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EFFICIENCY OF RESOURCE USE FOR RICE PRODUCTION ON INLAND VALLEYS OF CENTRAL AGRICULTURAL ZONE OF CROSS, RIVER STATE, NIGERIA.

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ABSTRACT

This study examined the efficiency of resources used by rice farmers on inland valleys of Central Agricultural zone of Cross River State, Nigeria during the 2019 rice cropping season. Primary data were used to conduct the study. The data were collected from 120 respondents with the aid of questionnaire using a multi-stage sampling procedure. Descriptive statistics, multiple regression analysis and the allocative efficiency index were used to achieve the objectives of the study. The descriptive statistics revealed that majority of the rice farmers (60.8%) were males, 60% were married, and 35% were within the age range of 31-40years, 82% had a family size of between 6-10persons, 82.5% had some forms of formal education, 37.5% had a rice farming experience of between 11-15 years, and 87% had a farm size of between 0.1-2 hectares. The multiple regression analysis revealed that the variable of farm size (X_1), farm capital (X_3), fertilizer (X_5) and herbicides (X_6) had positive and significant relationship with rice output. The allocative efficiency index revealed that rice farmers in the study area were not allocatively efficient as farm size, seeds, fertilizer and herbicides were all greater than one (1) which indicated that these productive resources were under-utilized. The study recommends that for rice farmers to increase their output level in the area, they need to employ more of the productive resources that have allocative efficiency index of greater than one.

KEY WORDS: Resource use, rice production, Inland valleys.

INTRODUCTION

Rice, *Oryza sativa* (Asian rice) or *Oryza glaberrina* (African rice) is the second most growing cereal in the world after maize and is grown normally as a seasonal crop, although in tropical areas it can survive as an annual crop (FMARD, 2010). Rice is eaten on daily basis worldwide. It is grown for many purposes other than human consumption alone, it is the most important grain with regards to human nutrition and caloric intake, providing more than one fifth of the calories consumed worldwide (Damola, 2010).

Nigeria has great potentials and wide area of land that could be cultivated for rice yet the area cultivated for rice still appears to be small. Significant improvement in rice was in 1980 when the output increased to one million ton, while area cultivated and yield rose to 550,000ha and 1.98ton/ha respectively. Throughout the 1980's rice

output and yield increased, but in the 1990's while rice output increased, the yield of rice declined, suggesting extensive area in rice cultivation but with low productivity (FAOSTAT, 2015).

Average yield of rice of between 1.0-1.5ton/ha in Nigeria is low compared to achievable yield of between 2.5-6.0ton/ha in China and Thailand FAO, (2012). These differences between the average yield and the achievable yield, has created the need for the importation of rice to fill the supply-demand gap over the years. USAID (2017) reported that Nigeria spent about 655 million US dollars on rice imports which accounted for about 40% of all cereal imports in 2016.

Since increased productivity is directly related to production efficiency, it is imperative to raise productivity of the small-scale rice farmers by helping them reduce technological inefficiency. This can be done through investigating the nature of resource productivity and inefficiency in production. The study will help farmers to efficiently allocate and utilize resources efficiently for optimum rice production per hectare on inland valleys of the Central Agricultural zone of the State.

METHODOLOGY

The study area is the Central Agricultural Zone of Cross River State, Nigeria. The zone lies between Latitudes 4^0 and 6^0 N and Longitudes 6^0 and 9^0 E (Essoka and Esu, 2003). It is bounded to the North by Yala and Ogoja local government areas, to the South by Biase local government area and Abia state, to the East by the Republic of Cameroon and to the West by Ebonyi state. It has a land mass of 8,762 square kilometers, with a rainfall of between 2,942mm to 3,424mm per annum and an average temperature of 29^0c (FMARD, 2010).

