers in the study area. Purposiverandom technique was used in the study. Out of 10 communities in Ohaukwu L.G.A, 6 were purposively selected for the study. The farmers who grew swampy rice in the selected communities were known and identified. For instance, 30 swampy rice farmers were randomly selected from each of the 6 communities. This gave a total of one hundred and eighty (180) respondents.

Method of Data Analysis

Descriptive statistical tools such as frequency counts, percentages and means were used to describe the data collected, while inferential statistical tools such as stochastic frontier model, budgetary technique and total factor productivity indices were also employed to analyze the data for the study.

Model Specifications

Stochastic Frontier Model:

Review of literature showed that Cobb Douglas and Translog production functions are the extensively used techniques in agriculture. However, Translog production function specification suffers from multicollinearity problem as a result of the square and interaction terms of the inputs used (Hussain et al., 2012). The stochastic frontier model can be specified as:

$Yi=f(Xi;\beta)+Vi-Ui$ --- eqn 1

Where Yi is output (or logarithm of production) of the i^{th} farm,

Xi is the vector of input quantities used by the i^{th} farm,

β is a 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 unsystematic variations in output due to factors beyond the control of the farmer; examples are weather, disease outbreaks and measurement errors. The term Ui is a non- negative random variable representing inefficiency in production relative to the stochastic frontier. The random error Vi is assumed to be independently, and identically distributed as $N(o, \sigma^2v)$ random variables independent of the Ui's

ISSN: 2455-6939

Volume:02, Isuue:03

which are assumed to be non-negative truncation of the $N(o,\sigma^2u)$ distribution (i.e half-normal distribution) or half-exponential distribution.

Technical Efficiency (T.E) model is thus:

$T.E = Yi / Yi^* = f(Xi; \beta) \exp(Vi-Ui)/f(Xi; \beta) \exp(Vi) = \exp(-Ui)$ ___________eqn 2

This production function is used in the measurement of efficiency in production. Technical efficiency (TE) is defined in terms of the observed output relative to production frontier, given the available technology, such that $0 \leq TE \leq 1$.

The production technology of swampy rice farmers in Ohaukwu L.G.A of Ebonyi State is presumed to be quantified by the cobbdouglas frontier production function as follows:

$\text{In } Y = \beta_o + \beta_1 \text{In}X_1 + \beta_2 \text{In}X_2 + \beta_3 \text{In}X_3 + \beta_4 \text{In}X_4 + Vi\text{-}Ui$ --------------------------------eqn 3

Where: Y = Swampy Rice Output (Kg),

X_1 = Farm size (hectare)

X_2 = Labour cost (₦)

X_3 = Fertilizer application in kg

X_4= Seed input in kg

X5= Credit (₦)

β_o is the intercept, $\beta_1,\ldots,\beta_4$ are regression parameters to be estimated;

Vi = symmetric error.
Ui = a non-negative random variable representing the inefficiency in production relative to stochastic frontier.

The determinants of technical efficiency were modelled in terms of farmer characteristics using stochastic frontier model in a single stage maximum likelihood estimation procedure using the computer software Frontier version 4.1 (Coelli, 1996).

$TEi = a_o + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + a_6Z_6 + ei$----------------------------eqn 4

Where TEi is the technical efficiency of the ith farmer,

Z_1= farmers' age (years),
Z_2 = sex of farmers (Dummy variable: 1 = male, 0 = female),
Z_3 = farming experience (years),

ISSN: 2455-6939

Volume:02, Isuue:03

Z_4 = farm income,
Z_5 = educational level, (years),
Z_6 = farm size (Ha),
Z_7 = household size (Number of persons).
ei = Error term

While; a_0 is the intercept; $a_{1,..}$ a_6 are parameters to be estimated.

Stochastic frontier production functional form is used in this study because the coefficients estimated directly represent elasticity of production (Abedullah and Ahmad, 2006). Moreover, it has been widely applied in estimating farm efficiencies (Kalirajan and Shand, 1986; Onyenweaku and Ohajianya, 2005; Hussein et al, 2012, Samuel and Kelvin, 2013).

Total Factor Productivity (TFP)

Following Key and Mcbride (2005), total factor productivity (TFP) is measured as the inverse of unit cost. This is so since TFP is the ratio of the output to the total variable cost (TVC).

