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Full Length Research Paper

Gender differential in yam production in Ogbomoso Agricultural Zone of Oyo State: Data envelopment analysis

Ogunniyi, L.T., Adepoju, A.A., Olagunju, F.I., Ojedokun, I.K. And Ganiyu, M.O

Department of Agricultural Economics Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

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Data Envelopment Analysis (DEA) is a non parametric method of measuring the efficiency of a decision making unit (DMU), first introduced into Operations Research literature by Charnes et al., 1978. This study used primary data with the aid of structured questionnaire to elicit information on relevant variables such as the inputs and output and their prices. Data envelopment analysis was used to measure the profit efficiency while ordinary least square (OLS) was then used to determine producer characteristics that are likely to lead to higher profit efficiencies and findings compared on the gender basis. The average profit efficiency score was 0.20 and 0.16 for male and female farmers respectively implying that the average male and female farmers producing 20 and 16% of yam could improve profit by 80 and 84% respectively by improving their technical and allocative efficiency. Estimation of profit – loss given prices and fixed factor endowments revealed that yam farmers are losing to the tune of ₦33, 811.69k, ₦ 35,341.88k and ₦ 39,086.66k for male, female and pooled data respectively. The determinants of profit loss were examined and significance evidence was found that education, experience, farm size and extension visit determined the variation in profit loss among yam farmers in the study area.

Key word: Yam, DEA, Gender, Profit efficiency, Profit loss.

INTRODUCTION

The Nigeria agricultural sector is dominated by small – scale farmers. This group of farmer plays a very important role in food and fibre production. This claim was supported by Olayide and Heady (1982) who state that small – scale farmers dominated the agricultural economy of Nigeria because they accounted for about 81% of all farm holdings in the country, using traditional hoes, cutlass and oxen – plough. The role of agriculture in an agrarian economy like Nigeria cannot be overemphasized. Over 70 percent of the economically active population is employed in agriculture and agro – allied industries, the sector provides over 90% of the food consumed locally and it is a major earner of foreign exchange after the petroleum sector (Adedipe, 2000).

According to Argyrous and Stilwell (2003), gender has more than one valid definition. In ordinary speech, it is used interchangeably with sex to denote the condition of being male and female. In the social sciences, however, it refers specifically to socially constructed and institutionalized differences such as gender roles. The World Health Organization (WHO), for example, uses gender to refer to the social constructed roles, behaviours, activities, and attributes that a given society considers appropriate for men and women.

According to World Bank Statistics, women perform two third of the entire world's work and produce more than half of the food in most developing countries. However, males are playing leading role in ridge making and irrigating fields (Hassan et al., 2002).

According to Williams (1993),

*Corresponding author. E-mail: ltogunniyi@lautech.edu.ng; titiogunniyi@yahoo.com. Tel:+2348035688873

rural women are major contributors to subsistence agriculture as producers and marketers, they also engaged in keeping livestock's. However, in spite of their prominent feature in agricultural production, they are usually under remunerated in terms of financial gains, social acceptability, appreciation and time taken off when compared with men (Aweto, 1996).

The world production of yam according to FAO statistics was estimated at 48.7 million tonnes in 2005. Out of this population, 97% came from Sub – Saharan Africa, the main producers being Nigeria with 34 million tonnes of world production (IITA, 2007).

Gender participation also affect yam production despite the widespread assumption, men make the key farm management decision but women play a dominant role in yam production. This was confirmed by the finding of study by financed by the United Nations Development Programme(UNDP)) revealed that women make up 60 – 80% of agricultural labour force in Nigeria depending on the region and produce two-thirds of food crop (World Bank,2003).

The pivotal role of the efficiency in accelerating agricultural productivity and output has been applauded and investigated by numerous researchers and policy makers with Africa and outside alike. An underlying premise behind much of the work in efficiency is that if farmers are not making efficient use of existing technology, then efforts designed to improved efficiency would be more cost – effective than introducing new technologies as a means of increasing agricultural output (Bravo – Ureta and Everson, 1994).

