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GENDER AND PRODUCTIVITY DIFFERENTIALS AMONG RICE FARMERS IN NIGER STATE, NIGERIA

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Abstract

The study compared the differences in the productivity of male and female rice farmers in Niger State, Nigeria. Data used for the study were obtained from primary source using a multi-stage sampling technique with structured questionnaires administered to 150 randomly selected male and female rice farmers from the study area. Descriptive statistics such as means, standard deviations and percentages were used to summarize the variables used in the analysis while input– oriented data envelopment analysis (DEA) was used to empirically determine the total technical, pure technical and scale efficiency with respect to gender in the study area. The DEA results revealed that the male rice farmers were more scale efficient than their female counterparts with mean scale efficiency scores of 0.71 and 0.63 for male and female rice farms respectively. The results also showed that about 77 % and 83% of male and female rice farms operated at increasing returns to scale level respectively. This implies that the two farm groups could achieve higher efficiency level by increasing the production scale. The comparison test for significant differences in mean technical efficiency among the two farm categories confirmed that the mean total and pure technical efficiency with scale efficiency are statistically and significantly higher on male rice farms than on female rice farms. The implication of these findings is that male rice farmers are fairly efficient in utilizing their resources than their female counterparts and any expansion in the use of resources would bring more than proportionate increase in their outputs. The study therefore recommended that research efforts directed towards the generation of new technology, especially for rice farmers, should be encouraged in the study area.

Keywords: Gender, Productivity, scale efficiency, rice production

Introduction

Rice is a major staple food in Nigeria, but its domestic production has never been able to meet the demand. It has been estimated that annual rice production needs to increase from 586 million metric tonnes in 2001 to meet the projected global demand of about 756 million metric tonnes by 2030 (Kueneman, 2006). The crop is commonly consumed even as a food crop for household food security. The average Nigerian consumes about 24.8 kg of rice annually, representing 9 per cent of the total annual calories intake and 23 per cent of total annual cereal consumption (Fakayode, 2009). Although rice production in Nigeria has boomed over the years, there has been a considerable lag between production and demand level with imports making up the shortfall. Domestic productions of this commodity have been inadequate and unable to bridge the increasing demand-supply gap (Idiong, 2007*)*. The Government's goal of achieving self sufficiency in rice production to a large extent will depend on the level of farmers' productivity.

In Nigerian agriculture, rice farming is practiced by both genders (men and women) which bring about differences in farmers' productivity. Gender in agriculture focuses on the relationship between men and women with regard to their roles, access to and control of resources, division of labour and needs. In agricultural production, women have been found to be

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more constrained in accessing production resources than their male counterparts. This has often been reflected in women having less access to information, technology, inputs and credit resulting in women having more depressed productivity than men counterpart (Shultz, 1988 quoted from Ojo *et al*, 2013). The gender yield differential apparently is caused by the difference in the intensity, with which measured inputs of labour, manure, and fertilizer are applied on plots controlled by men and women, rather than by difference in the efficiency with which these inputs are used (Adeleke *et al*, 2008).

The subject on whether men are more resource-use productive than women has been extensively discussed in literatures, while some reported that women are as productive as men, others found that women are less productive than men. Agricultural productivity of production unit, defined as the ratio of its output to its input varies due to differences in production technology, differences in setting in which production occurs and differences in efficiency of the production process (Tewodros, 2001). Currently, policy makers have started to believe that an important source of growth in agricultural sector is efficiency gain through greater technical, economic and allocative efficiency by producers in response to better education and information. Efficiency is an important factor of productivity growth especially in developing agricultural economies where resources are meagre and opportunity for developing and adopting better technologies have lately started dwindling (Ali and Chaudhry, 1990). The role of increased efficiency and productivity of rice farms across genders is no longer debatable but a great necessity in order to reverse the low resource productivity of small holder farms in Nigeria. The main objective of this paper is to compare the resource productivity level between men and women rice farmers in the study area. This will help in providing information that may be useful in designing effective policies toward agricultural productivity in the nation at large.

