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GENDER ANALYSIS OF RICE PRODUCTION EFFICIENCY IN OSUN STATE: IMPLICATION FOR THE TRANSFORMATION AGENDA.

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Abstract

This study examined the gender characteristics in the efficiency of rice production in Osun state. Primary data were elicited from 100 rice farmers with the aid of structured pre-tested questionnaire and analysed using frequency counts, budgetary analysis and stochastic frontier production function. Findings showed that the majority (62%) of the farmer were males, below 50 years of age (52%) with only 6 years of formal education (58%) having farming as their primary occupation (65%) and cultivating up to 5 hectares of land (66%), while, only 42% of the female farmers were below 50 years of age. Most (71%) respondents had up to 6 years of formal education, cultivated up to 5 hectares (61%) of land, few (18%) chose farming as primary occupation. The budgetary analysis revealed that ₦2.18 profit accrued to every ₦1 invested in rice production. Hiring an additional female labour during planting improved total output by 7.1kg, while an extra male labour hired during land clearing, fertilizer application and harvest reduced output by 46.4kg, 35.5kg and 11.2kg respectively. A naira increase in the cost of fertilizer increases total output by 2.7kg. The study concluded that male farmers' were more efficient than the female farmers. Farmers' efficiency can be enhanced through mechanisation and fertilizer input supply; while provision of postharvest equipment will help women diversify into value addition.

Keywords: Rice production, Gender, Technical efficiency, Stochastic production frontier

Introduction

Rice has become a strategic commodity in the Nigerian economy. Since the mid-1970s, rice consumption in Nigeria has risen tremendously, at about 10% per annum. A combination of factors seems to have triggered the structural increase in rice consumption. Like elsewhere in West Africa, urbanization appears to be the most important cause of the shift in consumer preferences towards rice in Nigeria (Akpokodje *et. al*., 2001). Akande (2003), however, added increasing population growth, increased income levels, changing consumer preferences and associated changes in family occupational structures as factors responsible for the rising demand for rice.

Though, Nigeria the highest rice producer in West Africa (Daramola, 2005); it is also the largest consuming nation in the region (USDA FAS, 2003). Current national consumption is about five million tonnes and it is projected to reach 35 million tonnes by 2050. Domestic production which stands at about 3 million metric tonnes, has never been able to meet the demand, leading to considerable imports which today stands at about 1,000,000 metric tons yearly. Nigeria has thus become a major rice importer in the world market and second only to Indonesia in the first five years of the last decade (2000-2005). Estimates indicated that rice imports represent more than 25 per cent of agricultural imports and over 40 per cent of domestic consumption (FMARD, 2004).

The considerable political interest in sustainable rice production stems from a number of reasons. First, rice import consumes considerable share of Nigeria's foreign exchange (Umeh and Ataborh, 2007). Second, international rice market is relatively small, accounting for only about 6% of the total rice produced globally. Specifically, the ongoing Asian agricultural transformation, induced by the diversification of consumption patterns and the continuous growth of total rice consumption, may affect the volume of exportable, surplus rice (as have policy shifts, and political and environmental events in the past) (Nwanze *et. al*., 2006). In addition, high global demand for rice and thin trading volume being witnessed, are the major causes of rice price volatility in the global market, with the price moving from US$400/metric ton in 1981 to over US$1000/metric ton in 2010 (FMARD, 2010).

Third, Nigeria is endowed with favourable ecologies for rice cultivation. Virtually all the rice growing ecologies (the upland irrigated, inland valley swamp, deep water floating and tidal mangrove swamp) abound in Nigeria (Umeh and Ataborh, 2007). Nigeria's total land mass cropped to rice is not fully developed (Akpokodje *et. al*., 2001) as potential and actual areas for rice production stood at 4.6-4.9 million hectares and 1.77 million hectares respectively (WARDA, 1996; Singh *et.al*., 1997 and Imolehin and Wada, 2000).