Average productivity = $\frac{Y}{Xi}$……………………………………………………............... eqn 1
Marginal productivity = $\frac{\partial Y}{\partial Xi}$……………………………………………………..............eqn 2
TFP = $\frac{Y}{TVC}$……………………………………………………..eqn 3
Where Y = quantity of output and TVC = Total variable cost
TFP = $\frac{Y}{\sum Pi\, Xi}$ (i = 1,2,…n) ………….……………………………................................ .eqn 4

Where Pi = unit price of i^{th} variable input and Xi = quantity of i^{th} variable input. This methodology ignores the role of total fixed cost (TFC) as it does not affect both the profit maximization and the resource-use efficiency conditions. In any case since it is fixed, then it is a constant.

The Gross Margin Analysis

The gross margin analysis was employed to determine the overall gross margin per hectare and net farm income (NFI) per hectare. The gross margin and net farm income were estimated as equations (9) and (10)

GM = TR – TVC……………………….. eqn9
NFI = GM – TFC………………………… eqn10

Where;

GM = Gross Margin (₦)
TR= Total Revenue (₦)
TVC = Total Variable Cost (₦)
NFI = Net Farm Income (₦)
TFC = Total Fixed Cost (₦)

RESULTS AND DISCUSSIONS

Socioeconomic characteristics of the farmers in the study area

Table 1: Distribution of Respondents According to Socioeconomic Characteristics.

Gender	Frequency	Percentage
Male	124	69
Female	56	31
Age of the farmers (yrs)		
Less than 20	-	-
20-30	18	10
31-40	90	50
41-50	45	25
51-60	18	10
Above 61	9	5
Marital Status		
Singled	14	8
Married	126	70
Divorced	13	7
Widowed	27	15

ISSN: 2455-6939

Volume:02, Isuue:03

Household Size		
1-3	36	20
4-6	92	51
7-9	38	21
10-13	9	5
13 and above	5	3
Educational Status		
No formal Education	90	50
Primary Education	54	30
Secondary Education	22	12
Tertiary Education	14	8
Participation		
Full time farming	126	70
Part time farming	54	30
Farm size (Ha)		
Less than 1	-	-
1.1-2.0	36	20
2.1-3.0	108	60
3.1-4.0	18	10
Above 4.0	18	10
Farmers Income (₦)		
Less than 20000	9	5

ISSN: 2455-6939

Volume:02, Isuue:03

21000 to 30000	18	10
31000 to 40000	27	15
41000 to 50000	18	10
51000 to 60000	51	28
Above 60000	57	32
Farming Experience (yrs)		
Less than 5	14	8
5-9	36	20
10-14	52	29
15-19	58	32
20-24	11	6
25-29	9	5
Above 29	-	-
Total	**180**	**100.0**

Source: Field Survey, 2015

The socio-economic characteristics of swamp rice farmers directly or indirectly affect their farming operations as presented in table 1. The analysis of the results revealed that majority of the swamp rice farmers were mostly males (69%) and that most of the respondents fell within the age group 31 – 50 years which was about 75% of the total sample, with a mean of 33years.This finding is consistent with the findings of Ohen and Ajah, (2015), who found that the mean age of rice farmers in their study area was 35years. This implied that the rice farmers are active and are in their prime and are more mentally alert to embrace new techniques of swamp rice production. The result also showed that 70% of rice farmers were full time farmers and that rice farming has been a long time practice amongst the farmers in the study area which on the average was 13 years. There was high level of illiteracy in the study area, majority (50%) had no formal education while only 8% had tertiary education. Lastly, the result showed that farmers in the study area were small –scale farmers with an average of 2.65 hectares and this small farm size make mechanization difficult thereby limiting output of swamp rice to

ISSN: 2455-6939

Volume:02, Isuue:03

subsistence level leaving little for commercial. Also, Ibitoye et. al., (2012) confirmed that (53.00%) of rice farmers in Ibaji cultivated between 1-3 hectares. Moreover, the mean household size is 6 persons. This agrees with the findings of Tashikalma et. al., (2014) that the mean household size of swamp rice farmers is 6 persons, a repository of labour for production activities. Also, the mean farm income was N49,767.

