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DETERMINANT OF ALLOCATIVE EFFICIENCY AMONG RAINFED RICE FARMERS IN ARDO-KOLA AND JALINGO LOCAL GOVERNMENT AREAS OF TARABA STATE, NIGERIA

[1]Christopher K. Hassan, [2]Stephen Jonathan and [3]Idris, Abdulazeez
[1]Department of Agricultural Economics and Extension,
Faculty of Agriculture and Life Sciences, Federal University Wukari, Taraba State, Nigeria
[2]Department of Agricultural Economics and Extension, School of Agriculture and Agricultural Technology, Modibbo Adama University, Yola, Adamawa State, Nigeria
[3]Department of Agricultural Economics and Extension,
Federal University Duste, Jigawa State, Nigeria
Corresponding Author's E-mail: christopher@fuwukari.edu.ng **Tel.:** 08163507835

ABTRACT
The study determined allocative efficiency among rainfed rice farmers in Ardo-kola and Jalingo local government area of Taraba State, Nigeria. The objectives of the paper were to determined allocative efficiency of rice farmers in the study area. Purposive and simple random sampling techniques were used to collect data from 180 rice farmers through a structured questionnaire. Both descriptive statistics and stochastic frontier approach were used to analyze data collected. Diagnostic statistic, gamma (0.856) and sigma squared (0.191) were statistically significant at $P \leq 0.01$. probability level. The result further revealed that cost of seed and cost of fertilizer were significant at $P \leq 0.01$, while cost of family labour and cost of agrochemicals were significant at $P \leq 0.05$. The mean allocative efficiency (AE) is 0.89. The study also revealed that education, age and extension contact and gender increases allocative efficiency of rice farmers in the study area. The study recommends diversification of income, especially to rice farmers with large household size. However, farmers should be encouraged with improved facilities either from government and non-governmental agencies.

Keywords: Allocative efficiency, Determinants, Rainfed, Rice production, Taraba State.

INTRODUCTION
Nigeria is blessed with varied climatic zones, enormous resources, with potentials of producing, processing, marketing and exporting different agricultural products (Isa *et al.,* 2012). Rice (*Oryza sativa*) is one of the cereal most commonly consumed in the world, especially in Asia and African specifically in Nigeria (Oguniyi *et al.*, 2012). It is a major commodity in the international market, and the second most important cereal in the world after wheat in terms of production (Tijjani and Bakari, 2014). It is a staple food for more than half of the world's population and has become increasingly important in Africa, both as a food source and as an economic commodity (Tashikalma, *et al.*, 2014). Rice is critical for food security throughout Africa, and especially in Nigeria. In sub-Saharan Africa there is daily growing demand for rice so faster than for any other grain, where both the elite and poor relied on as a major source of calories (Kormawa and Akande, 2004). Rice served as food for over 4.8 billion people in over 150 countries, feeding over 2.89 billion Asian, over 40 million people in Africa and over 150.3 million American (Biyi, 2005). In Nigeria, rice production is not only a source of nutrients, but a major employer of labour and source of income for the poor. This is because in rice producing areas, the enterprise create employment for more than 80% of the inhabitants in various activities along the rice value chain from cultivation to consumption

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(Ogundele and Okoruwa, 2006). Rice is a good source of protein in many parts of the world, but it is not a complete protein, it does not contain all of the essential amino acids in sufficient amounts for good health and should be combined with other sources of protein such as nuts, seeds, beans, fish or meat. It is the predominant dietary energy source for 17 countries in Asia and the pacific, 9 countries in North and South America and 8 countries in Africa. Rice protein contains high lysine and amino acid, it is important in making beer, rice wine and vinegar (Ndubueze and Ogbona, 2016).

Rice production is basically grown in all the agro-ecological zones. Rice growing environment ranged from Rain-fed upland, Rain-fed lowland, Irrigated lowland, Deepwater to Mangrove swamp (Biyi, 2005). However, production is mainly done by small scale farmers with and average farm size of 1-2 hectares. In terms of annual world production and consumption of major cereals, rice falls in the categories of maize and wheat (FAO, 2012). Due to growth in demand for rice especially in the urban centers, rice has the fastest growing consumption rate among all staple crops (Nneka *et al.*, 2019). The rice industry has showed a rising trend in milled rice supply deficit in Nigeria, from 1,100 metric tons in 1960s to 2.3 million metric tons in 2013. Between 1960 and 2013, Nigeria has persistently imported foreign milled rice to augment local supply deficit. This was an average of 2.3 million metric tons of imported rice per annum. Consumers are exhibiting a shift in preference from traditional staples (such as cassava, maize and yams) to rice (Nigerian National Food Reserve Agency, Federal Ministry of Agriculture and Water Resources, Japan International Cooperation Agency, 2009). There is a demand of 5 million MT of rice yearly in Nigeria. However, only about 3.2 million MT are produced locally (Federal Ministry of Agriculture and Rural Development [FMARD], 2012) with a demand gap of 1.8 million metric tons. The inability to meet rice consumption needs through local production makes the country import-dependent (Onyenweaku and Ohajianya 2008; Akinbile, 2010). Studies have shown that in Nigeria just as in other developing countries of the world, most resources are not efficiently used in production (Fan, 1999; Okoruwa and Ogundele 2004; Tiamiyi *et al.*, 2008; Akighir and Shabu, 2011).

