Economic Efficiency Of Leafy Vegetable Production In Oyo State, Nigeria

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ABSTRACT: The economic efficiency of leafy vegetable production in Oyo State, Nigeria was investigated using stochastic frontier production function, which incorporates a model f inefficiency effects. Primary data were collected through the use of structured questionnaires from 120 leafy vegetable farmers randomly selected from four local government areas. Stochastic frontier production function, using maximum likelihood estimation (MLE) was used to analyze the economic efficiency. The MLE results revel that farm size, family labour, hired labour, seed and fertilizer are the major factors influencing gross margin in leafy vegetable production. The efficiency model shows that older farmers and farmers with more extension contacts tend to be less economically efficient in leafy vegetable production. The mean economic efficiency score is 0.42.
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INTRODUCTION

Among the various foods, production and consumption of vegetables are very important because of their contribution to good health and as cheap sources of minerals and vitamins needed to supplement people's diet which are mainly carbohydrate (Adedoyin et al., 1996). The daily need of vegetables, as reported by Wainjemberg (1981), is normally 150 – 250g per person. This is expected to provide balanced diet needed by people particularly in a diet characterized by low inclusion of meat and other animal proteins.

Sustainable vegetable production is the production of vegetables using a system that increases inherent productive capacity of natural and biological resources in step with demand. At the same time, it must allow farmers to earn adequate profit, provide consumers with wholesome safe food and minimize adverse effect impact on the environment (National Research Council, 1991). Such productive capacity should be able to meet the nutritional needs of the populace, thereby reducing incidence of malnutrition to the nearest minimum (Ayinde, 1974).

Many green leafy vegetables are grown in West Africa. Such vegetables have little calorie value: they have minute quantities of fat and very little carbohydrate; the limited protein they contain is however very useful for supplementary the protein lacking in the staple. They have a very high content of carotene often called pre – vitamin A because this substance can be turned into vitamin A in the human body. The greener the leaf, the more the pre – vitamin A. Green leaves are good source of iron and thiamine a well as riboflavin and nicotinic acid (Tindall and Florence, 1965).

According to Stanlake and Grant (1999), leafy vegetable have a high content of water and abundance of cellulose. The cellulose though not digested serves as a useful purpose in the intestine as roughage, thus promoting normal elimination of waste products.

Nigerian up till now is yet to achieve 5% total calorie intake of non-starch vegetables recommended by food and Agriculture Organization (FAO) unless there is efficient production, storage, processing and distribution programme and consumption training programme, this target will not be met. (Taylor, 1988). These however, could not as well be achieved without using appropriate technologies. There are several production constraints that impede the full benefits of leafy vegetables as an important supplementary sources of food and nutrition which includes; small scale production, incurment of heavy loss, inefficient use of resource available and involvement of few farmers in vegetable production.

For increased level of agricultural productivity, a combination of measures designed to increase available farm resources and efficiency in the use of existing resources is necessary (Heady, 1962). Therefore, this study is aimed at examining the economic efficiency of leafy vegetable production in Oyo State, Nigeria, and to identify the sources of inefficiency among vegetable farmers.

MATERIALS AND METHODS

They study area is Oyo State, which is one of the six states in South Western Nigeria. The state

is located between latitudes 2^0 39^1 and 4^0 35^1 east of the Greenwich meridian. According to NPC (2006), Oyo State had a population of 5,591, 585 people. Oyo State comprises of 33 local government Areas (LGAs) divided into four agricultural zones, namely Ibadan/Ibarapa, Oyo, Ogbomoso and Saki. A LGA was selected from each of the zones. The selected local government areas are Akinyele, Afijio, Orire and Olorunsogo. From each of the LGA, two villages were randomly selected giving a total of 8 villages, 15 leafy vegetable farmers were randomly selected giving a total of 120 farmers used for the study.

Data collected include farm size, labour supply and use, fertilizer, seed, equipment, pesticides output of vegetable and their farm gate and market prices. Data on socio-economic characteristics of farmers such as age, farming experience as well as level of education and contact with extension agents, were also collected.

The stochastic production frontier model used for analysis is of the form

$Q_i = f(X_1; \beta)\, e^{\varepsilon}$ …… (1)

Where

Q_1 = output of ith farmer (obtained using gross margin)

X_i = vector of inputs

β = vector of parameters to be estimated

e = error term

Where ε is a stochastic disturbance term consisting of two independent elements V and U.

Where; $\varepsilon = V = U$ …….. (2)

V is a symmetric random error that is assumed to account for measurement error and other factors not under the control of the farmer e.g. weather and luck (Thanda and Mathias, 1988) while U reflects the technical inefficiency i.e what s left for the farmer to reach the outer bound production function or the frontier.

To estimate β, the stochastic production frontier model has to be linearised thus:

$\ln Q_i = \beta_o + \beta_1 \ln X_i + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5$

$+ \beta_6 \ln X_6 + V - U$ …… (3)

The output (Q_i) here is the farm gross margin. Hence the measure of efficiency is economic efficiency (this is done because of the difficulty in getting the output of the farming in kilogramme. Coelli and Battese (1996) did Similar thing.

