ANALYSIS OF RESOURCE USE EFFICIENCY IN YAM PRODUCTION IN YAKURR LOCAL GOVERNMENT AREA OF CROSS RIVER STATE, NIGERIA

TIKU, N. E. & ENOIBOR, J. H.
Department of Agricultural Economics and Extension, Faculty of Agriculture and Forestry, Cross River University of Technology, Obubra Campus.
Corresponding author: ejorntiku@gmail.com

Abstract
The aim of this study was to determine resource use efficiency in yam production in Yakurr local government area of Cross River State, Nigeria. The study covered 3 villages that were purposely selected. The villages are Mkpani, Agol-Ibami and Agol-Ekpo. Data were obtained through a structured questionnaire administered to 135 randomly selected yam farmers. 130 questionnaires were retrieved and used for analysis. The stochastic frontier production function model was used for the analysis. The result was used to determine their technical, allocative and economic efficiencies. Two of the variables, planting material ($x_1$) and farm size ($x_2$) were highly significant at 1% level of probability and labour ($x_3$) was significant at 10% probability level. Allocative efficiency revealed that planting material and farm size were under utilized while labour and capital were over-utilized. The economic efficiency differed subsequently among the farmers ranging from between 0.089 and 0.861 with mean efficiency of 0.36. The low mean economic efficiency is an indication of inefficiency in resources used by yam farmers in the study area. The study recommended that production inputs especially farm size be increased by yam farmers and improved technology be adopted to increase yam production in the study area.

Keywords: Technical, Allocative and Economic Efficiencies, yam production

INTRODUCTION
Agriculture constitutes a major sector of Nigeria’s economy. The sector is significant in terms of employment of labour, contribution to Gross Domestic Product (GDP), and until early 1970, agricultural exports were the main source of foreign exchange earnings (Amaze and Olayemi, 2002). During the 1960s, the growth of the Nigerian economy was derived mainly from the agricultural sector. However, in more recent years, there has been a decline in the performance of Nigeria’s agriculture. The contribution of agriculture to the GDP which stood at an average of 56% between 1960 and 1964, declined to 47% in 1965, 1969 and more rapidly to 32% between 1996 and 1998 (Amaze and Olayemi, 2002), and then to 31.9% in 2001.

However, as rural labour is becoming more scarce and expensive and the prices of other inputs are on the increase, yam consumption is far becoming a luxury food item rather than staple food products. Although yams can be grown on flat soils, holes, ridges or mounds, it is traditionally planted on mounds in Cross River State. The sizes of the mounds vary from place to place depending on the size of the set and the hydromorphic nature of the soil. The most important part of the yam plant is the tuber. The yam tuber is a good source of energy derived mainly from their carbohydrate content, since its low in fat and protein, vitamin C has been found in unpeeled yam slices (Pius and Odjuvwuederhie, 2006). How efficient are the farmers in the utilization of their resources in yam production is what is brought to the fore by this research.

The agricultural sector’s changing shares of GDP is partly a reflection of the relative productivity of the sector, since increased output and productivity are directly related to production efficiency (Amaze and Olayemi, 2002). In Nigeria, due to the rise in population, the demand for agricultural products is continually rising. This has resulted in the need to allocate farm resources efficiently. Therefore, in order to increase food self-sufficiency and agricultural production, efficient allocation resources at the
farmers’ disposal should be encouraged.

Although yams are grown throughout Africa, Nigeria is said to be the world’s largest producer of yams accounting for over 76% of the world’s total output (FAO, 2010). It also reported that Nigeria alone in 1985 produced 18.3 million tones of yams from 1.5 million hectares representing 73.8 percent of 28.8 million tones of yams produced in Africa. Yam can be grown in nearly all tropical countries provided water is not a limiting factor (Pius and Odujyweuderhie, 2006). In Cross River State Nigeria, yam cultivation still depends largely on labour traditional hoes-cutlasses. Many aspects of the production like clearing, planting, weeding, staking and harvesting requires considerable inputs of labour.

THEORETICAL FRAMEWORK

The efficient method of producing a product is that which uses the least amount of resources to get a given amount of the product. The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or certain level of output at least cost. Increase in production and productivity are direct consequences of efficiency input combination given the available technology (Ogunbadejo and Ojo, 2007).