Analytical Framework

The terms productivity and efficiency are often used interchangeably but these are not precisely the same things. Productivity is an absolute concept and is measured by the ratio of outputs to inputs while efficiency is a relative concept and is measured by comparing the actual ratio of outputs to inputs with the optimal ratio of outputs to inputs. Productivity could be measured in terms of marginal physical product (MPP) in which case, the interest is in the addition to total product resulting exclusively from a unit increase in the use of that input i.e., total factor productivity (TFP) growth, which is measured using the frontier and non-frontier approaches. It therefore suffices to say that productivity can only be measured and ascertained from farm-level efficiency (Udoh and Falake, 2006). According to Arthur *et al.,* (2001), an important concept of productivity analysis is technical efficiency. Productivity is generally measured in terms of the efficiency with which factor inputs, such as land, labour, fertilizer, herbicides, tools, seeds and equipment etc are converted to output within the production process (Umoh and Yusuf, 1999). Generally, there are two approaches to measure efficiency estimates of a firm i.e. parametric approach and non-parametric approach. Parametric approach involves the use of stochastic frontier analysis (SFA) while non-parametric approach involves the use of data envelopment analysis (DEA). DEA approach was preferred over parametric approach for the estimation of efficiency in this study because it provides means of decomposing total technical efficiency into pure technical and scale efficiency (SE). Technical efficiency scores can be obtained by running a constant returns to scale DEA model or variable returns to scale (VRS) DEA model. Technical efficiency scores obtained from constant returns to scale (CRS) DEA model are called total technical efficiency and from variable returns to scale DEA model as pure technical efficiency. Total technical efficiency of a firm can be decomposed into pure technical and scale efficiency. Pure technical efficiency relates to management practices while scale efficiency relates to the residuals. This would enable better understanding of the nature of technical efficiency of farms and would assess the possibilities for productivity gains by improving the efficiency of farmers in the study area. The key construct of a DEA model is the envelopment surface and the efficient projection path to the envelopment surface (Charnes *et al*., 1978). The

envelopment surface will differ depending on the scale assumptions that underline the model. The efficiency projection path to the envelopment/surface will differ depending on if the model is output-oriented or input oriented. The choice of model depends upon optimization production process characterizing the firm. Input oriented DEA determines how much the mix for a firm would have to change to achieve the output level that coincides with the best practice frontier. Output-oriented DEA is used to determine a firm's potential output given its inputs mix if operated as efficiently as firms along the best practice frontier. For this study input-oriented DEA was used to determine how much input mix the farmers would have to change to achieve the output level that coincides with the best practice frontier. For this study, technical efficiency was used to estimate the resource productivity of the farmers in the study area. Measurement of technical efficiency is important because it is a success indicator of performance measure by which production units are evaluated (Ajibefun, 2008).

DEA is a relative measure of efficiency where the general problem is given as:

$$\text{Max TE} = \frac{\sum_{r=1}^{s} \alpha_r Y_{ro}}{\sum_{r=1}^{m} \beta_i X_{i0}} = \frac{q}{q^*} \qquad (1)$$

Subject to :

$$\frac{\sum_{r=1}^{s} \alpha_r Y_{rj}}{\sum_{r=1}^{m} \beta_i X_{ij}} \leq 1, \; j = 1, \ldots\ldots, n \quad (2)$$

$$\alpha_r, \beta_i \geq 0; \; r = 1, \text{-----}, s; \; i = 1, \ldots, m$$

Where X_{ij} and Y_{ij} respectively are quantities of the i^{th} input and *rth* output of the j^{th} firm and $\alpha_r, \beta_i \geq 0$ are the variable weights to be determined by the solution to this problem. Scale efficiency can be obtained residually from CRS and VRS technical efficiency scores as follow:

SE= CRSTE/VRSTE

SE= 1 indicates scale efficiency or constant return to scale (CRS) and SE <1 indicates scale inefficiency. Scale inefficiencies arise due to the presence of either increasing returns to scale or decreasing return to scale.

Methodology

Description of Study Area

The study was conducted in Niger State of Nigeria. Niger State is located between latitudes 8º11′N and 11° 20′ N and longitude 4° 30′E and 7° 20′E. It is bordered on the north-east by Kaduna state and on the South-east by the Federal Capital Territory, Abuja. It is also bordered on the North, West, South West and South by Zamfara, Kebbi, Kogi and Kwara States respectively (see figures 3.1 and 3.2). It shares a foreign border with the Republic of Benin in the North West. The state covers an estimated land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia, 2011). The state is agrarian and well suited for production of arable crops such as rice, cassava, cowpea, yam, and maize because of favourable climatic conditions. The annual rainfall is between 1100mm – 1600mm with average monthly temperature ranges from 23 º C and 37 º C (Wikipedia, 2010). Kaduna State and Federal Capital Territory (Abuja) are her borders to the North-East and South-East respectively; Zamfara state borders the North, Kebbi State in North-West, Kogi State in South and Kwara State in South-West. The vegetation consists mainly of short grasses, shrubs and scattered trees.

