



**FARO-44 RICE PRODUCTION EFFICIENCY OF FADAMA III ADDITIONAL  
FINANCE II BENEFICIARIES IN TARABA STATE, NIGERIA**

**\*Banseka, R. F., Murtala, N. and Sani, R. M.**

Department of Agricultural Economics, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa  
Balewa University, Bauchi, Nigeria

**\*Corresponding Author's E-mail:** rbfestus@gmail.com

**GSM:** +2347068022856

**ABSTRACT**

The study analysed the *faro-44* rice production efficiency of *fadama* III additional finance II beneficiaries in Taraba State, Nigeria. A Multi-stage sampling procedure was used to select 250 respondents. Data were analyzed using descriptive and inferential statistics. The findings of the study revealed that The result of maximum likelihood estimates of the stochastic frontier production Function of dry season *faro-44* rice farmers reveal that farm size ( $P<0.01$ ), fertilizer ( $P<0.05$ ), quantity of seed (kg) ( $P<0.01$ ), herbicide (liter) ( $P<0.05$ ), were positive and significant increasing output of the farmers. Similarly, the age ( $P<0.01$ ) level of education ( $P<0.01$ ), farming experience ( $P<0.05$ ) and household size ( $P<0.05$ ) were the socio-economic characteristics influencing the increase in technical efficiency of the farmers. Furthermore, the technical efficiency of the farmers is glaringly below 1, an indication that the farmers are operating below their production efficiency frontier. A reasonable proportion (41.20%) of the respondents were within 0.60-0.69 technical efficiency index range with highest value of 0.91 for the most efficient farmers and minimum of 0.50 for the least efficient or worst farmer. Consequently, farmers obtained mean technical efficiency of 0.76 which will improve their technical efficiency by 24%. The result further revealed that, the farmers attained an estimated mean allocative efficiency of 0.88. It was concluded that most of the farmers were unable to obtain technical efficiency level above 76% and farmers were 88% allocative efficient. The study recommended that farmers level of technical efficiency can be increased by 27% by building farmers' capacity through training, workshops and seminars on postharvest loss management, processing techniques, farm record keeping in order to avoid wastages and sustain efficiency.

**Keywords:** Allocative, Efficiency, Farmers, Rice and Technical

**INTRODUCTION**

Agriculture is the major sector of the Nigerian economy that has the potential to make significant impact in poverty reduction efforts since it accounts for 22% of the country's gross domestic product (GDP) and employs 54% of the 54.5 million workforces (National Bureau of Statistics [NBS], 2012). the sector employs 54% of the 123.6 million workforce (NBS, 2021).

Notwithstanding the importance and consumption pattern of rice in the Nigerian economy, local production falls far short of the consumption, resulting in massive importation to bridge the gap (Sani, 2017). Rice covers a very vital part of the daily meal intake of man, as such its production and efficiency (Banseka, 2015) measurement in relation to technical, allocative and economic efficiency are very critical in *faro-44* rice production. In Sub-Saharan Africa, particularly West African region, rice is an important food commodity for most people in their daily consumption.

In Nigeria, rice has assumed a strategic position in the food basket of rural and urban households (Oyinbo *et al.*, 2013). It has changed from being a luxury to a necessity whose consumption will continue to increase with per capita GDP growth implying that its importance



in the Nigerians' diet, as a major food item for food security will increase as economic growth continues to increase (Ojogho and Alufohai, 2010) and most of the farmers operated below the production frontier, hence will not be able to maximize their yield per hectare (Sani *et al.*, 2018). Oyinbo *et al.* (2013) stressed that the status of rice as a necessity in most household's food basket justifies the growing consumer preference for rice in Nigeria. This has therefore, made rice the major staple food in Nigeria where every household, both rich and poor, consumes a greater quantity (Godwin, 2012).