In a stochastic frontier production function approach, an efficient farm is said to operate on the product frontier while inefficient ones operate below the production frontier.

The various types of efficiency to be studied are technical efficiency, allocative efficiency and overall or economic efficiencies (Farrell, 1957; Olayide and Heady, 1982a). Technical efficiency shows the ability of a farm to obtain maximum output from given inputs. It is the ratio of output to input and the greater the ratio, the more the magnitude of technical efficiency.

Allocative efficiency shows the ability of a farm to utilize the inputs at its disposal in optimal proportions given their respective prices. A farm is efficiently allocative when its production takes place at a point where the marginal value product (MVP) is equal to the Marginal Factor Cost (MFC).

Economic efficiency is a product of technical and allocative efficiency (Olayide and Heady, 1982). In one sense, the efficiency of a firm is its success in producing as large an amount of output as possible from given sets of inputs. Maximum efficiency of a firm is attained when it becomes impossible to reshuffle a given resource combination without decreasing the total output. Olukosi and Erhabor (1980) categorized resources into variable and fixed resources. Variable resources include, labour, seeds and fertilizer which are normally used in one production process. Fixed resources include land, machinery, farm building and capital etc.

In yam production, the inputs/resources are land, labour, capital, yam seeds, fertilizers and the management. Olukosi and Ogunbile (1989) agreed that in a production process, inputs are converted into output. They emphasize that output is that which is valuable to the producers. Efficiency measurement is important because it leads to substantial resource savings (Bravo-Ureta and Rieger, 1991). Efficiency measurements have been attempted in several studies (Shanmugau and Palanisami, 1993; Janyaram et al, 1989; Hang and Bagi, 1984; Kalirajan, 1981 and Janker, 1980).

A study carried out in Kogi state, Nigeria found that roughly 70% of yam production costs were for planting materials. As the campaign for household food security gains momentum all over the world and since extreme poverty and hunger must be eradicated by year 2015, yam are some of the food crops whose production has got to be emphasized (Oluwatusin, 2011). Yam being an important food crop for at least 60 million people in West Africa, it is necessary to lower its production cost and scale up its production through an efficient use of its production resources.

MATERIALS AND METHODS

Yakurr Local Government Area lies between latitudes 50° 401l and 60° 101l north of the equator and longitude 80° 21l and 60° 101l east of the Greenwich Meridian and 120km (75miles) northwest of Calabar the capital of Cross River State, Nigeria. The people share their Northern and Eastern boundaries with Assiga, Nyima and Agoi clans of Yakurr Local Government Area, the southern boundary with Biase Local Government Area and the Western boundary with Abi Local Government Area of the State.

SOURCES OF DATA

Primary sources formed the major source of data collected. This was done through the use of structured questionnaire and interviews designed to capture the objectives of the study. A total of 135 questionnaires were distributed to selected yam farmers in the study area retrieved. Personal interviews and field observations farmers’ farm was done so as to ensure that the information provided by the respondents reflect the true position of the farming activities in the yam sector of the area.

SAMPLING PROCEDURE

A multi-stage sampling technique was used for the study. It involved 3 stages. The first stage was the random selection of three clans from Yakurr Local Government Area. The second was a purposive selection of three communities each from the selected clans in which farmers cultivate
yam, making a total of nine communities. The third stage was the selection of fifteen yam farmers from each of the nine communities giving a total of 135 yam farmers.

TECHNIQUES FOR DATA ANALYSIS

The stochastic frontier production function was used to analyse the efficiency of inputs used in the production of yam in the study area. A production frontier is defined in terms of the maximum output given the technology available to the farmer. This is specified by the Cobb-Douglas frontier production function defined by Coelli (1994) as:

\[
\log Y = b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + \ldots (V_i - U_i) \ldots (1)
\]

Where: \( \log = \) natural logarithm; \( Y = \) quantity of yam produced in kg/ha; \( X_1 = \) area cultivated/ha; \( X_2 = \) planting material (seed yam) kg/ha; \( X_3 = \) labour (man-days/ha); \( X_4 = \) fertilizer kg/ha; \( b_0, b_1, b_2, b_3, \) and \( b_4 = \) regression coefficients;

\[ V_i = \text{random variables which are assumed to be independent of } U_i; \]

\[ U_i = \text{non-negative random variables which are assumed to account for technical efficiency in production}. \]