COST AND RETURN ANALYSIS OF SWAMP RICE PRODUCTION SYSTEMS

Table 2: Cost and Returns of swamp rice production/ha in the Study Area

ITEM	Amount in Naira (₦)
Total value of production (revenue)	242,654
Variable Cost	
Planting material	28800
Fertilizer	20000
Labour	9180
Total variable cost	**57980**
Fixed costs	
Depreciated cost of capital inputs	21095
10% contingences of fixed cost	2109.5
Total fixed cost	**23204.5**
Total cost	**81,184.5**
Gross margin	184,674
Net farm income	161,469.5
Profit Margin %	87.97%

Source: Field Survey, 2015

ISSN: 2455-6939

Volume:02, Isuue:03

Table 2 shows the estimated costs and return of swamp rice farmers cultivating 1 hectare on the average were ₦81,184.5 and ₦242,654 per annum, respectively. Among the cost components, cost of planting material input had the largest share of the total cost (49.67%), followed by fertilizer (34.49%), while labour inputs (15.83%) had the lowest share. The gross margin and net farm income on the average for swamp rice farmers was ₦184,674 and ₦161,469.5 respectively. The profit margin percentage was 66.54%. These measures of performances indicate that swamp rice production in the study area is viable and profitable.

Maximum likelihood Estimates for Swamp Rice Farms

Table 3 shows the maximum likelihood estimates for expected parameters of the Cobb Douglas based stochastic production frontier functions for swamp rice production systems.

Table 3: Maximum Likelihood Estimates (MLE) of the Stochastic Production Function for Swamp Rice Production in Ohaukwu L.G.A of Ebonyi State

Variable	Coefficient	Standard error	T – ratio
Constant	5.324	0.376	14.149
Farm size (X_1)	0.355*	0.126	2.826
Labour cost (X_2)	0.234*	0.098	2.391
Fertilizer application (X_3)	0.199*	0.085	2.354
Seed input (X_4)	0.353**	0.091	3.866
Credit (X_5)	0.187	0.139	1.345
Log-likelihood function	-107.7390		
Gamma (γ)	0.935**	0.242	3.864
Sigma-squared (σ^2)	2.416**	0.772	3.129

Lamda (λ)	4.205**	1.115	3.771

**,significant at 1 % ; * significant at 5 %.
Source: Field survey, 2014

The results in Table 3 show the Maximum Likelihood Estimates (MLE) of the stochastic frontier for swamp rice farmers in the study area. As indicated in the Table 3, the estimated variance (σ2) was significant at 1 percent level indicating goodness of fit and correctness of the specified distribution assumption of the composite error term. Besides, the variance of the non-negative farm effects is a small proportion of the total variance of rice output. The estimated value of the gamma (γ) was also significant at 1 percent level. The gamma (γ) value of 0.935 for swamp rice farmers implies that systematic influences that are unexplained by the production function are the dominant sources of random errors or fluctuation in the yield of swamp rice farms, indicating that only 94% of the total variation in swamp rice output is due to technical inefficiency. The variance ratio parameter, Lamda (⋋) is estimated at 4.205 and it is statistically significant at 1% level, implying that variation in actual swamp rice output from maximum swamp rice output between swamp rice farms mainly arose from differences in farmer practices rather than random variability. The generalized likelihood ratio is significant at 1 percent level, implying the presence of one sided error component.

However, the coefficients of farm size (X_1), labour cost (X_2), fertilizer application (X_3) and seed input (X_4) have the expected positive a priori signs414and are statistically significant at 1 % and 5 % level showing undeviating relationship with swampy rice output. Though credit (X_5) coefficient was positive, it is shown to be insignificant even at 10 per cent level.

Elasticity of Production and Return to Scale

Table 4: Elasticity of Production and Return to Scale of Swamp Rice Production in the Study Area

Variables	Elasticity
Farm size (X_1)	0.355
Labour cost (X_2)	0.234
Fertilizer application (X_3)	0.199
Seed input (X_4)	0.353

Credit (X_5)	0.187
Returns to scale (RTS)	**1.328**

Source: Field Survey, 2014

The estimated coefficients of a Cobb Douglas production function can be directly interpreted as elasticity of production. Therefore the overall estimated elasticity of the swamp rice output with respect to production input variables: farm size, labour, fertilizer, seed and credit is 1.328 as shown in table 4 above. Thus an indication of an increasing return to scale and that swamp rice production was in stage 1 of the production surface. These implies that the level of input used in the production of swamp rice should be reduced.