Studies carried out on technical and economic efficiencies of crop production, for wheat and rice, showed a 'yield gap', which is the difference in productivity on 'best practice' and on other farms operating with comparable resource endowments under similar circumstances (Abedullah and Khalid, 2007). This differences between actual and technically feasible output for these crops (wheat and Rice) implies great potential for increasing food and agriculture production through improvements in productivity, without further advancement in technology and employment of additional production factors. In developing countries, resources in the agricultural sector are inefficiently utilized, as such they farmers are maninly concerned with profitability may directly or indirectly depends on resource use efficiency (Abedullah and Khalid, 2007). In recent times, high cost of planting materials, seasonal fluctuations, shortage of material inputs, incidence of pest and diseases, inadequate information, marketing problems and inadequate good road network have been observed to impede rice production in Taraba State. However, little work has been done along this line (allocative efficiency) in the rice sector of Northern Taraba state, Nigeria and present study is attempting to fill/and to this gap.

MATERIALS AND METHODS

The Study Area

The study area was Ardo-Kola and Jalingo Local Government Areas of Taraba State, Nigeria. The state has a land area of 59,400 km^2 with a population of 2,300,736 people (Federal Republic of Nigeria Official Gazette, 2009). It comprises 16 Local Government Areas (LGAs) and lies between latitudes 6^0 30´ and 9^0 36´ North of the equator and between longitudes 9^0 10´ and 11^0 50´ East of the Greenwich meridian (Taraba State Diary, 1999). It shares a common boundary with Bauchi State in the north and Gombe State in the north east, Adamawa State in the east and Plateau State in the North West. It is further bounded to the West by both Nasarawa and Benue states, while it shares an international boundary with the republic of Cameroun to the south and south east (Taraba State Diary, 1999).

Taraba State has two distinct climatic seasons – the wet season which starts in April and ends in October and dry season which starts in November and ends in March. Annual rainfall and relative humidity are relatively high, especially in the southern part of the State (Ahmadu and Erhabor, 2012). The State is predominantly agrarian in nature, with majority (80%) of its inhabitants depending on subsistence agricultural practices. Some of the arable crops produced in the State are rice, maize, guinea corn, millet, groundnut, beans, sesame, soyabeans, cassava, yam and tomatoes (Tijjani, 2010). The main vegetation cover of the state is the guinea savanna, the topography is essentially marked with mountainous land transverse by large river valley such as Benue, Taraba, Donga and Bibinu.

Sampling Techniques and Data Collection Method

This study adopted purposive and simple random sampling techniques; six clusters were purposively selected based on respondent's concentration. Subsequently, 180 respondents (Table 1) were randomly selected and administered with structured questionnaire.

Table 1: List of Rice Registered Farmers in the Study Area

S/N	LGA	Rice farmer cluster	Membership	No. of farmers selected
1	Ardo-Kola	Sunkani Rice Cluster	397	56
		Mayo-Ranewo Rice Cluster	152	22
		Jauro Yinu Rice Cluster	175	25
2	Jalingo	Koffai Rice Cluster	235	33
		Kona Rice Cluster	134	19
		Wuro Sembe Rice Cluster	176	25
		Total	1269	180

Source: Taraba State Agricultural Development Programme (TADP), 2017

However, the selection of the farmers was based on this formula as adopted by Kehinde *et al.* (2012):

$$n1 = \frac{n}{N} \times N1 \qquad \ldots(1)$$

where;

n_1 = number of farmers selected

n = sample size

N = total population of the rice farmers

N_1, N_2, N_3, N_4, N_5, N_6 = population of rice farmers in each cluster.