The Central Agricultural Zone comprises of six local government areas which are Abi, Boki, Etung, Obubra, Ikom and Yakurr. Essoka and Esu (2003) noted that this zone has extensive inland valleys and favours the growing of crops like yam, rice, maize, cassava, melon, pepper, vegetables and fruits. Cash crops like cocoa, oil palm and rubber are also grown. Abi, Obubra and Yakurr Local Government Areas however produce rice in greater quantities on inland valleys by small scale farmers than the other Local Government areas in the zone. Oniah and Okoye (2018) however opined that the timing, cultivation and harvesting of rice in the area is dependent on the climatic conditions experienced which means that the rice farming calendars is dictated by the major climatic variables of rainfall, temperature, relative humidity, sunshine and wind. Also, IPCC (2007) ascertained that climate variability and climate change are sources of risks to farmers because of the uncertainty surrounding the farming system, planning and management,

Sampling Procedure

A multi-stage sampling technique was used to select respondents for the study. The first stage was the purposive selection of rice farmers in the block known to produce rice on inland valleys in the zone. The local government areas are Abi, Obubra and Yakurr.

The second stage was the purposive selection of 12 communities from the cell in the three selected Local Government areas known to cultivate rice by small-scale farmers. The third stage involved the collection of the sample frame from the cell of all registered rice farmers through the extension agents in the local government areas selected. A proportionality factor of 10% was used to choose the sample size from the registered rice farmers given a total

of 120 rice farmers that were used as respondents for the study.

Table 1: Selection of respondents in the study area.

Local government (Block)	Village (Communities)	No. of registered rice farmers	No. of respondents (sample size)
Abi	Ekureku	80	8
	Akarefor	110	11
	Agbara	120	12
	Usumutong	100	10
Obubra	Oyadema	90	9
	Apiapum	100	10
	Ovonum	130	13
	Ofumbongha	150	15
	Ogurede	120	12
Yakurr	Asiga	80	8
	Idomi	50	5
	Mkpani	70	7
TOTAL	**12**	**1,200**	**120**

Source: Field Survey Data, 2019

Data collection and analysis

Data were collected primarily from primary sources. This was achieved through the use of structured questionnaire that was designed to capture the objective of the study. Personal interviews and field observations were made to ensure that the information supplied by the respondents were accurate.

Descriptive statistics was used to discuss the socio-economic characteristics of rice farmers; regression analysis was used to estimate the relationship between rice output and the productive resources, while the allocative efficiency index was used to measure the elasticity of production with respect to the input $x_{1....Xn.}$

The explicit forms of the models were;

Linear regression:

$Y=bo + b_1x_1+b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6$ ut…… (i)

Semi-log:

$y=logbo + b_1logx_1 + b_2logx_2 + b_3logx_3 + b_4logx_4 + b_5logx_5 + b_6logx_{6+}$ ut.....(ii)

Double log (Cobb- Douglas):

$logy=logbo + b_1logx_1 + b_2logx_2 + b_3logx_3 + b_4logx_4 + b_5logx_5 + b_6logx_{6+}$ ut ...(iii)

Resource-use Efficiency

The allocative efficiency index was used to determine the resource productivity of the rice farmers expressed thus:

$$AEI = \frac{MVP}{MFC}$$ .....(iv)

Where:

AEI = Allocative efficiency index

MFC = Marginal factor costs.

MVP = Marginal value product, given as:

$MVP = MPP \times P_y$

MPP = Marginal physical product, given as,

$MPP = b_1 \times APP$

APP = Average physical product, given as,

$$APP = \frac{\hat{Y}}{X_a}$$

Where, $\hat{Y}$ = mean of output,

P_y = price of output, and

b_1 = regression coefficients

X_a = mean of factor inputs

Also, the inputs and output prices were taken based on the prevailing market prices in the study area during the 2019 rice cropping production season. Accordingly, land rent was taken at N4,500.00 per hectare per year, labour wage rate at N1,500.00 per man-day, cost of seeds at N100.00 per kg, cost of fertilizer at N98.00 per kg, cost of herbicides at N900.00 per litre and output price at N380.00 per kg of rice paddy.