Farmers' Level of Efficiency in Swamp Rice Production.

Table 5: Distribution of Farmers According to Level of Efficiency in Swamp Rice Production in the Study Area

Efficiency range	Frequency	Percentage
0.51 – 0.60	18	10.00
0.61 – 0.70	25	13.89
0.71 – 0.80	109	60.56
0.81 – 0.90	20	11.11
0.91 – 1.00	8	4.44
Total	**180**	**100**

Mean TE: 0.731; Minimum TE: 0.523; Maximum TE: 0.964
Source: Maximum Likelihood Estimates (MLE) from Field Survey, 2014

Technical efficiency of individual swamp rice farmers was presented in Table 5. The content of table 5 showed that the individual technical efficiency indices ranged between 0.523 and 0.964 with a mean of 0.731. While 61 % of the farmers attained between 0.71 and 0.80 efficiency levels, only 4 % attained a technical efficiency level of between 0.91 and 1.00. However, none of the respondents attained less than 0.50 efficiency levels. Thus, this result on technical efficiency of swamp rice farmers implies that the swamp rice farmers are technically inefficient in resource

ISSN: 2455-6939

Volume:02, Isuue:03

utilization since the overall technical efficiency index was less than 1.00. Therefore, the hypothesis which states that swamp rice farmers in Ohaukwu Local Government Area of Ebonyi State are technical inefficient in resource use is hereby accepted. The mean technical efficiency of 0.731 obtained in this study implied moderate level of technical efficiency in resource use and is consistent with the low variance of the farm effects in the study area.

Determinants of Technical Efficiency

Table 6: Maximum Likelihood Estimates of Determinants of Technical Efficiency of Swamp Rice farmers in the study area.

Variable	Estimates	T – ratio
Constant	18.7118	7.472
Farmers' age (Z_1)	-0.054**	-3.646
Sex of farmers (Z_2)	-0.076	-1.221
Farming experience (Z_3)	0.289*	2.513
Farm income (Z_4)	1.007	0.821
Educational level (Z_5)	0.310*	2.490
Farm size (Z_6)	-0.028**	-3.130
Household size (Z_7)	0.721**	3.695

**; * Estimates are significant at 1 % and 5 % respectively.

Source: Field survey, 2014.

The estimated determinants of technical efficiency among rice farmers in Ohaukwu Local Government Area of Ebonyi State are presented in Table 6, the coefficients of farming experience (Z_3), educational level (Z_5) and Household size (Z_7) were positive and statistically significant at 1 % and 5 % level of confidence, indicating a direct relationship with technical efficiency, while the coefficients of age (Z_1) and farm size (Z_6) was negative and significant at 1% level of confidence, indicating an inverse relationship with technical efficiency. These results imply that these variables are the determinants of technical efficiency of swamp rice farmers in Ohaukwu Local Government Area of Ebonyi State.

The coefficient of age (Z_1) was negative and highly significant at 1 %, implying that the older the farmer becomes the less his/her technical efficiency in swamp rice production. This result agrees with Okoye et al., (2008) who found out that ageing farmers would be less energetic to work.

The coefficients for farming experience (Z_3) was positive and significant at 10 % level of confidence. This agrees with apriori expectations that increase in years leads to increase in technical efficiency. This also agrees with Onyenweaku and Nwaru, (2005) who found out that farming experience had a direct relationship with technical efficiency. The coefficient of educational level (Z_5) was positive and significant at 10 %, implying that higher education leads to improvements in technical efficiency of swamp rice farmers.

The coefficient of farm size (Z_6) was negative and highly significant at 1 %, indicating that increase in farm size will lead to decrease in technical efficiency. This shows that smallholder swamp rice farmers could be more efficient in resource allocation than large scale farmers and do not require advance farm management knowledge, which could be lacking among smallholder farmers. Moreover, it agrees with the findings of Hazarika and Subramanian (1990); Edeh and Awoke (2011), that if farm size is small, farmers are able to combine their resources efficiently.