However, the aim of every farmer is to make profit whether must or little, profit efficiency can be defined as the ability of a firm or farm to achieve potential maximum profit, given a level of fixed factors and prices faced by the firm (Adesina and Djato, 1996).

A lot of work has been done on profit efficiency in agriculture using stochastic frontier (Abdulai and Huffman, 1998; Rahman, 2003; Ogundari, 2006, and Hyuha, 2006) but to my knowledge none focused on gender and the use of DEA. In view of this, there is the need to examined gender differentials in yam production in Ogbomoso Agricultural Zone of Oyo State, Nigeria using Data Envelopment Analysis.

MATERIALS AND METHODS

The study was conducted in Ogbomoso agricultural zone of Oyo State, Nigeria. Primary data were collected with the aid of a well structured questionnaire and personal interview. The research was conducted in April 2010. One hundred and twenty (120) respondents comprising of 63 male and 57 female yam farmers were randomly selected from areas of intensive yam cultivation. Baseline information on socio – economic characteristics, input use and output levels as well as their unit prices were collected and analyzed. Descriptive statistics, Data Envelopment Analysis and regression analysis were used to analyze the data collected.

Efficiency Measure

In order to identify the profit efficiency of farms in my sample, the following linear programme problem.

Max $W = P_o y - C_o x$

Subject to

$x = x\lambda \leq x_o$

$y = y\lambda \geq y_o$

$L \leq e\lambda \leq U$

$\lambda \geq 0$

Where P_O = unit price vector

C_O = unit cost vector

$L \leq e\lambda \leq U$ is a constraint on scale. Base on an optimal solution (x*, y*), the profit efficiency is defined by

$$Ep = \frac{P_O y_O - C_O x_O}{P_O y^* - C_O x^*}$$ (Olawuyi, 2005)

Where y*, x* are optimal for the object function and y_O and x_O are the corresponding vectors of observed value for DMU. Under the assumption of $P_O y_O > C_O x_O$ we have $0 < \varepsilon p \leq 1$ and DMU (x_O, y_O) is profit efficient if $\varepsilon p = 1$.

Where P_O = price of yam sold (₦)

y_O = quantity of yam produce (kg)

C_1 = cost of labour (₦)

x_1 = labour use in mandays

C_2 = Cost of fertilizer (₦)

x_2 = quantity of fertilizer (kg)

C_3 = Cost of Insecticide (₦)

x_3 = quantity of Insecticide (l)

C_4 = Cost of fungicide (₦)

x_4 = quantity of fungicide (l)

C_5 = Cost of yam sett (₦)

x_5 = quantity of yam sett (kg)

The profit loss due to inefficiency was then calculated as maximum profit at farm – specific price, multiplied by farm – specific profit inefficiency. Profit loss is defined as the amount that has been lost due to inefficiency in production given prices and fixed factor endowments and is calculated by multiplying maximum profit by (1 – Pε).

Maximum profit per hectare is computed by dividing the actual profit per hectare of individual farmers by its efficiency score.

Profit Loss = Maximum Profit (1 – Pε).

Where,

Tables 1. Per hectare mean values of Inputs and yield by Gender.

Farm variables	Male Owned Farms			Female Owned Farms		
	Mean	**S.D**	**C.V**	**Mean**	**S.D**	**C.V**
Output (kg)	918.9	578.9	0.63	764.5	752.5	0.98
Farm Size (ha)	3.4	3.2	0.92	1.4	0.9	0.61
Family labour (mandays)	87.7	52.2	0.60	67.2	22.6	0.34
Hired Labour (mandays)						
Clearing	165.9	79.2	0.48	121.6	47.6	0.39
Ridging	160.8	121.9	0.76	111.9	39.8	0.36
Planting	124.4	70.6	0.57	101.4	29.4	0.29
Harvesting	112.81	48.9	0.43	92.1	23.9	0.26
Total	564.19	253.80	0.45	427.0	124.7	0.29
Insecticide	6.3	6.2	0.97	8.8	9.6	1.09
Fungicide	12.2	10.6	0.86	7.3	4.6	0.63
Fertilizer	352.5	209.5	0.59	317.5	188.3	0.59
Yam Sett	173.9	89.2	0.51	131.6	57.6	0.44