RESULTS AND DISCUSSION

Table 2: Socio-economic characteristics of the small-scale rice farmers

VARIABLES	FREQUENCY	PERCENTAGE (%)
GENDER		
Male	73	60.8
Female	47	39.2
Total	**120**	**100**
MARITAL STATUS		
Single	18	15.0
Married	72	60.0
Divorced	7	5.8
Widow	8	6.7
Widower	15	12.5
Total	**120**	**100**
AGE (years)		
20 – 30	28	23.3
21 - 40	42	35.0
41 - 50	33	27.5
Above 50	17	14.2
Total	**120**	**100**
FAMILY SIZE (number of persons)		
2 – 5	26	21.7
6 – 10	82	68.3
Above 10	12	10.0
Total	**120**	**100**
EDUCATIONAL LEVEL (years)		
Never attended school	21	17.5
Primary school	34	28.3
Secondary school	43	35.8
Tertiary institution	22	18.4
Total	**120**	**100**
FARMING EXPERIENCE (years)		
1 – 5	12	10.0
6 – 10	24	20.0
11 – 15	45	37.5
16 – 20	29	24.2
Above 20	10	8.3
Total	**120**	**100**
FARM SIZE (hectares)		
0.1 – 2.0	87	72.5
3 – 4	17	14.2
Above 5	16	13.3
Total	**120**	**100**

Source: Field Survey data, 2019

The results in table 2 shows that the male farmers represented 73(60.8%) of the respondents while the female farmers were 47 (39.2%). This finding implies that more males are involved in rice production in the study area and so rice production in the area is not gender selective. The marital status of the respondents indicates that out of the 120 respondents, 18 (15%) are single, 72 (60%) are married, 7 (5.8%) are divorced, 8 (6.7%) are widows while 15 (12.5%) are widowers. The variable of age reveals that out of the 120 respondents, 28 (23.3%) are within the age range of 20-30years, 42 (35%) within 31-40, 33 (27.5%) within 41-50years and 17(14.2%) above 50 years. This result indicates that rice farming is mostly carried out by farmers within the age range of 31-40 years who are in their active of farming. The variable of family size shows that 26 (21.7%) had a family size of 1-5persons, 82 (68.3%) had a family size of 6-10 persons and 12 (10%) had a family size of above 10 persons. This indicates that majority (68.3%) of the respondents had a family size of 6-10n persons and hence could actively utilize these in farming activities.

The table also shows that out of the 120 respondents, 21(17.5%) had no formal education, 34(28.3%) had primary education, 43(35.8%) had secondary school education and 22 (18.4%) had attended tertiary institution. This implies that about 82.5% of the rice farmers in the study area have had some form of formal education and hence can learn new innovations that can improve their farming status. The result on farming experience shows that 12(10%) of the respondents had 1-5years of farming experience, 24(20%) had 6-10years, 45(37.5%) had 11-15, 29(24.2%) had 16-20 years while 10(8.3%) had above 20 years of experience in rice cultivation. The variable on farm size reveals that 87(72.5%) of the respondents had farm size of between 0.1-2 hectares, 17(14.2%) had 3-4 hectares while 16(13.3%) had above 5 hectares. This implies that majority of the rice farmers are small-scale farmers cultivating on less than 5 hectares on inland valleys.

Table 3: Multiple regression results on rice output and the productive resources.

VARIABLES	Linear Function	Semi-log function (LE)	Double-log function
Constant	1.951 (35.456)*	0.659 (17.324)*	0.606 (4.219)*
Farm size (X_1)	0.016 (1.251)*	0.011 (1.251)***	0.012 (0.654) NS
Labour (X_2)	0.010 (1.405)NS	0.007 (1.305) NS	-0.016 (-1.050) NS
Farm capital (X_3)	0.004 (2.981)*	-0.003 (-2871)NS	0.043 (0.913) NS
Seeds planted (X_4)	0.001 (0.268)NS	0.001 (0.268) **	-0.009 (-0.591) NS
Fertilizer (X_5)	-0.018 (-2.091)**	0.012 (2.112)**	0.016 (0.906) NS
Herbicides (X_6)	-0.003 (-2.330)**	0.002 (2.330)**	-0.024 (-1.461) NS
R^2	0.543	0.431	0.342
Adjusted R^2	0.542	0.410	0.329
F-Ratio	212.228	173.228	99.981

Field survey data, 2019.

*,**,***Significant at 1%, 5% and10% level of probability respectively.