The coefficients of households' size (Z_7) was positive and highly significant at 1 % level of confidence. This shows that household with large household size are likely to be more technically efficient than their counterparts with smaller household size. Large household size is a source of labour for most farm operations, as noted by Effiong (2005).

Total Factor Productivity (TFP) Estimates

Table 7: Frequency distribution of Total Factor Productivity Indices of Rice Farms

TFP Indicies	Frequency	Percentages
1.0 – 2.0	98	54.44
2.1-3.0	35	19.44
3.1-4.0	19	10.56
4.1-5.0	23	12.78

ISSN: 2455-6939

Volume:02, Isuue:03

5.1-6.0	5	2.78
Total	180	100
Mean	**2.42**	

Source: Field survey, 2014

The Table 7 indicates that the swamp rice farming system has an average TFP value of 2.42. Majority (54 %) of the swamp rice farms fall between 1.0-2.0 productivity indice levels, while the minority (3 %) of the swamp rice farms fall between 5.1-6.0 productivity indice levels. This implies that the swamp rice farmers in the study area do not use their scarce resources efficiently. However, a lower total factor productivity for the swamp rice farms is implied since it has a higher average variable cost that stems from output per resource use ratios. Thus the need for a reduction in total variable cost per output.

Constraints Associated with Swamp Rice Production in the Study Area.

Table 8: **Distribution of respondents according to perceived constraints militating against swamp rice production in the study area.**

Problems	**Frequency**	**Percentages (%)**
Land tenure system	122	67.78
Pests and Diseases	99	55.00
Inadequate storage facilities	85	47.22
Lack of credit accessibility	127	70.56
Poor feeder and road	125	69.44
Lack of infrastructures	88	48.89
High cost labour	72	40.00
Poor market system	119	66.11
Inadequate supply of inputs	111	61.67
Total	***948**	

*Multiple responses recorded

Source: Field survey, 2014.

ISSN: 2455-6939

Volume:02, Isuue:03

The distribution of respondents with regards to the constraints militating against swamp rice production in the study area is presented in table 8. The result revealed that Lack of credit accessibility (70.56%), poor feeder and road (69.44%), land tenure problem (67.78%), poor market system (66.11%), inadequate supply of inputs (61.67%) and pests and diseases (55%) were major constraints experienced by the respondents in the study area.

CONCLUSION

The study showed that swamp rice farmers in the Ohaukwu L.G.A of Ebonyi State are technically inefficient in using the productive resources. Furthermore, the stochastic frontier function showed that increase in all the resources will lead to an increase in swamp rice output. However, it is shown that swamp rice farming in the study area is viable and profitable, although characterized by low productivity. The fact that swamp rice systems in the study area are characterized by increasing returns to scale may indicate that resources employed on the swamp rice farms could be better manage. Thus, raise swamp rice output per hectare. Farming experience, educational level and Household size were found to be important determinants of technical efficiency. The analysis of factor productivity of rice farms indicated that the swamp rice farmers operated at a total factor productivity (TFP) level of 2.42 on average. In the light of the study findings therefore, efforts at improving swamp rice efficiency and productivity for the Nigerian nation are steps in the right direction considering the low productivity and the increasing rate of returns to scale estimated for the swamp rice production systems

RECOMMENDATIONS

The following recommendations are made based on the findings of the study:

- Government policy should concentrate on how to encourage new entrants into swamp rice production and not necessarily increase in farm size.
  This recommendation flows from the negative significance of the farm size, which revealed that increase in farm size would lead to a decline in efficiency.

- There is need to encourage credit flow into small scale farm production through policy initiatives that address farmers' constraints in accessing farm credit.
  This can be achieved by strengthening and reorganizing the micro-credit schemes to be able to deliver by solving farmers' credit and timely input supply problems.

- The study showed that increasing age of farmers would lead to decline in their efficiency. It is therefore recommended that government policy should focus on ways of

ISSN: 2455-6939

Volume:02, Isuue:03

enticing and inspiring the youths who are active and resilient in order to elevate the current level of efficiency.

Most of the swamp rice farmers were illiterates but had to depend on their many years of experience. Thus affecting their productivity. Government policy on encouraging the youths to take swamp rice production should have a multidimensional approach and a suitable program on education.

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