Source: Field Survey, 2010.
Profit Efficiency

PL = Profit loss
Pε = Profit efficiency

Determinants of Profit Loss

In order to identify the factors associated with profit loss, multiply regression model was estimated.

PL = f (Z_1, Z_2, Z_3, Z_4, Z_5, e)

Where

PL = profit loss

Z_1 = years of schooling
Z_2 = years of experience
Z_3 = farm size (ha)
Z_4 = Family labour (man – days)
Z_5 = Extension visit (No. Of visit)

A linear function using profit loss as the dependent variable was estimated to determine the significance of these factors to profit inefficiency (Olawuyi, 2005).

RESULTS AND DICUSSIONS

Per hectare Mean value of Input and Yield by Gender

From Table 1, the mean yield for male farmers was 918.8kg/ha while their female counterparts realized 752.5kg/ha. The average farm size, among the male farmers was 3.4ha as against 1.4ha recoded among the female farmers. Hence the female farmers cultivate less than half of the average farm size of the male farmers. Both male and female farmers are small scale farmers.

In the use of family labour, female farmers were highly discriminated against. Thus, the female committed an average of 67.2 man – days of family labour per hectare while their male counterparts recorded an average of 87.7 man – days/ha. The same situation was observed in the case of hired labour. The male farmers recorded 564.2 man – days/ha while their female counterparts recorded 427 man – days/ha.

In the use of insecticide, the female (8.8 litre/ha) farmers recorded higher use over their male counterparts (6.3litre/ha). In terms of fungicide, fertilizer and yam sett, male recorded a higher use than female farmers.

Profit efficiency indices for male and female farmers are reported in (Table 2). The average profit efficiency score was 0.2 and 0.16 for male and female farmers respectively. This implies that the average male and female farmers producing 20% and 16% could improve profit by 80% and 84% respectively by improving their technical and allocative efficiency. Profit efficiency indexes for male farmers were, on average, larger than for female farmers. In addition, a higher percentage of male farmers were profit efficient. Nonetheless, male farmers still had the potential to increase their profit by almost 89%.

Both male and female farmer exhibits a wide range of profit inefficiency. Observation of wide range of profit efficiency is not surprising and similar to result from some developing economy e.g. Ali and Flinn (1989) reported mean profit efficiency level of 0.69 for rice production, Ali

Table 2. Distribution of Profit Efficiency.

Profit Efficiency	Male	Female	Pooled
< 0.2	56(88.9)	50(87.7)	101(84.2)
0.2 – 0.39	0	5(88)	9(7.5)
0.4 – 0.59	0	0	4(3.3)
0.6 – 0.79	0	0	2(1.7)
0.8 – 0.99	0	0	1(0.8)
1.00	7(11.1)	2(3.5)	3(2.5)
Total	63(100)	57(100)	120(100)
Mean	0.2	0.16	0.16
Minimum	0.01	0.01	0.01
Maximum	1	1	1

Source: Data Analysis, 2010.
Figure in Parentheses are percentages.

Table 3. Distribution of farmers by profit loss.