X_1 =- Farm size (Hectares)

X_2 = Family labour used in production (Mandays)

X_3 = Hired labour used in production (₦)

X_4 = Seed (Kg)

X_5 = Fertilizer (₦)

X_6 = Pesticide and Herbicides (₦)

In the efficiency analysis, certain factors that contribute to the ability of the farmers to operate on the frontier were examined.

$\eta_I = f(Z_i; \delta)$ …… (4)

Where $\eta_I = 1 - \mu_i$ …… (5)

μ_I = economic inefficiency

η = economic efficiency

Z_i = vector of farmer's specific factors

δ = vector of parameters to be estimated

$\eta_{i=} \delta_o + \delta_i \ln Z_i + \delta_2 \ln Z_2 + \delta_3 \ln Z_3 + \delta \ln Z_4$ …… (6)

Z_1 = age of farmers (years)

Z_2 = years of experience in vegetable production

Z_3 = years of formal education

Z_4 = number of extension visits in the cropping season.

The FRONTIER version 4.1 computer programme (Coelli, 1996) was used to estimate and also to predict the individual efficiency of the farmers.

RESULTS AND DISCUSSION

Summary Statistics

The summary statistics for the production estimation is presented in Table 1. The table revealed that the average gross margin of all leafy vegetable produced is ₦11, 920.38 with a standard deviation of ₦9251.64. The mean farm size was 0.62ha with a standard deviation of 1.33ha. The variability in farm size measured by the standard deviation is due to changes in hactarage of leafy vegetable under the production season. The mean family labour used was 176.1 with a standard deviation of 142.34. This is an indication that leafy vegetable production is a labour intensive exercise considering the large variability recorded. The average cost of fertilizer used was ₦1984.07 with a standard deviation of ₦1628.74 indicating a large variability in the fertilizer usage among the farmers. The average quantity of seed used was 3.5kg with a standard deviation of 4.8kg.

The average age of the farmers was 43.98 years with a standard deviation of 11.32 years. The results imply that farmers in the area are relatively old, a condition that may affect their overall efficiency, since their production is labour intensive. The average farming experience was 13.38 years with a standard deviation of 11.54 years. This implies that the farming experience varied significantly among the farmers. The average years of schooling was 5.78 years with standard deviation of 3.73 years showing that most of the farmers were not educated. The average number of extension visit was 2.36 with standard deviation of 1.73.

The Stochastic Frontier Analysis

The parameters and related statistical test results obtained from the stochastic frontier production function analysis are presented in Table 2. All the coefficients in the model except one (Pesticide and Herbicide) have the expected *a prior* signs and they are mainly significant.

There is positive relationship between farm size and gross margin. This implies that gross margin increase as farm size increases. The magnitude of the coefficient is 1.10. This shows that gross margin in the leafy vegetables enterprises is elastic to changes in the level of cultivated land area. The coefficient is significant at 0.01 level. Farm size is therefore a significant factor associated with changes in the gross margin.

The coefficient of family labour vegetable production is positive and statistically significant at 0.01 levels. This shows that gross margin is expected to increase with an increase in family labour input.

Hired labour is positive and significant factor in leafy vegetable production at 0.05 levels. Hence increase in hired labour input in the leafy vegetable production will lead to an increase in gross margin. The production elasticity of 0.13 with respect to hired labour in the study area shows that gross margin is inelastic to changes in the amount of hired labour used.

The coefficient of seed is a significant and positive determinant of gross margin. The elasticity of seed was a positive decreasing function to the gross margin in the study area (Stage II).

The elasticity of gross margin with respect to fertilizer is positive and statistically significant at 0.01 levels. The value of the coefficient (0.36) indicates that 1 percent increase in the amount of fertilizers applied to the farm leads to a 0.36 percent rise in the gross margin.

The production elasticity with respect to pesticides and herbicides was negative and not statistically significant even at the 0.10 level.

Sources of Inefficiency

The sources of inefficiency were examined by using the estimated δ - coefficients associated with the inefficiency effect in Table 2. The inefficiency effects are specified as those relating to age, farming experience, education and extension.

The estimated coefficient of age is positive and statically significant at 5 percent level. This indicated that aged farmers are relatively less efficient in leafy vegetables production, and vice versa.

The coefficient of farming experience variable is estimated to be negative and statistically significant at 0.01 levels. Hence the more the years of experience a farmer has on his vegetables enterprise, the more economically efficient he is.

The estimated coefficient of education variable was appropriately signed and statistically significant at 0.05 level. The implication is that farmers with more years of formal schooling tend to be more economically efficient in vegetable production, presumably due to their enhanced ability to acquire technical knowledge, which makes them closer to the frontier output.