The major contributing countries in Africa are Nigeria (47.9%), Guinea (5.20%), Côte d'Ivoire (5%) and 4% for Mali (Osanyinlusi and Adenegan, 2016). However, as internal part of national development in Nigeria, it is imperative to assess the level of rice production in order to satisfy the nutritional requirement of its citizens in terms of quantitative and qualitative source of carbohydrate, and at the same time improve the farmers' income. Nigeria has the potential to be self-sufficient in rice production, both for food and industrial raw material needs and for export purpose (WARDA, 2019).

Technical efficiency, allocative and economic efficiencies are intended to achieve marginal physical product of farmers which is referred to the change in output as a result of change in the variable inputs used in the production so that maximum level of output can be obtained where the marginal physical product is zero (Sani, 2015) and if the production sum is less than unity, it means decreasing returns to scale; greater than unity is increasing return to scale; and if equal to unity it indicates constant return to scale, however, it is the elasticity of production that can be used to determine the return to scale in agricultural productivity and efficiency (Omonoma *et al.*, 2010). According to Taphee (2015), economic theory provides analytical framework for empirical research of productivity and efficiency and in most cases, increase in agricultural productivity will certainly contribute to the well-being of the whole economy (Seun, 2014). Efficiency studies helps in exploring opportunities in cropping patterns for better output (Nikhil-Raj and Azeez, 2011).

It is important to emphasize that efficiency of household's production activities is determined strongly first by the farmer's production function and secondly by their managerial ability and capacity. Most often, because of the peace meal production process of the farmers coupled with their inadequate economic empowerments and the desire to meet family consumptions/welfare, farmers ignore the use of potentially acclaimed technological resources which ultimately lead to their inefficiency in production decisions making on both farm and non-farming activities (Sani, 2017; Banseka, 2015).

Efficiency studies are important in that they serve as reliable guidance in formulating policies, especially when it comes to the search for the primary causes of inefficiency and improvement potentials. Farmer's production efficiency analysis is an issue of interest given that the overall productivity of an economic system is directly related to the efficiency of production of the various production functional inputs within the farming system.

GAIN (2012) revealed that rice farmers in Nigeria are not getting the maximum returns from the resources committed to the enterprise. Rice varieties such as NERICA and *faro-44* production in Nigeria are being hailed of recent as a major cereal miracle crop that can bring Africa to its long-promised green revolution and food security. The restoration of the agricultural and livelihood amongst the farming households is the basic function of *fadama* III additional financing II. In view of the foregoing, the study analyzed *faro-44* rice production efficiency of *fadama* III additional finance II beneficiaries in Taraba State, Nigeria. Therefore, the study intends to provide answers to the following questions: what are the technical, allocative and economic efficiency of the *faro-44* rice farmers under *fadama* III AF-II project?



and what are the factors responsible for technical, allocative and economic efficiency of the *faro-44* rice farmers under *fadama* III AF-II project in the study area?

## **MATERIALS AND METHODS**

### **The Study Area**

Taraba State lies between Latitude 8°30" North and 9°30" North of the Equator and Longitude 8°30" East and 10°30" East of the Greenwich meridian. The State covers landmass of 14,099km<sup>2</sup>. The State had 2,300,736 people (National Population Commission [NPC], 2006) and a projected 3,552,344 people as at 2023 based on 3.2% annual population growth of the State. The State has annual rainfall of between 1,000 mm to 1,250 mm and maximum temperature ranges of between 21.1°C to 26.7°C. The mean annual rainfall ranges from 800mm to over 1800mm in the southern Taraba. The State shares boundary with Nasarawa 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], 2010; TADP, 2019). 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 minimum daily temperature recorded is 14.8°C and the mean maximum daily temperature recorded is 34.4°C (TADP, 2010). 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, 2010; TADP, 2019).

