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ANALYSIS OF ALLOCATIVE EFFICIENCY AMONG SMALL-SCALE RAIN-FED RICE (*Oryza sativa*) FARMERS IN ADAMAWA STATE, NIGERIA

D.C. MAURICE; U.M. BAKARI; VIMTIM, M.B
Department of Agricultural Economics and Extension Modibbo adama University of Technology Yola, Nigeria
Correspondence Author: bmusavimtim@gmail.com, bmusavimtim@yahoo.com

ABSTRACT: The research estimated the allocative efficiency among small-scale rain-fed rice farmers in Adamawa State, Nigeria. A multi-stage random sampling technique was used to select 362 rain-fed rice farmers in eight Local Government Areas of Adamawa State. Stochastic frontier production cost function was employed for the analysis of the data. Maximum Likelihood Estimate of the stochastic frontier production cost function revealed that all the variables included in the cost function had the expected positive signs. This suggest that there is a positive relationship between the total cost of production and the cost of these variables. Cost of seed, labour, herbicides and output of rice carried the expected sign and were significant at varying degrees of probability and the gamma (ϒ) coefficient of 87% implying that these variables contributed 87% of the total cost of rice production incurred by the farmers included in the model. The allocative efficiency among the farmers ranged between 0.52 - 0.98 with a mean of 0.83, indicating that there is a scope for improving allocative efficiency by 17% given the prices of these inputs. Age of the farmer, literacy level, farming experience, seed variety and primary occupation were found to reduce cost inefficiency among the farmers. The study, recommends revitalization of formal education and accessibility to improved seed varieties to the farmers through government agricultural transformation agenda.

Keywords: Rain-fed, Small-scale, Rice, Allocative, Efficiency

INTRODUCTION

Globally, rice is a very important food crop. It is an ancient crop consumed as healthy and staple food by more than half of the world population. Rice is consumed by more than 4.8 billion people in 176 countries and is the most important food crop for over 2.89 billion people in Asia, over 40 million people in Africa and over 150.3 million people in America (Biyi, 2005). Rice is the second most important cereal in the world after wheat in terms of production; while Nigeria ranks the highest as both producer and consumer of rice in the West Africa sub region (Jones

1995). Rice is an increasingly important crop in Nigeria. It is relatively easy to produce and it is grown for sale and for home consumption. In some areas there is a long tradition of rice growing, but for many, it is considered a luxury food for special occasion only. With the increased availability of rice, it has become part of the everyday diet of many in Nigeria. There are many varieties of rice grown in Nigeria; some of these are traditional varieties while others have been introduced into the country. Rice is grown virtually in all the agro-ecological zones in Nigeria (Akande, 2003). This is because, Nigeria have ideal climatic conditions which is a kin to that of South East Asia where the crop is produced for export. Although rice production in Nigeria has boomed over the years, there has been a considerable lag between production supply and demand levels with imports making up the shortfall. According to the Nigerian Agricultural Policy document, specific objective of agricultural sector policies is the attainment of self sufficiency in basic food commodities with particular reference to those food commodities which consume considerable shares of Nigeria's foreign exchange and which can be produced locally within the country (Adesina, 2012). In this regard therefore, Nigeria will aim to be more than self sufficient in the production of all cereals except wheat, most roots and tubers, most grain legumes, most oil seeds and nuts, most vegetables and fruits and most vegetable oils. Going by this policy scenario therefore production of rice in Nigeria is bound to expand for several reasons: Rice import consumes considerable share of Nigeria's foreign exchange; the proportion of rice in the food basket of Nigerians has continued to rise and Nigeria has the capacity for the expansion of rice production.