The inefficiency of production, \( u_i \) is modeled in terms of the factors that are assumed to affect the efficiency of production of the farmer. Such factors are related to the socioeconomic variables of the farmers. The determinants of technical efficiency are as defined by Coelli (1994).

\[
U = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} \ldots (3.2)
\]

Where:

\( U = \) technical efficiency; \( Z_1 = \) gender (dummy 1 for male 0 otherwise); \( Z_2 = \) age (in years); \( Z_3 = \) marital status (1 married 0 if otherwise); \( Z_4 = \) family size (number of persons); \( Z_5 = \) educational level (number of years of schooling); \( Z_6 = \) land tenure (1 if personally own, 0 if otherwise); \( Z_7 = \) farming experience (in years); and \( \delta_0 \) to \( \delta_6 = \) inefficiency parameters.

ALLOCATIVE EFFICIENCY

The allocative efficiency index (AEI) was used to determine whether the farmers were efficient or inefficient in the allocation of their productive resources in yam farming. This is expressed thus:

\[ A_i = \frac{MPP_x}{P_x} \]

Where:

\( A = \) the allocative efficiency index; \( MPP_x = \) marginal value product (MPP x P_y); \( P_x = \) unit price of input; \( MPP = \) marginal physical product; and \( P_y = \) unit price of output.

Decision Rule

If \( A = 1 \), then the farmers are allocatively efficient.

If \( A \neq 1 \), then the farmers are allocately inefficient.

If \( A > 1 \), then the resources are under utilized.

If \( A < 1 \), then the resources are over utilized.

RESULTS AND DISCUSSION

The socio-economic characteristics of the yam farmers in the study area and the results of the regression analysis of the respondents are discussed and presented in Tables 1, 2, 3 and 4. The study revealed from table 1 that majority of the yam farmers (83%), were male while 17% were female. This might be due to the labour intensive nature of yam production hence female farmers may prefer to grow other crops with lesser labour requirements. This result agrees with Izekor and Olumese (2010). Majority of the respondents (56.9%) were between the age of 41 and 60 years. The mean ages was 51 years. This implies that majority of the farmers were adults who are little above their active ages, a condition that may affect their overall efficiency since yam production is labour intensive.

Most of the respondents (93.1%) are married. This contribute widely to the use of family labour by the households as their wives and children constituted the labour force as 35.7% of the families are more than 11 members in their household sizes, this finding is in line with the results of Rahman and Umar (2009). The literacy level among the farmers in the study area was relatively high with primary and secondary school leavers dominating, with 83% and tertiary education accounting for 13.9%. Njoku (1991) observed that formal education has a positive influence on adoption of innovation. Majority of the respondents (56.2%) had between 11 and 30 years of farming experience and this shows that the managerial ability of the farmers can be inferred to be reasonably good. It is of the general opinion that experienced farmers would be more efficient, have a better knowledge of climatic conditions and market situation and are thus expected to run more efficient and profitable enterprises (Oluwatayo et al., 2008).

The study also revealed that a larger proportion of the respondents (67.7%) had farm size of less than 1 hectare. This is probably due to land tenure system in the prevailing area that do not allow for large ownership of land through inheritance (Holden et al., 2009). Land tenure accounts for 87.7% inheritance in the study area.
THE STOCHASTIC RESULTS USING MLE

The Maximum Likelihood Estimates (MLE) of the stochastic production parameters for yam production as presented in table 1 below. The table shows that all the coefficients of the variables in the production function are positive and the results conform with the a priori expectations. That is also an indication that the estimated production function is an increasing function. The coefficient of farm size, planting materials and labour are statistically significant. Gamma (γ) is estimated as 0.916 which implies that 92% of the total variation in yam output is due to technical inefficiency. The coefficient of farm size was positive and highly significant at 1% level. This indicates that the farm size (X1) has a positive relationship with output. This implies that, an increase in the variable under static condition of other explanatory variables result in increased output level. This result is in conformity with Shehu et al. (2009) that increase in farm size implies more output.