The vegetation of Taraba State is the Guinea Savannah type with the State being predominantly agrarian and some of the major crop produced are cassava, yam, maize, rice, soybeans, oil palm, cocoa, coffee, mangoes, citrus, and banana, dry season production of maize, rice sugarcane and vegetable. Other economic activities include: livestock rearing, fishing, trading and tailoring. Taraba State was predominantly agrarian in nature with about 50% of its inhabitants depending on subsistence agricultural practices mainly in food crops. The soil type in the study area was predominantly alluvial and sandy light loamy soil with occasional laterite out-grouped here and there. There are rugged hills and mountains with fertile plains and valleys intervening within the northern part of the local government area (Taraba State Government (2015). The ethnic groups include: Chambas, Mambilas, Mumuyes, Jukuns, Wukums, Fulani, Jenjo and the Tivs among others (Taraba diary, 2014). TADP (2019) revealed that as at 2019, the number of farm families in Taraba State was 230, 000 and is projected 0.5% annual growth to be 1,265,000 as at 2021 (Taraba diary, 2014).

### **Sampling Procedure and Sample Size**

A Multi-stage random sampling procedure was used in the selection of respondents. In stage one, three LGAs were randomly selected from each of the three Agricultural Zones (Northern Taraba, Central Taraba and Southern Taraba) making a total of nine LGAs that participated in the project. In stage two, 22 communities based on their wards were randomly selected from the nine selected LGAs. In the final stage, 250 Faro 44 rice farmers who participated in *fadama* III additional finance II project were randomly selected for the study.

### **Method of Data Analysis**

The data were collected using structured questionnaire and analyzed using Stochastic production frontier model. The explicit form is presented as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + U \quad \dots(1)$$

where;

$\beta_0$  = Constant

$X_1$  = Land size (ha)



$X_2$  = Fertilizer (kg)

$X_3$  = Seed (kg/ha)

$X_4$  = Herbicide (liter/ha)

$X_5$  = Insecticide (liter/ha)

$X_6$  = Labour by family and hire (man days/ha/₦)

$\beta_1 - \beta_6$  = Coefficients of the explanatory variables

U = Error term.

The inefficiency model is characterized by:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e \quad \dots(2)$$

where;

Y = *Faro-44* rice farmers' output (kg/ha as the dependent variable)

$\beta_0$  = constant

$Z_1$  = Age (Years)

$Z_2$  = Level education (Years)

$Z_3$  = Farming experience (Years)

$Z_4$  = Extension contacts (Number)

$Z_5$  = Sex (male or female)

$Z_6$  = Household size (Number of persons)

$Z_7$  = Access to credit (Access or No access)

$\beta_1 - \beta_7$  = Coefficient of the explanatory variables

U = Error term.

The variable included in the cost function was explicitly stated as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + e \quad \dots(3)$$

where;

C = Cost of production by *faro-44* rice farmers (₦/ha)

$\beta_0$  = constant

P = price or cost (₦)

$P_1$  = Cost of land clearing (₦/ha)

$P_2$  = Cost of planting (₦/ha)

$P_3$  = Cost of weeding (₦/ha)

$P_4$  = Cost of fertilizer application (₦/ha)

$P_5$  = Cost of quantity insecticide (₦/ha)

$P_6$  = Cost of herbicides application (₦/ha)

$P_7$  = Cost of harvesting (₦/ha)

$P_8$  = Cost of threshing (₦/ha)

$P_9$  = Cost of winnowing (₦/kg/bag)

$P_{10}$  = Cost of bagging (₦/kg/bag)

$P_{11}$  = Cost of loading and off-loading (₦/kg/bag)

$P_{12}$  = Cost of transportation cost (₦/km/distance)

### Elasticity of production

The function they used to model production was of the form.

$$P(L, K) = bL^a K^B \quad \dots(4)$$

where;

P = total production (the monetary value of all goods produced in a year)

L = Labour input (the total number of person-hours worked in a year)

K = Capital input (the monetary worth of all machinery, equipment and buildings)

b = total factor productivity



$\alpha$  and  $\beta$  are the output elasticity of labour and capital, respectively. These values are constants determined by available technology. The output elasticity measures the responsiveness of output to a change in levels of either labour or capital used in production, *certris paribus*. For example, if  $\alpha = 0.15$ , a 1% increase in labour would lead to approximately a 0.15% increase in output. Further, it  $\alpha + \beta = 1$ .