The Federal Government of Nigeria has initiated several strategic policies and programs to address low production efficiency in Nigeria's rice subsector. These policies are targeted at removing production constraints associated with rice production, some of which include: inadequacy and high price of inputs such as fertilizer, rice seeds, herbicides, insecticides, poor access to farm credits, land, extension services, poor rural infrastructure and irrigation facilities, market failures in local paddy rice market and high rice milling costs (Nwinya *et al.*, 2014). Some of these policies, programs and projects include: the national fertilizer policy, national seed policy, land use policy, national extension service policy, agricultural credit guarantee

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scheme fund (ACGSF), commercial agriculture credit scheme, national irrigation policy, government guaranteed minimum producer's price, rice trade policies, rural development programs and recently the anchor borrowers and presidential task force on food security. The Federal Government of Nigeria also simultaneously created several agricultural institutions, agencies, research institutes and universities to implement these policies and programs. These include: Agricultural Development Projects (ADPs), River Basin Development Authorities (RBDA), Bank for Agriculture and Rural Development and National Cereal Research Institute (NCRI) and other research institutes. The Federal, State and Local Governments have also encouraged rice farmers to form cooperative societies so as to enhance their credit worthiness and to enable them benefit from the these policies, programs and projects.

METHODOLOGY

Study area

Adamawa state is located in the North-eastern part of Nigeria and consists of three geo-political zones for the convenience of administration as obtained in other states of Nigeria. These zones are the northern zone, central zone and the southern zone. It shares common boundary with Taraba state in the south and west, with Gombe state in the North-west and Borno state in the North The State has an international boundary with Cameroon Republic along its eastern side. It lies between Latitude 7^o and 11^o North and Longitude 11^o and 14^o East (Adebayo and Tukur, 1999). Adamawa State has a land area of about 38, 741 Km^2 and a population of 4.2 million people. The state is divided into (21) Local Government Areas.

The state has a tropical climate marked by dry and rainy seasons. The rainy season starts in April and ends in October while dry season spans from November to March. The average rain fall ranges from 700mm in North-western part of the state to 1600mm in the southern part of the state (Adebayo and Tukur, 1999). The maximum temperature in the state can reach 40^oC particularly in April, while the minimum temperature can be as low as 18^oC between December and January, monthly mean temperature in the state ranges from 26.7^oC in the south to 27.8^oC in the north-eastern part of the state. The northern part of Adamawa State has the sub-sudan

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vegetation zone marked by short grasses interspersed with short trees, while in the southern part, the northern guinea savannah vegetation exist.

Sources of data and sampling techniques

Primary data were used for the study and it was collected with the aid of well-structured questionnaires administered by trained enumerators under the supervision of the researcher. Adamawa State is made up of 21 Local Government areas (LGAs) divided into four agricultural zones by the Adamawa State Agricultural Development Programme (ADADP) for administrative convenience. Multi-stage sampling technique was employed for the selection of respondents in these zones. In the first stage, two Local Government Areas each was purposively selected from each of the Four ADADP zones since rice is produced across all the Local Government Areas of the state. In the second stage Five Villages were also purposively selected from each of the Local Government Areas, based on the relative concentration of the rice farmers to give a total of fourty Villages. In the third stage, 362 respondents from the selected villages were randomly sampled proportionate to the size of the villages. Where there was no available sampling frame showing the list of all the rice farmers in the villages sampled, village heads/community leaders were used to provide the list of the farmers which was used as the sampling frame.

Data analysis

Analysis of data employs a Cobb-Douglas production function to simultaneously estimate allocative efficiency and the random disturbance term which is outside the control of the production unit and the inefficiency effects. The model was applied to be accomplished by the use of Maximum Likelihood Estimates which have been used extensively by various authors in estimating efficiency among crop farmers (Maurice, 2012, Musa, 2014 and Nwinya *et al*., 2014). Specified thus:

$$\ln C_{ij} = \beta_0 + \beta_1 \ln P_{1ij} + \beta_2 \ln P_{2ij} + \beta_3 \ln P_{3ij} + \beta_4 \ln P_{4ij} + \beta_5 \ln P_{5ij} + \beta_6 \ln P_{6ij} + \beta_7 \ln Y_{7ij} + V_{ij} - U_{ij} \quad (1)$$

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Where:

Subscript ij refers to the j^{th} observation of the i^{th} farmer.