Analytical Techniques

1. Stochastic Cost Function: In order to estimate economic and allocative efficiencies of the rice farmers, a Cobb-Douglas cost frontier function for rice farms in the study area is specify as follows:

$$InCi = \alpha_0 + \alpha_1 LnP_1i + \alpha_2 LnP_2i + \alpha_3 LnP_3i + \alpha_4 LnP_4i + \alpha_5 LnP_5i + \alpha_6 LnP_6i + Vi + Ui \qquad \ldots(2)$$

Journal of Agripreneurship and Sustainable Development (JASD)
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where;
C = total production cost rice per farmer for the season
P_1 = the rental value of land per hectare
P_2 = the wage rate of family labor per manday
P_3 = the wage rate of hired labor per manday
P_4 = the cost of rice seed per kilogramme
P_5 = the cost of fertilizer per kilogramme
P_6 = the cost of agrochemicals per liter
α = parameters to be estimated.
2. Cost inefficiency effects is thus as:
$\mu = \delta_0 + \delta_1 W_1 + \delta_2 W_2 + \delta_3 W_3 + \delta_4 W_4 + \delta_5 W_5 + \delta_6 W_6 + \delta_7 W_7$ ...(3)
where;
μ = cost inefficiency effect
δ = Parameters to be estimated
W_1 = Age of farmer in years
W_2 = Educational level of farmer (number of years spent in school)
W_3 = Household Size
W_4 = Years of Rice farming experience
W_5 = Extension contact (1 if the farmer has extension contact, 0 if otherwise)
W_6 = Access to credit (1 if farmer has access to credit, 0 if otherwise)
W_7 = Gender (1 if male, 0 if otherwise).

RESULTS AND DISUSSION

Estimate of Stochastic Frontier Cost Function

The maximum likelihood estimate of the Cobb-Douglas stochastic frontier cost function shows the relative importance of cost of input as used during rice production in the study area. These estimates include the sigma squared (σ^2), gamma (γ) and the log likelihood. The sigma squared indicates the goodness of fit of the model, while gamma gives the proportion of the deviation of output from the cost frontier.

The estimates of the stochastic frontier cost function are presented in Table 2. The results revealed that all the independent variables conform to the a priori expectations as all the estimated coefficients gave positive coefficients. This implies that the variables used in the regression analysis have direct relationship with total cost of rice production. The cost of production increases by the value of each coefficient as the quantity of each variable input is increased by one percent. The estimated coefficient of cost of land (β_1) is 0.500 and not statistically significant even at 10% level. The cost of family labour (β_2) was estimated to be 0.152 and statistically significant at 5% level. This implies that a unit increase in the cost of family labour will result to 0.152% significant increase in the total cost of rice production in the study area. However, hired labour (β_3) estimate (0.069) was not significant. The estimated coefficient of cost of seed (β_4) was revealed to be 0.277 and statistically significant at 1% level. The implication is that a unit increase in the cost of seed will result to 0.277% significant increase in the total cost of production. The result was contrary to the findings of Akinbode *et al.* (2011) which revealed that increase in price of seed did not significantly contribute to total cost of rice production in Ogun State, Nigeria. The cost of fertilizer (β_5) was estimated to be 0.436 and statistically significant at 1%. This means that a unit increase in the cost of fertilizer will result to 0.436% significant increase in the total cost of rice production. The implication is that rice farmers in the study area rely more in the use of fertilizer. The estimated coefficient of agrochemical (β_6) was revealed to be 0.184 and significant at 5% level. This means that a unit increase in the cost of agrochemical will result in 0.184% significant increase in total cost of production. The result of the diagnostic statistics revealed that both sigma squared and gamma are significant at 1% level. The gamma estimate (0.856) shows that about 86% of the variation in rice production cost among the respondents is due to differences in allocative efficiency. Sigma squared was estimated to be 0.191. This indicates a good fit and correctness of the specified distributional assumption of the model or about the error term. Thus, the result of the diagnostic statistics confirmed the relevance of stochastic frontier cost function using maximum likelihood estimates.

Table 2: Maximum-likelihood Estimates for parameters of the Stochastic Frontier Cost Function

Variables	Parameter	Coefficient	Standard Error	t-ratio
Cost factors				
Constant	β_0	1.221	0.990	1.233
Cost of land(X_1)	β_1	0.500	0.691	0.724
Cost of family Labour(X_2)	β_2	0.152	0.066	2.286**
Cost of Hired Labour(X_3)	β_3	0.069	0.651	0.106
Cost of seed(X_4)	β_4	0.277	0.085	3.272***
Cost fertilizer(X_5)	β_5	0.436	0.077	5.637***
Cost of Agrochemicals(X_6)	β_6	0.184	0.084	2.191**
Inefficiency model				
Constant	δ_0			
Age(Z_1)	δ_1	-0.286	0.099	-2.899***
Education(Z_2)	δ_2	-0.159	0.066	-2.405**
Household size(Z_3)	δ_3	0.049	0.620	0.079
Farming experience(Z_4)	δ_4	-0.043	0.099	-0.433
Extension contact(Z_5)	δ_5	-0.240	0.099	-2.405**
Gender(Z_6)	δ_6	-0.345	0.168	-2.049**
Diagnostic statistics				
Sigma squared	σ^2	0.191	0.046	4.109***
Gamma	γ	0.856	0.239	3.574***
Log likelihood function		176.92		
LR test		1.93		
Number of observations		180		