## RESULTS AND DISCUSSION

### Estimated Frontier Production Function of the Dry Season *Faro-44* Rice Farmers

Table 1 shows that the farm size has positive coefficient (0.791) and significant at  $P < 0.01$  meaning that farm (land) size has the tendency of increasing the output of dry season *faro-44* rice farmers in Taraba State, Nigeria. This implies that with a 1% increase in *faro-44* rice land size cultivation, output of *faro-44* rice will increase by 0.79%. The reason could be due to the fact that land is an important factor of production to the extent that its ownership in the study area is by inheritance without restriction on usage by family members. This is in consonance with Aboki *et al.* (2020) that elasticity of output from 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.

To improve crop growth performance and yields, organic and inorganic fertilizer fixing is vital. Fertilizer has a positive coefficient of 0.057 and statistically significant at 1% meaning that a 1% increase in fertilizer use will lead to 0.057% increase in output of *faro-44* rice meaning that fertilizer is an important farm input to which output of *faro-44* rice responded to in the study area. Even though fertilizer is majorly sourced from open market, farmers resort to alternative fertilizer uses in rice production in order to be technically efficient in output. The finding is in consonance with Osanyinlusi and Adenegan (2016) in a study on the determinants of rice farmers' productivity in Ekiti State, Nigeria that quantity of fertilizer used had positive relationship with productivity among the rice farmers meaning that the higher the use of fertilizer, the more productive the rice farmers become.

Also, the coefficient (0.1412) of quantity of seed (kg) was also positive and significant at 5% meaning that seed is an important variable input in agriculture. The high level of positively significance level of seed input shows that rice farming cannot be technically and efficiently practiced without the right seeds for nourishment of the rice plant embryo, covariance to a new location and by extension, it can lead to multiplication and dormancy of more and better seeds supplies in next planting season at low cost. This result implies that a 1% increase in rice seed use will result in a 0.14% increase in yields or output of the farmers. This finding agrees with Ayedun and Adeniyi (2019) who reported that 57% of the farmers were aware of improved rice seeds while 43% of them adopted the improved rice seeds.

Table 1 shows that herbicide (liter) has positive coefficient of 0.0742 and significant at 5%. By implication from this result, any variable with a positive coefficient will contribute to increasing output of the farmers. Similarly, this result is in consonance with Ayedun and Adeniyi (2019) that over 50% of the farmers had needed inputs such as family and hired labour, fertilizer, herbicides and insecticides/pesticides. The result is also in consonance with the work of Maurice (2012) who reported that agrochemical significantly and positively contribute to output in food crop production among farmers in Adamawa State, Nigeria. Sani *et al.* (2011) also reported that licensed marketers should register with the government so as to control problems of adulteration and sale of expired agrochemicals to farmers.

The stochastic production frontier results on quantity of insecticide (liter) used by *faro-44* dry season rice farming show a positive coefficient (0.1284) and significant at 5% in influencing farmers' output. This implies that a 1% increase in insecticide application will lead





to a 0.128% increase in *faro-44* rice output. This result is in agreement with Ali *et al.* (2017) who in their experiment said insect infestation was found below the economic threshold level at all experimental field plots in both locations, Rangpur and Barisal.

Similarly, in Table 1, the coefficient (-0.248) of age variable is negative and statistically significant at 1% level of probability. This implies that age increases technical efficiency. The reason could be based on the fact that most of the activities involved in rice farming are drudgery in nature and therefore as the farmers grow older, they become less active in undertaking such operations. This is contrary to the *a priori* expectation of this study that age of farmers is expected to have a positive effect on technical inefficiency effects as older farmers may be less energetic due to inefficient production routines and practices. This is in agreement with Angulu (2012) who obtained a negative coefficient of age and significant at 5% level.