The coefficient of planting material was positive which conforms to a priori expectation and significant at 1% level of significance. This indicate that higher seed rates would result in higher yam population and subsequently higher yield, except where there is over crowding leading to competition for available nutrients which will consequently lead to lower yield. This result is in conformity with that of Shehu, et al. (2010). The estimated coefficient for labour is also positive and significant at 10% level. Yam cultivation is labour intensive, from cultivation to harvesting. Thus, the 0.045 elasticity of labour implies that a 10% increase in labour, centeris paribus will lead to an increase of 0.45% in the farm revenue and vice versa. This shows the importance of family labour in yam production in the area. The findings agreed with several other studies (Umoh, 2006; Okezie and Okoye, 2006; Udoh and Ettim, 2008). The coefficient of capital was positive but not significant. This further explains the low external input production status of yam in the study area.

The determinants of technical efficiency in yam production in the study area from table 2 below, indicates that farmers age was positive and not significantly related with technical efficiency. This result agrees with that of Onyewakau et al (2004). Farming experience is positive and not significantly related to technical efficiency. The result agrees with that of Onyewakau and Nwaru (2005). Education is negative and shows no significant relationship with technical efficiency. This finding also agrees with that of Onyewakau and Effiong (2005), but disagrees with that of Onu, et al. (2000). Gender is positive and not significant with technical efficiency. This result disagrees with Rahman and Umar (2009). Household size was positive and significantly related with technical efficiency. This means that the more household, the more technically efficient the farmers will be, leading to more yam output. Finally, land tenure was negative and not significantly related to technical efficiency. Thus; gender, farming experience, age, land tenure, marital status and education are not significantly related to technical efficiency while household size has a high significant relationship with technical efficiency.

The frequency efficiency for sample is 78.8% with minimum of 54.2%. This implies that on the average, farmers were able to obtain 78.8% potential output from the given combination of production inputs. The implication of the result is that the average yam farmer requires 21.2% i.e [(1-0.788/0.999)] x 100 cost saving to attain the status of the most efficient level of yam production in the area. While least performing farmers would need 45.8% i.e [(1-0.542/0.999)] x 100 cost savings to be efficient.

Table 1: presentation of the maximum likelihood estimates of the parameters.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Parameters</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>T-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>X0</td>
<td>2.717</td>
<td>0.460</td>
<td>5.904*</td>
</tr>
<tr>
<td>Planting materials</td>
<td>X1</td>
<td>0.158</td>
<td>0.062</td>
<td>2.553*</td>
</tr>
<tr>
<td>Farm size</td>
<td>X2</td>
<td>0.479</td>
<td>0.108</td>
<td>4.438*</td>
</tr>
<tr>
<td>Labour</td>
<td>X3</td>
<td>0.045</td>
<td>0.030</td>
<td>1.539</td>
</tr>
<tr>
<td>Capital</td>
<td>X4</td>
<td>0.209</td>
<td>0.258</td>
<td>0.811</td>
</tr>
<tr>
<td>Efficiency factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>Z0</td>
<td>6.413</td>
<td>5.262</td>
<td>1.219</td>
</tr>
<tr>
<td>Gender</td>
<td>Z1</td>
<td>0.472</td>
<td>0.414</td>
<td>1.140</td>
</tr>
<tr>
<td>Farming experience</td>
<td>Z2</td>
<td>1.129</td>
<td>0.977</td>
<td>1.155</td>
</tr>
<tr>
<td>Land tenure</td>
<td>Z3</td>
<td>-1.814</td>
<td>1.657</td>
<td>-1.095</td>
</tr>
<tr>
<td>Age</td>
<td>Z4</td>
<td>0.248</td>
<td>0.332</td>
<td>0.741</td>
</tr>
<tr>
<td>Marital status</td>
<td>Z5</td>
<td>0.746</td>
<td>0.637</td>
<td>1.171</td>
</tr>
<tr>
<td>Education level</td>
<td>Z6</td>
<td>-0.505</td>
<td>0.095</td>
<td>-0.558</td>
</tr>
<tr>
<td>Household</td>
<td>Z7</td>
<td>0.046</td>
<td>0.009</td>
<td>5.077**</td>
</tr>
<tr>
<td>Sigma square</td>
<td>Y</td>
<td>0.091</td>
<td>0.095</td>
<td>9.653***</td>
</tr>
</tbody>
</table>