Sampling Technique and Sample Size

Primary data for this study were collected using multi-stage sampling technique. The first stage involved the random selection of 2 Local Government Areas (LGAs) in the study area. The second stage involved random selection of five villages in each LGA and 75 rice farmers (male and female) in each LGA totalling 150 farmers (eighty-six males and sixty-four females)

altogether in the selected two LGAs in the study area. The selection was based on the proportion of male and female registered farmers at the State Agricultural Development Programme (ADP).

Method of Data Collection

Primary data for study were collected with the use of a structured questionnaire that administered to the respondents. Data that were collected include total rice output produced per annum in kg, while the inputs included the size of farm land in hectare, quantity of seeds as planting materials in kg; quantity of fertilizer used in kg; quantity of herbicides used in litres and total labour in man-days which include family and hired labour utilised during pre and post planting operations and harvesting; unit price of the rice in naira; total production cost per year; average wage rate per man days of labour, price per kg of planting materials, average price of agrochemicals, average price of fertilizer and average price of farm tools.

Empirical Model specification

The empirical model is as specified in equations 1and 2. The output variable used for estimating efficiency scores was total rice output (kg) (Y). The inputs used included farm size (ha), labour (man-day), planting materials (kg), herbicides (litres), fertilizer (kg) and capital Input (Naira).

Results and Discussion

The summary statistics of the variables for the data envelopment analysis (DEA) for rice production in the study area are presented in Table 1. They include the sample mean and the standard deviation for each of the variables. The results from Table 1 shows that the average output of rice for men farmers is 452.50 kg obtained from about 3ha while their female counterparts recorded an average output of 167.89kg from about 2ha. This is an indication that the study covered small scale family managed farm units in the study area. This finding agrees with the findings of Oladeebo and Fajuyigbe, (2007) and Ojo *et al*., (2013), who reported that food crop production is mostly carried out by small scale farmers in Nigeria.

The total technical, pure technical and scale efficiency scores of tuber crop production in the study area are presented in Table2. Decomposition of technical efficiency shows that, on average, the male rice farmers are more scale efficient than their female counterparts. The mean scale efficiency of both male and female rice farms are 0.71 and 0.63 respectively. The result further revealed that the mean total technical efficiency of the male and female rice farms are 0.57 and 0.45 respectively, implying that the male and female farmers would have to reduce the level of inputs by 43% and 55% respectively if they were operating at the frontier All these findings indicate that male rice farmers are more resource-use productive than their female counterpart. This results agree with the findings of Ojo *et al*., (2010) and Ogunniyi *et al*., (2012), who reported that male farmers are more resource-use efficient than their female counterpart.

Table 3 presents mean efficiency estimates for the male and female rice farms in the study area. The results show the overall technical inefficiency ranges from 43% on male rice farms to 55% on female rice farms, suggesting that male rice farms are more technically efficient than female rice farms. The decomposition of technical efficiency into pure technical efficiency and scale efficiency further reveals that male rice farms are pure technically more efficient (0.79) than female rice farms (0.68). The high level of technical efficiency observed on male rice farms was mainly due to scale efficiency.

Table 1: Summary statistics of the variables in data envelopment analysis for rice production in the study area

Male farmers				
Variables	Mean	Standard Deviation	Minimum	Maximum
Rice output(kg)	452.50	232.82	60.00	900.00
Farm size(ha)	2.82	1.69	1.00	9.00
Labour(manday)	145.49	145.68	62.50	1375.00
Fertilizer(kg)	283.78	109.79	50.00	500.00
Herbicide(litres)	7.75	3.46	2.00	16.00
Seed(kg)	99.36	40.34	30.00	200.00
Depreciation(Naira)	2118.43	1924.97	200.00	10800.00
Female farmers				
Rice output(kg)	167.89	73.42	60.00	400.00
Farm size(ha)	2.10	1.41	0.53	5.00
Labour(manday)	211.23	288.33	12.50	1250.00
Fertilizer(kg)	261.02	117.55	25.00	500.00
Herbicide(litres)	5.95	2.97	1.00	16.00
Seed(kg)	83.00	32.73	10.00	200.00
Depreciation(Naira)	3205.03	2709.98	150.00	13500.00

Source: Field survey, 2014

Table 2: Summary statistics of efficiency estimates in rice production by sex in the study area.