Level of education has positive coefficient (0.757) and significant at 1% meaning that the level of education of the farmers has negative or decreasing effect on technical efficiency of the farmers. This is in consonance with Ohen and Ajah (2015) who obtained a positive coefficient of educational attainment and significant at 0.009 levels (1%), meaning with higher education, the farmer had greater potentials for adoption of improved farming activities. Education seems to have no influence on technical efficiency (Rahman, 2010) and as reported that effect of education on technical efficiency in Bangladesh agriculture is mixed (Rahman, 2010).

The coefficient of farming experience (0.206) is statistically significant at  $P < 0.05$  and carries a positive sign. This implies that more years of experience decrease farmers' production inefficiency because they would know the right management practices in order to attain higher output. This is contrary to Angulu (2012) that farming experience is not significant factors in swamp rice production.

**Table 1: Maximum likelihood estimates of the stochastic frontier production function of dry season *faro-44* rice farmers (n = 250)**

Variable	Parameters	Coefficient	Std. error	Z-ratio
<b>Production factors</b>				
Constant	$\beta_0$	2.147	0.1891	11.3554***
Land size (ha)	$\beta_1$	0.791	0.1205	6.5643***
Fertilizer (kg)	$\beta_2$	0.057	0.0144	3.9722***
Seed (kg)	$\beta_3$	0.1412	0.066	2.1394**
Herbicide (liter)	$\beta_4$	0.0742	0.0285	2.6035**
Insecticide (liter)	$\beta_5$	0.1284	0.0557	2.3052**
Labour (man-day)	$\beta_6$	0.0163	0.0158	1.0316 <sup>NS</sup>
<b>Inefficiency effects</b>				
Age ( $Z_1$ )	$\delta_1$	-0.248	0.081	-3.073***
Level education ( $Z_2$ )	$\delta_2$	0.757	0.229	3.313***
Farming experience ( $Z_3$ )	$\delta_3$	0.206	0.085	2.4158**
Extension contact ( $Z_4$ )	$\delta_4$	0.255	0.046	5.502***
Sex ( $Z_5$ )	$\delta_5$	-0.036	0.055	-0.656 <sup>NS</sup>
Household size ( $Z_6$ )	$\delta_6$	-0.160	0.066	-2.430**
Access to credit ( $Z_7$ )	$\delta_7$	0.074	0.055	0.013 <sup>NS</sup>
<b>Diagnostic statistics</b>				
Log likelihood ratio	LR	70.72*		
Sigma squared	$\sigma^2$	0.158	0.030	5.221***
Gamma	$\Gamma$	0.739	0.215	3.441***

Source: Field survey, 2022

Note: \* $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\* $p < 0.01$ ; and NS = Not significant



Extension contact has positive coefficient of 0.255 and significant at 1% level of probability meaning that decrease in extension contact will lead to decrease in production inefficiency. This is contrary to Angulu (2012) who obtained a negative coefficient of extension contact was negative and significant at 5% level. This means that an increase in extension contact will lead to increase in technical efficiency.

Furthermore, household size has negative coefficient (-0.160) and significant at 5% meaning that more household size of the farmer will lead to increase in technical efficiency of the farmer. According to Olumba (2014), most rural farmers look at large household size as a good and economical way of maximizing farm returns by using family labour.

### Estimated Stochastic Frontier Costs of Dry Season *Faro-44* Rice Production

Analysis of dry season maximum likelihood estimates of the parameters of stochastic frontier costs function of *faro-44* rice farmers is presented in Table 3. The cost of land clearing ( $\beta_1$ ) with positive coefficient of 0.0109 and significant at 1% meaning that a 1% increase in the cost of land clearing in dry season, will increase total production cost by 0.0109%. Also, as vital activities in *faro-44* rice production in the study area, cost of planting ( $\beta_2$ ) has positive coefficient of 0.0719 and significant at 1%; cost of weeding ( $\beta_3$ ) with positive coefficient of 0.0329 and significant at 1%; and cost of fertilizer ( $\beta_4$ ) with positive coefficient of 0.0534 and significant at 5% indicating that a 1% increase in the cost of planting, weeding and fertilizer application will increase total cost by 0.07%, 0.03% and 0.05%, respectively.