NS = not significant, LE = lead equation

t-values are in parentheses

Table 3 presents the multiple regression estimates of the field data. The three forms estimated were the Linear, Semi-log and double-log. Rice output (Y),

the dependent variable was regressed against six independent variables which were the farm size (X_1), labour (X_2), farm capital (X_3), seeds planted (X_4), fertilizer (X_5) and herbicides (X_6)). The semi-log functional model was chosen as the lead equation to explain the variables based on the positive signs of the coefficients and the level of significance. The coefficient of multiple determination (R^2) of 0.431 indicates that the independent variables accounted for about 43.1% variation of the rice output on the inland valleys. This implies that the farm resources investigated in this study have effects on rice output per hectare on inland valleys of Central Agricultural zone of Cross River State.

The coefficient of farm size (X_1), had a positive value of 0.011 and was significant at 10% level of probability. This is in agreement with the findings of Basoru and Fasakin (2012) who reported a positive relationship between farm size and farm output in rice production in Igbemeo-Ekiti Region of Nigeria. The result also conforms to the work of Oniah, Kuye and Idiong (2008) who reported a positive and significant relationship between farm size and rice output among rice farmers in Obubra Local Government Area of Cross River State. Nigeria.

The variable of quantity of seeds planted (X_4), had a positive coefficient of 0.001 and was significant at 10% level. This implies that quantity of seeds planted has a positive and significant relationship with rice output. This suggests that if seed rate is increased by 1% rice output per hectare will be increased by ten percent.

Also, the variable of quantity of fertilizer (X_5) had a coefficient of 0.012 and was significant at 5% level of probability. This result indicates that if fertilizer is applied appropriately, it will positively influence rice output. This implies that fertilizer has a positive effect on rice production per hectare in the study area.

Finally, the variable of herbicide (X_6) had a positive coefficient of 0.002 and was significant at 5% level of probability. This result indicates that effective use of herbicides applied may control weed on the rice farm resulting in better rice output per hectare.

The variable of farm capital (X_3), had a negative coefficient of -0.003 and was not significant. This finding indicates that if the costs of farm implements are increased, they will negatively affect the purchase of such implements for rice production.

Table 4: Determination of resource productivity on rice output

Variable	Coefficients	Mean (X)	APP	MPP	MVP	MFC (₦)	AEI
Farm size	0.011	2.3ha	145.74	1.60	15229	4500/ha	3.384
Seeds	0.001	20kg	16.76	0.016	152.0	100/kg	1.52
Fertilizer	0.012	21.25kg	15.77	0.19	1805	98/kg	18.42
Herbicides	0.002	2.91L	115.19	0.23	2185	900/L	2.43
Total	0.026	-					

Computed from the lead equation and field data, 2019

The elasticities of production for the various inputs were 0.011, 0.001, 0.012 and 0.002 for land, seeds, fertilizer and herbicides respectively. The sum of partial elasticity was (0.026) which suggests that the rice

farmers were operating at the stage one of the production process.

The allocative efficiency of the productive resources indicates that farm size (X_1) had MVP of 15229 while the MFC was 4500, seeds (X_4) had MVP of 152 while the MFC was 100, fertilizer (X_5) had a MVP of 1805 while the MFC was 98 and herbicides (X_6) had a MVP of 2185 while the MFC was 900. The Marginal Value products (MVPs) were greater than their respective factor prices which implies that these resources were inefficiently utilized by the rice farmers for rice production on the inland valleys of the Central Zone of Cross River State.

Finally, the allocative efficiency index (AEI) of farm size, seeds, fertilizer and herbicides were all greater than one (1) which indicates that the productive resources were under-utilized, This finding is in agreement with Oniah *et al.* (2008) who obtained similar results from their findings on resource productivity in rice production in Obubra Local Government area of Cross River state, Nigeria.

Conclusion and recommendations

Based on the findings of this study, it concludes that majority of the rice farmers in the study area are small-scale farmers with an average farming age of 36 years. Farm productive resources of farm size, quantity of seeds planted, quantity of fertilizer applied and herbicides used for weed control positively and significantly influenced rice output in the study area. It also concludes that the farmers were generally inefficient in the allocation of their productive resources in rice production on the inland valleys since most of the resources were generally under-utilized. The study recommends that farmers should efficiently manage their farm size, farm capital, increase the quantity of fertilizer that they apply and use herbicides appropriately so as to raise rice output per hectare on inland valleys of Central Agricultural zone of the state.

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