Fourth, rice has become a major source of calories for the urban poor in Nigeria as the poorest third of urban households obtain 33% of their cereal-based calories from rice, and rice purchases represent a major component of cash expenditures on cereals (World Bank, 1991). In several African states, including Nigeria, rice availability and rice prices have become a major determinant of the welfare of the poorest segments of consumers who are least food secure. Hence, rice is on the front line in the fight against hunger and poverty in SSA (Nwanze *et al*, 2006). Ibrahim *et al.,* (2008), then concluded that increase in rice production is necessary because it has a great potential to play a crucial role in contributing to food and nutritional security, income generation, poverty alleviation and socioeconomic growth of Nigerians.

The Nigerian government has actively interfered with the rice economy over the over the past few decades. The country's policy on rice has been inconsistent and has oscillated between import tariffs and import restrictions including outright ban (Emodi and Madueke, 2008) and domestic production has continued to lag behind demand. The most recent policy is the Agricultural Transformation Agenda of the Federal government. Under the agricultural transformation agenda, rice transformation plan aimed at achieving massive local production and milling of rice which will be aimed at substituting parboiled (imported) rice. The expectation is that with the advent of high quality lower cost milled rice, a significant portion of demand in the domestic rice market will shift from parboiled rice to milled rice (FMARD, 2011). Demand-supply gap in rice can only be filled through promoting vigorous rice production across all the six geopolitical zones in Nigeria to be self-sufficient. To this end, a call was made to all the rice producing states, among which Osun state is one, to play a key role in achieving the goal of this agenda.

Various studies has attributed major sources of decline in rice production in Nigeria to fluctuation of water table; and attendant dangers of flooding; inadequate water supply at the

end of the dry season; high cost of water lifting devices; lack or shortage of agrochemicals; lack of improved seeds and high cost of labour among others (Kolawole and Scoones, 1994; Atala and Voh, 1994). Other problems include the socio-economic and production characteristics of the farmers, inconsistent and unfocussed government policies, the poor infrastructure base which interacted in a synergism to asphyxiate the sector, resulting in low production (Okuneye, 2001). The implication is that there is scope for additional increases of output from existing hectares of rice, if resources are properly harnessed and efficiently allocated.

Oladeebo and Fajuyigbe, (2007) pointed out that a very important feature of the Nigerian agriculture is the fact that men and women, who are interested in farming, practice it. The same is true for rice production. They also hypothesized that there are differences in the productivity of men and women farmers. Such differences are likely because men and women within the African rural household pursue their own activities both on and off the farm. They also have different endowments (such as land rights and education), different levels of human strength, different access and adoption of technologies, factor of production (such as capital, labour and management) etc. which add to the efficiency of production. They also alluded to Boserup's argument that development policies were biased against women's issues, and that women's contributions were unrecognized and unaccounted for. Consequently, development outcomes met with little successes. Hence, this study becomes crucial in examining gendered gap in the production efficiency of rice in Osun state in order to eliminate waste and identify entry points for rice transformation plan of the Federal Government in the state, since increased output and productivity are directly related to production efficiency (Amaza and Olayemi, 2002).

While considerable efforts have been directed at examining productive efficiency of farms in Nigeria (Ojo 2004; Ogundari and Ojo 2005), the few available location specific studies such as Ogisi *et. al*., (2012), *Aihonsu et. al.*, (2005), Busari and Omonona, (2010) explored technical efficiency of rice production in different states in Nigeria. Oladeebo and Fajuyigbe (2007) compared the technical efficiency between men and women rice farmers in Osun state, and also examined factors affecting efficiency of each gender. Little attention has been given to measuring the effect of the labour contribution of men and women involved in various stages of rice production on total output.

To address that gap, this study was designed to disaggregate the gender characteristics in rice production efficiency in Osun state. The specific objectives of the study are to:

(1) Describe the socioeconomics characteristics of rice producing household by gender,
(2) Determine the profitability of rice production, and
(3) Determine the factors influencing the technical efficiency of rice farmers.