**Table 3: Maximum Likelihood Parameters Estimate the Stochastic Frontier Cost Function of Dry Season *Faro-44* Rice Production (n = 250)**

Variable	Parameters	Coefficient	Std. error	Z-value
<b>Cost factors</b>				
Constant	$\beta_0$	3.0717	0.1914	16.0486***
Land clearing	$\beta_1$	0.0109	0.0015	7.2667***
Planting	$\beta_2$	0.0719	0.0143	5.0280***
Weeding	$\beta_3$	0.0329	0.0018	18.2778***
Fertilizer application	$\beta_4$	0.0534	0.0188	2.8404**
Insecticide application	$\beta_5$	0.0163	0.0349	0.4665 <sup>NS</sup>
Herbicides application	$\beta_6$	0.0368	0.0375	0.9832 <sup>NS</sup>
Harvesting	$\beta_7$	0.0469	0.0175	2.6773**
Threshing	$\beta_8$	0.0814	0.0401	2.0328**
Winnowing	$\beta_9$	0.0248	0.0299	0.8309 <sup>NS</sup>
Bagging	$\beta_{10}$	0.0161	0.0052	3.1225***
Loading and off-loading	$\beta_{11}$	0.0121	0.0452	0.2682 <sup>NS</sup>
Transportation	$\beta_{12}$	0.0729	0.0197	3.7092***
<b>Inefficiency effects</b>				
Age ( $Z_1$ )	$\delta_1$	-1.233	0.483	-2.5528**
Education ( $Z_2$ )	$\delta_2$	0.046	0.041	1.1220 <sup>NS</sup>
Farming experience ( $Z_3$ )	$\delta_3$	-0.322	0.237	-1.3586 <sup>NS</sup>
Extension contact ( $Z_4$ )	$\delta_4$	-0.197	0.077	-2.5584**
Sex ( $Z_5$ )	$\delta_5$	-0.442	0.208	-2.1250**
Household size ( $Z_6$ )	$\delta_6$	-0.173	0.059	-2.9322**
Access to credit ( $Z_7$ )	$\delta_7$	-0.0152	0.038	-0.4000 <sup>NS</sup>
<b>Diagnostic statistics</b>				
Log likelihood ratio	LR	55.79*		
Sigma squared	$\sigma^2$	0.085	0.026	3.2692***
Gamma	$\Gamma$	0.835	0.029	28.7931***

Source: Field survey, 2022

Note: \*p<0.10, \*\* p<0.05, \*\*\*p<0.01; and NS = Not significant



### **Technical Efficiency of *Faro-44* Rice Farmers**

The results of the distribution of the technical efficiencies of *faro-4* rice farmers under dry season is presented in Table 5. The results shows that the technical efficiency of the farmers is glaringly below 1, an indication that the farmers are operating below their production efficiency frontier. Thus, there was a wide variation of technical efficiency index across the farmers in Taraba State, Nigeria. The results reveal that few (33.60%) of the respondents in dry season *faro-44* rice farms have technical efficiency index within range intervals of 0.60-0.69 with highest value of 0.98 for the most efficient farmers and minimum or least value of 0.54 for the least efficient. Consequently, in dry season, the farmers obtained mean technical efficiency of 0.76 which by implications means that in the short run, the farmers still have ability and capability to improve their technical efficiency by 24% to guarantee sustainability of increasing yield and profitability of *faro-44* rice farming in Taraba State, Nigeria. This is in agreement with Sani (2017) who reported that the ratio of physical amount of output to physical amount of input (technical efficiency) should be an activity at a given level of production technologies in ensuring that costs are minimal, profits are maximum and the farmers are ready to operate at non-negative values of inputs and output levels.