There is a positive relation between the extension contact variable and efficiency effect in leafy vegetable production. The coefficient is statistically significant at the 0.10 level. One would expect that increase in extension services to farmers would increase efficiency rather increase in number of extension visits leads to a decrease in the economic efficiency of the farmers. It is either that the quality of extension service is poor in the study area (for example, may be wrong information is being passed to the farmers from extension quarters) or the farmers do not follow extension advice to the letter.

The Diagnostic Statistics

The estimated sigma square (σ^2) for the leafy vegetable production (2.09) are significantly different from zero at 1 percent level. This indicates a good fit and the correctness of the specified distributional assumptions of the composite error term. This suggests the conventional production function is not an adequate representation of the data. Also the magnitude of the variance ratios estimated at 0.99 is high suggesting that systematic influences are the dominant sources of errors. This means that 99 percent of the variation in gross margin among the farms is due to differences in economic efficiency. The log- likelihood function is estimated to be 139.06. This value represents the value that maximizes the joint densities in the estimated model.

Efficiency Estimates of the Farmers

Given the specification of the Cobb – Douglas frontier production function in equation 3 and 6, the economic efficiencies of leafy vegetable farmers in Oyo State were calculated. The predicted efficiencies differ substantially among the farmers, ranging between 0.06 and 0.99 with mean efficiency of 0.42. The low mean economic efficiency is an indication of inefficiency in resource use by leafy vegetable farmers in Oyo State of Nigeria. Also, there exists a wide gap between the efficiency of best economically efficient farmers and that of the average farmer. This type of wide variation in farmer specific efficiency levels is a common phenomenon in developing countries. (Amaza, 2000; Ike and Inoni, 2006) (Table 3). Furthermore, the varying socio economic characteristics of the sampled farmers such as age, farming experience, education and contact with extension agents, must have influence the farmer's ability to use available technology and a situation that must have contributed to the observed variation and low level of efficiency amongst them.

Conclusion

Stochastic frontier production function was estimated for leafy vegetable production in Oyo State, Nigeria with farm size, labour (family and Hired), seed, fertilizers and pesticide and herbicides as explanatory variables. The maximum likelihood estimates (MLE) results shows that farm size, family labour, Hired labour, seed and fertilizer are the major factors that are associated with changes in the gross margin from leafy vegetable enterprise.

In order to ascertain the level of economic efficiency of leafy vegetable production, a model of inefficiency effects in the frontier function which included farmer specific variables such as age, farming experience, education and extension visits was also estimated. All the farmer specific variables significantly accounted for the observed variation in efficiency level among leafy vegetable farmers in Oyo State, Nigeria.

The implication of the study therefore is that the level of efficiency among leafy vegetables farmers in Nigeria could be increased by 58 percent through better utilization of available resources, given the current state of technology.

Table 1: Summary statistics of variables of stochastic frontier production

Variables	Mean	Standard Deviator	Minimum value	Maximum value
Gross margin (Nara)	11920.38	9351.61	3543.76	75435.20
Farm size (Ha)	0.62	1.33	0.30	2.00
Family labour (Man-days)	167.72	142.34	30.40	347.65
Hired labour (Naira)	6118.23	2484.07	1141.00	10478.74
Seed (Naira)	3.5	4.8	1.2	6
Fertilizer(Naira)	1984.07	1628.74	650.00	5450
Pesticide and herbicide(Naira)	760.65	435.15	237.90	2435
Age(years)	43.98	11.32	20.00	62
Farming experience (years)	13.38	11.54	2	35
Education (years)	5.78	3.73	0	14
Extension (number)	2.36	1.73	0	4

Source: Field Survey, 2007.

Table 2: Maximum likelihood estimates of the parameters of the stochastic production function (Economic efficiency model)

Variables	Parameter	Coefficient	t-ratio
Production factors			
Constant	β_0	10.32	2.05
Farm size	β_1	1.10	2.76***
Family labour	β_2	0.22	3.33
Hired labour	β_3	0.13	2.27**
Seed	β_4	0.39	2.42**
Fertilizer	β_5	0.36	-3.11***
Pesticide and herbicide	β_6	-0.62	
Inefficiency effects			
Constant	δ_0	2.09	2.14
Age	δ_1	0.18	2.64***
Farming experience	δ_2	-0.86	-3.03***
Education	δ_3	-0.32	-2.75***
Extension	δ_4	0.19	-2.53**
Diagnostic statistics			
Sigma-Squared	σ^2	2.69	6.27***
Gamma	γ	0.99	78.90***
Likelihood function		-139.06	

Source: computed from survey data, 2007.

***** Significant at the 0.01 level, ** at the 0.05 level**

Table 3: Frequency distribution of the predicted efficiency

Efficiency level	Frequency	Percentage
<0.5	77	64.2
0.5 – 0.59	07	5.8
0.6 – 0.69	08	6.7
0.7 – 0.79	05	4.2
0.8 – 0.89	11	9.2
0.9 – 0.99	12	10.0
Total	120	100
Mean	0.42	
Minimum	0.06	
Maximum	0.99	

Source: Data analysis, 2007.

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