Profit Loss(₦)	Male	Female	Pooled
≤ 10000	31(49.2)	30(52.6)	63(52.5)
10001 – 20000	0	12(21.1)	4(3.3)
20001 – 30000	0	4(7.0)	6(5.0)
30001 – 40000	7(11.1)	5(8.8)	22(18.3)
40001 – 50000	0	1(1.8)	14(11.7)
50001 – 60000	0	2(3.5)	1(0.8)
> 60000	25(39.7)	3(5.2)	10(8.3)
Total	63(100)	57(100)	120(100)
Mean	33811.69	35341.88	39086.66
Minimum	1039.68	1619.20	170.90
Maximum	172447.2	1183209.54	1883515
Standard Deviation	36710.86	161717.40	171240.9

Source**:** Data Analysis, 2010.

Figure in parentheses are the percentages.

et al., (1994) reported mean profit efficiency of 0.75, Rahman (2003) reported mean level of profit efficiency of 0.77 for rice production, Oloke (2007) reported a mean profit efficiency level of 0.12 for cocoyam production, and Matanmi (2007) reported a mean profit efficiency of 0.45 and 0.53 for male and female small holder farmers respectively.

Profit loss

Estimation of profit – loss given prices and fixed factor endowments reveals that yam farmers are losing to the tune of ₦33,811.69k for male, ₦35,341.88k for female and ₦39,086.66k for pooled data which could be recovered by eliminating technical and allocative inefficiency. Majority of the respondents (49.2% for male, 52.6% for female and 52.5% for pooled data) showed a profit loss between 0 and ₦10000. The largest farm – specific profit loss was ₦172447.20k for male farmers, ₦1, 183,209.54k for female farmers and ₦1, 883,515 for pooled data (Table 3).

Determinants of Profit Loss

The OLS estimate of the relationship between loss of profit and farm household characteristics showed that female farmers and pooled farmers with no education exhibited significantly more loss of profit than educated farmers (Table 4). This negative relationship between education and productivity is not consistent with the finding of Ohajianya (2005) and Lockheed et al., (1999). Experience was found to be significant in all the

Table 4. Determinants of Profit Loss.

Variables	Male	Female	Pooled
Constant	5612.21(1.46)	5218.30(0.46)	3241.30(0.20)
Education	-2269.83(-0.64)	-8069.28(-1.86)*	-5346.57(-2.47)**
Experience	2796.43(2.03)**	-634.44(-4.61)***	555.71(2.27)**
Farm size	2225.65(3.54)***	-1206.78(-2.22)**	3269.08(11.84)***
Family labouor	1.98(0.26)	0.45(3.04)***	2.65(0.35)
Extension Visit	1.39(5.29)***	0.04(0.45)	3.67(2.65)***
R^2	0.632	0.344	0.515
F	12.43***	4.48*	12.93***

Source: Data analysis, 2010
Figure parentheses are the t – value

respondents but it has a negative relationship with loss of profit in female. The negative relationship implies that female farmers with less years of experience exhibited significantly more loss of profit than farmers with more years of experience. Large farms did not exhibit a significantly higher profit loss than smaller farms in male and pooled data. In female respondents, small farms exhibited significantly higher loss of profit than large farms. This finding is consistent with those of Saleem (1978) and Ohajianya (2005) . Female farmers with more family labour exhibited significantly less loss of profit than farmers with less family labour. Extension contract was found to be significant in male and pooled data. The positive relationship implies that farmers with more extension contact exhibited significantly less profit loss than farmers with less extension contact.

CONCLUSION

In this study, a non parametric model was applied to estimate profit function in gender differential in yam production. Profit index for male and female famers involved in yam production was estimated and the determinants of profit loss differential among each gender class examined.

It was found that profit efficiency ranged between 0.01 and 1 with a mean of 0.2 for the male farmers and 0.01 and 1 with an average of 0.16 for female farmer. It could be seen that there is wide range in the efficiency indices and this conforms to findings from other studies such as Ali and Flinn (1989). Even though the female farmer incurred more loss than their male counterpart, it could still be observed that both male and female farmer have substantial potential to reduce their losses. In examining the factors responsible for variation in the profit loss, significance evidence was found that education, experience, farm size and extension visit determined the variation in profit loss among famers in the study area.

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