Ln = Logarithm to base e

C_{ij} = Total production cost (₦/ha) of the i^{th} farmer

P_1 = Cost of land acquisition (₦/ha)

P_2 = Cost of seed (₦/ha)

P_3 = Cost of inorganic fertilizer (₦/ha)

P_4 = Cost of labour (₦/ha)

P_5 = Cost of herbicides (₦/ha)

P_6 = Cost of transportation (₦/ha)

Y_7 = Output of rice (kg)

It is assumed that the cost inefficiency effects are independently distributed and U_i arises by truncation (at zero) of the normal distribution with mean, μ_{ij} and variance δ^2, where μ_{ij} is defined by:

$$\mu_i = \delta_0 + \delta_1 Z_{1ij} + \delta_2 Z_{2ij} + \delta_3 Z_{3ij} + \delta_4 Z_{4ij} + \delta_5 Z_{5ij} + \delta_6 Z_{6ij} + \delta_7 Z_{7ij} + \delta_8 Z_{8ij} \quad (2)$$

Where:

μ_{ij} = The technical inefficiency of the i^{th} farmer

Z_1 = Age of the farmer (years)

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Z_2 = Education (years spent in formal education)

Z_3 = Farming experience (years)

Z_4 = Household size (number)

Z_5 = Extension contact (number of extension visits)

Z_6 = Credit facilities (dummy, where: access = 1, and no access = 0)

Z_7 = Seed variety (dummy, where Improved seed =1, and local seed = 0)

Z_8 = Primary occupation (dummy, where: full time farming =1, and otherwise = 0)

RESULTS AND DISCUSSION

The maximum likelihood estimates for the parameters of stochastic cost function for rice farmers in the study area is presented in Table 17. The result showed that gamma (Υ = 0.867) was statistically significant at 1% level indicating the existence of allocative inefficiency effects. The sigma value (σ^2 = 0.072) also was significant at 1% level, which confirms good fit of the model and the correctness of the assumption of the composite error term. All the coefficients of the variables included in the cost function had the expected positive signs. This suggests that there is a positive relationship between the total cost of production and the cost of these variables. Cost of seed, cost of labour, cost of herbicides and output of rice were statistically significant at varying degrees of probability, which therefore implies that the factors are important determinants of total cost associated with rice production in the study area. Therefore an increase in these inputs will lead to increase in the total production cost of rice.

The coefficient of seed is 0.119, indicating that an increase in the cost of seed by 1% will cause the total cost of production to increase by 0.119%. Similarly, if the cost of labour is increased by 1% the total cost of production will rise by 0.585%. Also Table 17 showed that the cost of herbicides and impact of rice output on the cost of production were also significant at 1%.

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This indicates that 1% increase in the cost of herbicides and output of rice will increase total cost of production by 5.980% and 5.989% respectively.

Table 17 further revealed that age of the farmer, educational level, farming experience, seed variety and primary occupation were the determinants of allocative efficiency of the rice farmers in the study area. Age of the farmer was statistically significant at 5% level and had a negative sign. This means that increase in age of the farmer reduces his cost inefficiency this because as the farmer grow older the years he puts in to rice farming and the more experience he gains.. Education also carries a negative sign and statistically significant at 5% level. This means that increased educational advantage lowers the cost inefficiency of the rice farmers. The more farmers acquire formal education the better they are in taking decisions in allocating resources and the more productive they are. This shows that education plays a critical role in influencing efficiency of the farmer. This corroborates the findings of (Ogunniyi *et al.*, 2012) and Kadiri et. al. (2014) who observed that education represents a significant determinant of the cost efficiency of the rice farmers. The result also revealed that, estimated coefficient of farming experience carried negative sign and was statistically significant at 1%. The implication of this is that experienced farmers are likely to take cost decisions that will lead to allocative efficiency compared to farmers who have little or no experience.