	Male (Efficiency Measures)			Female(Efficiency Measures)		
Statistics	crste	vrste	scale	crste	Vrste	Scale
Mean	0.57	0.79	0.71	0.45	0.68	0.63
Standard Deviation	0.28	0.18	0.27	0.27	0.20	0.22
Minimum	0.06	0.40	0.11	0.13	0.33	0.21
Maximum	1.00	1.00	1.00	1.00	1.00	1.00

Source: Field survey, 2014

The comparison test for significant differences in mean technical efficiency among the two farm categories, summarised in Table 4, confirms that mean total and pure technical efficiency with scale efficiency are statistically and significantly higher on male rice farms than on female rice farms.

Table 3. Estimated mean efficiency measures and proportion of efficient farms

	Male farmers		Female farmers	
Efficiency Measures	Mean	%	Mean	%
CRS Technical Efficiency	0.57	0.10	0.45	0.13
VRS Technical Efficiency	0.79	0.29	0.68	0.16
Scale Efficiency	0.71	0.10	0.63	0.13

Source: Field survey, 2014

Table 4. Comparison tests for the differences in mean efficiency estimates between male and female farmers

Efficiency Measures	Male versus Female	
	Mean difference	Sig
CRS Technical Efficiency	0.123	0.000***
VRS Technical Efficiency	0.112	0.000***
Scale Efficiency	0.081	0.050**

*Note: *** and ** denote significance at 0.01 and 0.05 probability level respectively*

Source: Field survey, 2014

Table 5 further reveals that the highest share (16.28%) of scale efficient farms lies in the group of male rice farms. The results also showed that about 77 % and 83% of male and female rice farms operated at increasing returns to scale level respectively. This implies that the two farm groups could achieve higher efficiency level by increasing the production scale.

Table 5: Share of farms under CRS (scale efficient), IRS (increasing returns to scale) and DRS (decreasing returns to scale) by gender in rice production in the study area

Gender	Scale efficient farms	%	Farms under IRS	%	Farms under DRS	%
Male	14	16.28	66	76.74	6	6.98
Female	8	12.50	53	82.81	3	4.69

Source: Field survey, 2014

Table 6 shows slack inputs for rice farms in the study area. A slack variable represents the amount of excess expenditure on an input, i.e., the amount by which the expenditure on a particular input could be reduced without altering the production level. It is evident that 18 male rice farms and 8 female rice farms could reduce total expenditures on the farm land by 9.18% and 11.75% respectively, without reducing their current level of production. Similarly, excess expenditures on labour (8.74% and 1.57%), fertilizer (20.50% and 9.11%), herbicide (20.50% and 11.60%), seed (14.33% and 16.60%), and capital inputs (29.20% and 34.92%) are estimated for male and female farms, respectively.

Table 6. Input slacks and number of rice farms using excess inputs in the study area

Male farmers				
Inputs	Number of farms	Mean slack	Mean input used	Excess input use (%)
Farm size(ha)	18	0.259	2.82	9.18
Labour(manday)	29	12.722	145.49	8.74
Fertilizer(kg)	65	58.189	283.78	20.50
Herbicide(litres)	61	1.589	7.75	20.50
Seed(kg)	36	14.234	99.36	14.33
Depreciation(Naira)	55	618.656	2118.43	29.20
Female farmers				

Farm size(ha)	8	0.24	2.10	11.75
Labour(manday)	5	3.31	211.23	1.57
Fertilizer(kg)	24	23.79	261.02	9.11
Herbicide(litres)	31	0.69	5.95	11.60
Seed(kg)	41	13.78	83	16.60
Depreciation(Naira)	51	1119.06	3205.03	34.92

Source: Field survey, 2014

Conclusion and Recommendation

The study examines the productivity differentials between male and female rice farmers in Niger State, Nigeria. The findings in this study showed that the overall technical inefficiency ranges from 43% on male rice farms to 55% on female rice farms, suggesting that male rice farms are more technically efficient than female rice farms. The findings further revealed that most of the rice farms (both male and female farms) operated at increasing returns to scale level, implying that the two farm groups could achieve higher efficiency level by increasing the production scale. The implication of these findings is that male rice farmers are fairly efficient in utilizing their resources than their female counterparts and any expansion in the use of resources would bring more than proportionate increase in their outputs. It is therefore recommended that research efforts directed towards the generation of new technology, especially for rice farmers, should be encouraged in the study area.

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