Methodology

For this study, farm level data was collected from cross-sectional survey of 100 farmers in Osun state for the 2010/2011 farming season. Osun state is one of the rice producing states in Nigeria and has basically rainforest and savannah agro-ecological systems. Three-phase multistage sampling method for the choice of Local Government areas (LG), communities and households were carried out. The first stage involved the purposive selection of Oriade and Egbedore local government areas based on the *a priori* knowledge that the LGAs are the highest rice producing areas in both the rainforest and savannah agro-ecologies of Osun state respectively and both men and women are actively involved in it. The second stage involved a random selection of three communities from Oriade LG, namely, Erin-Ijesa, Erin-oke and Erinmojesa and two communities from Egbedore LG, namely, Awo and Iragberi. The last stage involved the selection of 20 rice farmers including men and women household heads from each of the five communities using the snowball technique. This gives a total of 100 rice farmers in all.

Primary data were generated through the use of structured questionnaire to elicit information on socio-economic characteristics of the farmers such as age, sex, education level, family size and so on. Also collected were price data input and output variables, production variable such as farm size, agrochemical use, labour utilization and quantity of rice seed utilised.

Data analysis was achieved through use of descriptive statistics, budgetary analysis and Cobb-Douglas stochastic frontier production function respectively.

Budgetary technique: According to Omonona *et al*., (2012), the gross margin analysis was used owing to the fact that in traditional agriculture, apart from the fact that very little fixed inputs are used, the practice of intercropping with different crops maturing at different times further complicates the estimation of the fixed costs that can be assigned to each crop harvested unlike the variable costs which are more reliable and easier to allocate. The Gross margin is therefore considered a good proxy of profitability in farms where intercropping is practiced because it uses only the total variable cost in the estimations.

Gross margin technique was employed to access the profitability of rice farmers in the study area. Mathematically, it is expressed as

$$GM = \Sigma P_i Q_i - \Sigma C_J X_J \qquad (3)$$

In which, GM = Gross Margin;

P_i = Unit price of product i,

Q_i = Quantity produced of product i,

C_J = Unit variable cost of input j,

Xj = Quantity of input used.

In addition, benefit cost ratio (BCR) was employed in the productivity analysis. The BCR is represented as:

$$BCR = \frac{Value\ of\ output}{Total\ Cost\ Incurred}$$

The items consisted in total cost incurred include: the imputed rent on land representing the amount the farmers paid for land or would have paid for land if they did not own it; and hoes and cutlasses utilized during production with their limited depreciation rate calculated as an annual percent over the useful life span of each item.

The stochastic frontier production function will be employed for the analysis of efficiency of rice production in the study as specified by the Cobb-Douglas functional form (Seyoum *et.al.*, 1998) is defined thus:

$$\ln Y_i = \ln b_0 + b_1 \ln X_{1i} + + b_2 \ln X_{2i} + b_3 \ln X_{3i} + b_4 \ln X_{4i} + b_5 \ln X_{5i} + b_6 \ln X_{6i} + b_7 \ln X_{7i} + b_8 \ln X_{8i} + b_9 \ln X_{9i} + b_{10} \ln X_{10i}\ V_i - U_i \quad (4)$$

Where Yi = Total amount of rice harvested (kg)

X_1 = Fertilizer Cost (₦)
X_2 = Herbicide Cost is labour (man-days)
X_3 = Seed cost (₦)
X_4 = Male hired for land clearing (man-days)
X_5 = Female hired for planting (man-days)
X_6 = Male hired for planting (man-days)
X_7 = Male labour for fertilizer application (man-days)
X_8 = Female labour for fertilizer application (man-days)
X_9 = Male labour for harvesting (man-days)
X_{10} = Female labour for harvesting (man-days)
b_i = parameter estimates
V*i* = Random error that is assumed to be normally distributed with zero mean and constant variance (δ_{vi}^2) and Ui is technical inefficiency effects which are independent of Vi, and have half normal distribution with mean zero and variance (δ_{ui}^2). Following Battese and Coelli (1995), the mean of farm specific technical inefficiency Ui is defined as:

$$U_i = \sigma_0 + \sigma_1 Z_1 + \sigma_2 Z_2 + \sigma_3 Z_3 \quad (5)$$

Where:
Z_1 is age of farmer
Z_2 is sex of farmers
Z_3 is farm size

These variables were included in the model to determine their influence on the technical efficiencies of the farmers. Generalised likelihood ratio test was used to test for the null hypothesis of no inefficiency effects. The b's and the σ are the scalar parameters to be estimated. The variances of the random errors, sv^2 and that of the technical inefficiency effects su^2 and overall variance of the model s^2 are related thus: $s^2 = sv^2 + su^2$ while the

ratio; g = su^2/ sv^2 measures the total variation of output from the frontier which can be attributed to technical inefficiency (Battese and Cora,1977). The estimates for all the parameters of the stochastic frontier production function and the inefficiency model are simultaneously obtained using STATA 11.2.

Result and Discussion

The result presented in Table 1 showed that rice production in the study area were dominated by the male which accounts for 62% of the respondents indicating that men who naturally are the stronger gender tends to engage more in rice production. This result suggested that gender may be a factor in enterprise selection and production in the study area. Many of the female farmers (42%) and more than half of the male farmers (53%) were less than 50 years old and, as such, are expected to be economically active to make meaningful impact in agricultural production. The study revealed that most (73.3%) of the respondents were married. This finding has implication for the availability of family labour for rice production given that family members are available for farm operations. Most of the men (58%) and women (71.1%) farmers had only primary school education, while a mere 38.7% of the men and 7.9% of the women attained secondary school level. The rest had up to tertiary education.
Many of the men farmers engaged in agricultural production as a primary (65.4%) and secondary (35.5%) occupation while only about 18% and 28.9% of the women farmers were engaged in agricultural production as a primary and secondary occupation. Most farmers, both men (66.1%) and women (60.5%), allocated not less than 3 hectares of land to rice cultivation.

Budgetary Analysis: Table 2 contained the gross margin analysis of rice production in the study area. The result revealed that rice production is quite profitable and it was also shown that labour cost accounted for 47.56% of the total variable costs. This result is consistent with that of Aromolaran, (1992) and Omonona, (2012), who reported that labour constitutes a large percentage of the total variable cost of production in rice cultivation. It is therefore worthwhile to devise technology that is less laborious so as to reduce cost of production. For a hectare of land cultivated to rice, a gross margin of ₦272,011.16 was realized. Benefit and cost ratio analysis also implies that a profit of ₦2.18 accrued to a farmer for every ₦1 incurred on rice production.

Technical Efficiency: Table 3 presented the estimates from the stochastic production frontier. The result showed that fertilizer cost and hired females involved in planting are significant and positively influenced production. Increasing the cost of fertilizer by ₦1 will increase total output by 2.7%. This is due to the fact that fertilizer adds nutrients to the soil. Hiring an additional female labour for planting will improve total output by 7.1%. This could be attributed to the fact that planting operation is less strenuous, hence females are involved.
The coefficient of the estimates of male hired labour involved in land clearing, fertilizer application and harvesting were negative and significant suggesting that the variables were

being operated at the level of diminishing returns. Hence, hiring additional male labour for these operations will reduce total output by 46.4%, 35.5% and 11.2% respectively.
The negative effect of farm size on total output implies that an additional hectare expansion in land results in 96.5% reduction in total rice produced. Hence, the use of traditional crude implement as well as manual technique of fertilizer application and harvesting of rice could be implicated in this reduction.