Similarly, the coefficient of seed variety of the sampled farmers carried the expected sign and was statistically significant at 1% probability level. This implies that rice farmers that use improved variety of seed tend to decrease cost inefficiency and thus increase cost efficiency thereby leading to the better output. This is because farmers that used improved varieties of seed may tend to have a higher yield compared to the farmer that used local variety. Also, the coefficient of primary occupation was statistically significant at 1% probability level and carries the expected sign. The inference here reveals that respondents who are full time farmers may tend to be more allocative efficient than part time farmers, this is because full time farmers may tend to denote more time, resources and energy on the farm.

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Table 17: Maximum Likelihood Estimates of the Parameters of the Stochastic Frontier Cost Function

Variables	Parameters	Coefficients	St. errors	t-ratios
Production Factors				
Constant	β_o	0.834	0,056	14.917*
Cost of land (P_1)	β_1	0.092	0.052	1.771
Cost of seed (P_2)	β_2	0.119	0.046	2.615*
Cost Inorganic fertilizer (P_3)	β_3	0.096	0.758	1.262
Cost of labour (P_4)	β_4	0.585	0.184	3.188*
Cost of herbicides (P_5)	β_5	0.072	0.012	5.980*
Cost of transportation (P_6)	β_6	0.113	0.076	1.479
Output of rice (Y_7)	β_7	0.083	0.014	5.989*
Inefficiency Factors				
Age of the farmer (Z_1)	δ_1	-0.114	0.053	-2.139**
Education (Z_2)	δ_2	-0.128	0.051	-2.500**
Farming Experience (Z_3)	δ_3	-0.206	0.059	-3.469*
Household size (Z_4)	δ_4	0.097	0.061	1.579
Extension contact (Z_5)	δ_5	0.029	0.029	0.981
Credit facilities (Z_6)	δ_6	-0.015	0.018	0.824
Seed variety (Z_7)	δ_7	-0.111	0.029	-3.740*
Primary occupation (Z_8)	δ_8	-0.867	0.034	-3.991*
Sigma squared	σ^2	0.072	0.011	5.864*
Gamma	Υ	0.867	0.034	25.814*
Log likelihood function		151.789		

Source: Computer Output from Frontier Version 4.1c
* Significant at 1%
** Significant at 5%

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The allocative indices derived from the analysis of the stochastic cost function is presented in Table 18. The minimum and maximum farmers' allocative efficiency of 0.52 and 0.98 showed that there was high variation between the least allocatively efficient rice farmer and the best allocatively efficient rice farmer. The least allocatively efficient farmer would require about 48%, (that is, 1.0 – 0.52) to achieve allocative efficiency gain while the best allocatively efficient farmer would require just about 2% to attain maximum allocative efficiency level.

The inference drawn shows that 1.66% of the sampled farmers had allocative efficiency of 0.51-0.60, while 13.53% had allocative efficiency of 0.61-0.70. However, majority of the respondents (84.81%) had allocative efficiency of more than 70 %. The result indicates that although the sampled farmers in the study area were allocatively efficient in producing a given level of output, given a mean of 0.83 (83%) there is still considerable potential for the farmers to improve in the allocation of resources so as to minimize resource wastage associated with production process and consequently reducing production cost.

Table 2: Distribution of Allocative Efficiency of Respondents

Efficiency Levels	Frequency	%
51-60	6	1.66
61-70	49	13.53
71-80	81	22.38
81-90	117	32.32
≥91	109	30.11
Total	362	100.00
Minimum	0.52	
Maximum	0.98	
Mean	0.83	

Source: Field Survey, 2017.

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CONCLUSION AND RECOMMENDATIONS

Emergent from the findings of this study, it was concluded that rice farmers in Adamawa State of Nigeria were not fully allocativelly efficient in the use of farm resources. This may be as a result of high cost of seeds, labour and herbicides. This implies that allocative efficiency in rice production in the study area could be enhanced through optimal use of such inputs. To ensure efficiency in the use of resources in rice production in the area, the study, recommend revitalization of formal education and accessibility and affordability to improved seed varieties to the farmers through government agricultural transformation agenda.

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