**Table 5: Distribution Based on Technical Efficiency of *Faro-44* Rice Farmers (n = 250)**

Range of technical efficiency (%)	Frequency	Percentage
0.50-0.59	33	13.20
0.60-0.69	84	33.60
0.70-0.79	60	24.00
0.80-0.89	42	16.80
0.90-0.99	31	12.40
<b>Total</b>	<b>250</b>	<b>100</b>
<b>Maximum</b>	<b>0.98</b>	
<b>Minimum</b>	<b>0.54</b>	
<b>Mean</b>	<b>0.76</b>	

**Source:** Field survey, 2022

### **Allocative Efficiency of *Faro-44* Rice Farmers**

Table 6 shows that the farmers attained an estimated mean allocative efficiency of 0.88 *faro-44* rice farming in the study area. This means that the farmers were 88% allocatively efficient and the shortfall of 12% was due to the farmers' allocative inefficiency. The minimum and maximum measures of allocative efficiencies of 0.46 and 0.98, respectively, in dry season means that the farmers that were most allocatively efficient were 98% efficient whereas, only 46% efficiency level was attained by the least allocatively efficient farmers. The implication of this results, in dry season, for an average farmer to sustainably achieve allocative efficiency level, going by the results of the most efficient farmer, the farmer has to realize cost saving of 10.21% ( $1 - 0.88/0.98$ ). This result is in disagreement with Akinbode *et al.* (2011) in a study on technical, allocative and economic efficiencies in *ofada* rice farming in Ogun State, Nigeria who reported a mean allocative efficiency of 0.93 ranging from 0.74 to 0.99 an indication that if the average farmer was to achieve the allocative efficiency level, the average farmer could realize a cost saving of about 5.8%.





**Table 6: Distribution based on Allocative Efficiency of *Faro-44* Rice Farmers (n = 250)**

Range of allocative efficiency (%)	Frequency	Percentage
0.40-0.49	39	15.60
0.50-0.59	76	30.40
0.60-0.69	61	24.40
0.70-0.79	32	12.80
0.80-0.89	14	5.60
0.90-0.99	28	11.20
<b>Total</b>	<b>250</b>	<b>100</b>
<b>Maximum</b>	<b>0.98</b>	
<b>Minimum</b>	<b>0.46</b>	
<b>Mean</b>	<b>0.88</b>	

Source: Field survey, 2022

### Economic Efficiency of *Faro-44* Rice Farmer

The distribution of the economic efficiency of dry season *faro-44* rice farmer in Taraba State, Nigeria is presented in Table 7. The result shows a mean economic efficiency level of 0.67. The least efficient farmers had economic efficiency estimates of 0.34. By implication, the farmers going by the mean efficiency levels, need cost saving of 33% so as to attain the frontier output mark or increase their overall economic efficiency in order to maximize profit and family welfare. Most farmers tend to underutilize production resources which may serve a better explanation of the variations between the most economically efficient and least efficient *faro-44* rice farmers in Taraba State, Nigeria. This agree with Sani (2017) that for an agribusiness firm to break-even and attain efficiency and effectiveness, there is need to avoid wastages and think of where and why and to what degree are wastages occurring in farm production. By implications, the farmers should engage in sustainable farm planning of the existing resources and their best allocation for achieving higher resource use efficiency, farm income and farm family welfare. It is very important to state that these results will also contribute in addressing the aim of *fadama* III additional financing II at restoration of the agricultural and livelihood needs of 31,600 households whose livelihoods have been devastated by conflicts. Tadesse *et al.* (2017) in a study on analysis of the technical efficiency of rice production in Fogera district of Ethiopia who reported that a farm operating at full efficiency level could reduce its input use, on average, by 22.8% to produce the same level of output.