The presence or absence of technical inefficiency was tested in the study using the parameter of log likelihood in the half-normal model $\lambda = \frac{\sigma u}{\sigma v}$. If $\lambda = 0$, there is no effects of technical inefficiency, and all deviations from the frontier were due to noise (Aigner et. al., 1977). The estimated value of $\lambda = 3.16$ was found to be significantly different from zero. The null hypothesis that there is no inefficiency effect was therefore, rejected at $p<0.05$; suggesting the existence of inefficiency effects for rice farmers in Osun state.

The estimated coefficients of inefficiency model in Table 3 indicated that the coefficient of farm size is negative and significant at 5% while that of sex is significantly positive . This result suggests that efficiency in rice production in the study area decline with increase in farm size but increases as the number of female headed households increases. An additional hectare put to rice cultivation increases rice output by 97%. Also, sex of the farmer is positively related to total output in the inefficiency model portraying the fact that male farmers are more efficient than the female farmers in rice production. This is further corroborated by the result in Table 4. The laborious nature of rice farming activities may be the reason for this finding.

The null hypothesis of no significant difference in the mean technical efficiency between men and women farmers was evaluated using t-test for large samples ($n > 30$) which was not rejected because $T_c < T_{0.95}$, that is, $0.33< 2.0$. This result suggested that there is no significant difference in the mean technical efficiency obtained by men and women rice farmers in the study area. In table 4, the farm-specific indices of technical efficiency vary widely among the farmers ranging between 0.37 and 0.99 with a mean technical efficiency of 0.77 for the male while for the female is 0.19 and 0.98 with a mean technical efficiency of 0.74. In addition, 72.6% of the male and 81.2% of the female farmers had technical efficiency exceeding 70%. These results compared favourably with the rather high technically efficient rice production indices documented by Oladeebo and Olajuyigbe, (2007) in Osun state.

The overall efficiency as shown in Table 4 was 78%, which implies that the technical efficiency in rice production in the study area would be increased by 22% with better use of available resources give the current state of technology.

Conclusion and Recommendations

This study analysed the stochastic frontier production functions for rice farmers in Osun state. The result of descriptive statistics showed that 62% of the respondents are male while only 38% are female. While most of the men (67.7%) and women (73.3%) were married, 53% of the male and only 42% of the women were less than 50 years. A mere 29% of the female and

42% of the men had above primary school education. The male rice farmers (64.5%) were primarily occupied with farming while few female farmers (18.4%) had farming as primary occupation.

The budgetary analysis revealed that ₦2.18 profit accrued to every ₦1 invested in rice production. The result revealed that availability of fertilizer and hiring of female planters positively affects total output. On the other hand, male hired labour for fertilizer application, land clearing and harvesting reduced output. In addition, determinants of inefficiency were found to be gender and farm size and are therefore important for the achieving effective transformation in the rice subsector in the study area. The policy implication of the findings from this study is that there is scope for additional increases of output from existing farm size planted to rice with provision of fertilizer and farm mechanisation. In addition, postharvest equipment and other labour saving devices, such as milling machine, could encourage the women to diversify into value addition and the women should be so stimulated through regular trainings and credit provision.

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Table 1: Socioeconomic characteristics of Rice Farmers in Osun State.