*** Significant at 1% level ** significant at 5% level
Source: Field Survey, 2018

An analysis of allocative inefficiency variables as shown in Table 2 revealed the coefficient of age (δ_1) to be negative and statistically significant at 1% level. This implies that aged farmers tend to attach high importance to minimizing production costs when compared with younger farmers thereby increasing cost efficiency. This finding is contrary to the findings of Tijjani and Bakari (2014) where age was estimated to be positive and decrease cost efficiency (0.0003). The coefficient of education (δ_2) was estimated to be negative and significant at 5% level. This means that farmers with more years of education tends to be more efficient in the allocation of factor inputs which minimize production cost and better managerial ability. Farming experience (δ_4) was estimated to be negative, but not significant. This finding does not agree with that of Tijjani and Bakari (2014) who reported that rice farmers in Taraba State with more years of education and farming experience are good in resource allocation that minimizes cost thereby increasing cost efficiency. However, the estimated coefficient of household size (δ_3) is revealed to be positive and not significant. This could be attributed to the fact that large family size could cause diversion of fund from farming activities to home consumption thereby increasing cost inefficiency. The coefficient of extension contact (δ_5) has the desired negative sign and statistically significant at 5% level. This means that farmers with more extension contact are better informed with good farming practices and technology. The estimated coefficient of gender (δ_6) is negative and also significant at 5% level of significance; this implies that most males are aged; have more years of education and are experienced household heads, thus, have better managerial ability than the female counterpart.

Rice Farmers' Allocative Efficiency

The frequency distribution of allocative efficiencies of the respondents is presented in Table 3. The mean measure of allocative efficiency in the area was estimated to be 0.89. This suggests that respondents were about 89% allocatively efficient while the remaining (19%) short fall can be attributed to their allocative inefficiencies. Majority (82.2%) of the respondents were efficient below the mean, whereas 17.3% were efficient above the mean value. The minimum and maximum measures of allocative efficiencies were 0.60 and 0.96, respectively. This implies that the least allocatively efficient farmer was 60% efficient, whereas the most allocatively efficient farmer was 96% efficient. Thus, if the average rice farmers in the area were to achieve the level of allocative efficiency shown by the most efficient farmer, then they would realize a cost saving of 11.46% that is (1-0.89/0.96). The table further shows that majority (69%) of the farmers had allocative efficiency from 0.78 and above, indicating that on the relative term most of the respondents were very efficient in allocating their cost during rice production in the study area. However, there is room for improvement of their allocative inefficiency. The finding does not agree with that of Akinbode *et al.* (2011) who examined technical, allocative and economic efficiencies in *Ofada* rice farming in Ogun State, Nigeria reported a mean allocative efficiency of 0.93 that ranged between 0.74 and 0.99 which implies that if the average farmer was to achieve the allocative efficiency level of his most efficient counterpart, the average farmer could realize a cost saving of about 5.8%. Similarly, the findings of Fadil and Mitsuyasu (2011) evaluated technical, allocative and economic efficiency in rice production a case study of rice farmers in Brunei Darussalam reported that farmers' allocative efficiency ranged between 0.018 to 0.85 with a mean of 0.66 which is below rice farmers' performance in Northern Taraba State, Nigeria.

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Table 3: Frequency Distribution of the Allocative Efficiencies of Rice Farmers

Range	Frequency	Percentage
0.60- 0.65	16	8.8
0.66-0.71	15	8.4
0.72-0.77	25	13.9
0.78-0.83	40	22.2
0.84-0.89	53	29.5
0.90-0.95	26	14.5
0.96-1.00	5	2.7
Total	180	100
Mean efficiency	0.89	
Minimum efficiency	0.60	
Maximum efficiency	0.96	

Source: Field Survey, 2018

CONCLUSION AND RECOMMENDATIONS

Farmers who operated below the maximum efficiency with a mean of (0.89) implies that the allocative efficiency of an average farmer could be increased by 11% through better utilization of resources in the optimal proportions given their respective prices and the current technology. Households, especially families with large household size should be encourage to engage in other non-agricultural activities that can enhance their income thus, increasing cost efficiency. Farmers should form cooperatives; this is to enable them access credits and other improved facilities from government and non-governmental agencies to boost production.

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