**Table 7: Distribution based on Economic Efficiency of *Faro-44* Rice Farmers**

Range of economic efficiency (%)	Frequency	Percentage
0.30-0.39	38	15.2
0.40-0.49	65	26
0.50-0.59	46	18.4
0.60-0.69	38	15.2
0.70-0.79	28	11.2
0.80-0.89	17	6.8
0.90-0.99	18	7.2
<b>Total</b>	<b>250</b>	<b>100</b>
<b>Maximum</b>	<b>0.94</b>	
<b>Minimum</b>	<b>0.34</b>	
<b>Mean</b>	<b>0.67</b>	

Source: Field Survey, 2022



### Elasticity of Production of *Faro-44* Rice Farmers Under *Fadama* III AF-II Project

The elasticity of production refers to the percentage change in output in relation to the percentage change in input. The concept of elasticity can be applied to the production function to determine the stages in which *faro-44* rice farmers are allocating their resources. In this study, the scale of production for all *faro-44* rice farmers was estimated by summing the values of the coefficients ( $b_i$ ) as presented in Table 8. The summation of coefficients of stochastic frontier production function gives the direct measure of returns to scale which indicates the stage of production. However, elasticities in dry season were 1.207 and in wet season, it was less than one (0.273) which indicates that the growers of *faro-44* rice under the *fadama* III AF-II project in Taraba State allocated their resources in the rational stage of production (stage-II) where diminishing returns to scale existed meaning by implications that the *faro-44* rice growers' marginal returns is equal to marginal cost. By implications, this will help in achieving the objective of *fadama* III AF-II project in restoration of agricultural and livelihood needs of 31,600 households whose livelihoods have collapsed due to conflicts in the study area. This finding is in consonance with Sani (2017) who reported that elasticity of production ( $E_p$ ) is the proportionate change in output as compared to proportionate change in input; and that if  $E_p$  is less than one ( $E_p < 1$ ), it means diminishing returns (stage II of production) implying rational zone of production in which the producer should operate to attain the objective of profit maximization.

**Table 8: Elasticity of Production *Faro-44* Rice in Dry and Wet Season**

Inputs (n = 250)	Elasticity of production
Fertilizer (Kg)*	0.057
Seed (Kg)**	0.141
Herbicide (Ltr)	0.074
Insecticide (Ltr)	0.128
Labour (Man-day)	0.016
Land size (ha)	0.791
<b>Total</b>	<b>1.207</b>

Source: Field survey, 2022

\*1 bag = 50 kg and \*\*1 bag = 20 kg.

### CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, it was concluded that most of the farmers were unable to obtain technical efficiency level above 76% in the dry season and 63% in wet season and farmers were 88% and 69% allocative efficient in dry and wet seasons, respectively while they are producing below the maximum frontier output of 0.98 in dry season and 0.91 in wet season. The study made the following recommendations:

- Policies support programmes are necessary like (a) farm input supports (fertilizers, better quality and quantity of rice seeds), better farm transport system, cluster rice processing and storage facilities and (b) women farmers in Taraba State, Nigeria to form strong cooperative associations in order to benefit more from such laudable *fadama* AF-II intervention/supports taking cognizance also of the enormous benefit of the women in agriculture programmes.
- More of the farmers should be scaled-up to formal educational levels through farmers forming cooperative societies for scholarship supports to further boost the farmers capacity in rice production.
- Farmers level of technical efficiency can be increased by 27% in dry season and 31% in wet season by building farmers' capacity through training, workshops and seminars on postharvest loss management, processing techniques, farm record keeping in order to avoid wastages and sustain efficiency.



- iv. Government extension advisory services or roles should be up-scaled in Taraba State by sponsoring more students (males and females) at catch them young Schooling levels in extension activities, farmer-farmer extension services, private extension service, etc.
- v. Farm inputs like herbicide, insecticide, farm land, improved rice seeds, fertilizers, rice harvesting and threshing technologies and at subsidized rate should be made timely available to farmers government through the Taraba State *fadama* office.

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