(a)	Sex	Frequency		Percentage	
	Male	62		62	
	Female	38		38	
	Total	**100**		**100**	
		Male headed		**Female headed**	
		Frequency	Percentage	Frequency	Percentage
(b)	Age				
	20 - 29	3	4.8	0	0
	30 - 39	17	27.4	3	7.9
	40 - 49	13	21.0	13	34.2
	50 - 59	12	19.4	11	28.9
	60 - 69	9	14.5	10	26.3
	70 - 79	7	11.2	1	2.6
	80 - 89	1	1.6	0	0
	Total	**62**	**100.0**	**38**	**100.0**
(c)	Marital Status				
	Single	12	19.4	1	2.6
	Married	42	67.7	28	73.7
	Widowed	5	8.1	5	13.2
	Divorced	3	4.8	4	10.5
	Total	**62**	**100**	**38**	**100**
(d)	Education				
	Primary level	36	58.1	27	71.1
	Secondary level	24	38.7	3	7.9
	Tertiary level	2	3.2	8	21.0
	Total	**62**	**100**	**38**	**100**
(e)	Primary Occupation				
	Farming	40	64.5	7	18.4
	Trading	10	16.1	12	31.5
	Civil Servant	5	8.1	10	26.4
	Carpentry	6	9.7	0	0
	Artisan	1	1.6	9	23.7
	Total	**62**	**100**	**38**	**100**
(f)	Secondary Occupation				
	Farming	22	35.5	11	28.9
	Trading	20	32.5	24	63.1
	Artisan	7	11.3	3	7.9
	Civil Servant	4	6.5	0	0
	Others	9	14.5	0	0
	Total	**62**	**100**	**38**	**100**
(g)	Farm Size				
	0 - 2	9	14.5	1	2.6
	3 - 5	32	51.6	22	57.9
	6 - 8	17	27.4	12	31.6
	9 - 11	4	6.5	3	7.9
	Total	**62**	**100**	**38**	**100**

Source: Field Data, 2011.

Table 2: Gross margin/hectare of rice production in Osun State

Item/hectare	Amount (₦)	% of TVC
Total Revenue	**489,950.00**	
Variable Cost:		
Rice Seed	50,986.00	23.40
Herbicides	28,387.32	13.03
Insecticides	14,691.85	6.74
Fertilizer	20,214.52	9.28
Labour	103,659.15	47.56
Total Variable Cost	**217,938.84**	
Fixed cost:		
Rent on land	5,000.00	
Depreciation of farm tools	2,030.00	
Total Fixed Cost	**7,030.00**	
Total Cost	**224,968.84**	
Gross Margin (TR-TVC)	272,011.16	
BCR	**2.18**	

Source: Field Data, 2011

Table 3: Stochastic frontier model of rice production in the study area

Variables	Coefficients	Standard Error	p>/z/
Fertilizer Cost	0.027	0.013	0.031*
Herbicide Cost	-0.008	0.007	0.250
Seed Cost	-0.149	0.029	0.600
Male Hired for land Clearing	-0.464	0.110	0.000*
Female Hired for Planting	0.071	0.023	0.002*
Male Hired for Planting	-0.007	0.032	0.820
Male Labour for Fertilizer Application	-0.355	0.106	0.001*
Female Labour for Fertilizer Application	0.011	0.018	0.545
Male Labour for Harvesting	-0.112	0.046	0.015*
Female Labour for Harvesting	0.029	0.031	0.718
Constant	-14.159	0.668	0.000
Inefficiency Model			
Age	-0.005	0.026	0.864
Sex	3.502	0.788	0.000*
Farm Size	-0.965	0.194	0.000*
Constant	-5.666	1.550	0.000
Diagnostic Statistics			
σ_v	0.150	0.050	
σ_u	0.460	0.070	
σ^2	0.230		
$\lambda = \frac{\sigma u}{\sigma v}$	3.160		0.005*
Likelihood ratio	1169.350		
Wald Chi	0.000		

Source: Field Data, 2011.

Table 4: Distribution of Technical Efficiency from Stochastic Frontier Model

	Male household		**Female Household**		**Pooled**	
Technical Efficiency	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
< 0.30	0	0	1	2.6	1	1
0.31 - 0.40	2	3.2	1	2.6	3	3
0.41 - 0.50	5	8.1	0	0	5	5
0.51 - 0.60	5	8.1	3	7.9	8	8
0.61 - 0.70	5	8.1	4	10.5	9	9
0.71 - 0.80	11	17.7	15	46.9	27	27
0.81 - 0.90	13	21.0	8	21.1	21	21
> 0.9	21	33.9	5	13.2	26	26
Total	62	100	38	100	100	100
Minimum	0.37		0.19		0.19	
Maximum	0.99		0.98		0.99	
Mean	**0.77**		**0.74**		**0.78**	

Source: Field Data, 2011.