*1%level of significance, and ***10% level of significance

A given resource is allocatively used when MVP=Px, this in in consideration of the acquired cost of all input in the prevailing market price per unit in the study area. It is assumed that the opportunity cost of family labour is valued at cost of hired labour per manday. The prevailing unit price of labour per manday at the time of the survey was N500 per manday. The price of land is the rent per hectare which was N3000 per annum at the time of the survey. The unit factor cost of capital was calculated to be N2503 using the prevailing interest rate (12%) as at the time of the survey. The unit factor cost of family labour is valued at cost of hiring labour per manday. The prevailing unit price of labour per manday at the time of the survey was N500 per manday. The price of land is the rent per hectare which was N3000 per annum at the time of the survey. The unit factor cost of capital was calculated to be N2503 using the prevailing interest rate (12%) as at the time of this project work. Unit price of output was determined based on the average prevailing price of yam output which is N116. Table 3 shows the result of the estimated allocative efficiency of the production resources of yam in the study area. The result indicated that planting material and farm size were underutilized as their allocative
efficiency index were found to be greater than 1 (>1). This means that for the farmers to maximize output there should be an increase in planting material and farm size. This result agrees with that of the technical efficiency in which, they were all positive and significant. Labour and capital were overutilized as their allocative efficiency index were found to be less than 1 (<1). This means that with less labour and less fund, they can produce maximum output if and only if they are able to technically allocate their input resources using adequate planting materials and farm size.

Nigeria with planting materials, farm size, and labour found to be significant factors that influence yam output. The result revealed that technical efficiency in Yam production in the study area range from 54% to 99% with a mean of 79%. This implies that there were substantial opportunities to increase productivity and income generation through more efficient utilization of productive resources.

**RECOMMENDATIONS**

Based on the findings of this study, it is thus recommended that farm size, and planting materials should be increased in order to obtain maximum output while labour and capital should be reduced in order to have optimal output. Improved planting materials should be provided to the farmers to boost their production as it has a significant relationship with production. The expenses on hired labour and capital should be reduced as they are over utilized. The socio-economic conditions of the farmers should be improved to enhance efficiencies of their farms.

**REFERENCES**


### Table 2: Estimation of the Allocative Efficiency

<table>
<thead>
<tr>
<th>Variables</th>
<th>MEAN</th>
<th>MVP=($Y/X.P_Y$)</th>
<th>$P_Y$</th>
<th>$P_X$</th>
<th>AEI(MVP/$P_X$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (Y)</td>
<td>410628</td>
<td>511.24</td>
<td>80</td>
<td>6.391</td>
<td></td>
</tr>
<tr>
<td>Planting material</td>
<td>14721</td>
<td>1901345.16</td>
<td>3000</td>
<td>6.3738</td>
<td></td>
</tr>
<tr>
<td>Farm size</td>
<td>1.2</td>
<td>23.175</td>
<td>500</td>
<td>0.046</td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>92491</td>
<td>477.265</td>
<td>2503</td>
<td>0.191</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>20859</td>
<td>477.265</td>
<td>500</td>
<td>0.046</td>
<td></td>
</tr>
</tbody>
</table>

Source: Survey data, 2011

Where:

$MVP =$ marginal value product; $B =$ regression coefficient input; $Y =$ mean of output; $X =$ mean of input; $P_Y =$ unit price of output; $P_X =$ unit price of input; and $AEI =$ allocative efficiency index.

The economic efficiency estimates of the yam farmers given the specification of the program Frontier (version 4.1c) production function in equation 1 and 2, the economic efficiencies of yam farmers in Yakurr LGA of Cross River state were calculated. The predicted efficiencies differ subsequently among the farmers ranging between 0.089 and 0.861, with mean efficiency of 0.36. The low mean economic efficiency is an indication of inefficiency in resource use by yam farmers in Yakurr. Also, there exist a wide gap between the efficiency of best economically efficient farmer and that of the average farmer. This type of wide variation in farmers-specific efficiency level is a common phenomenon in developing countries (Pius and Odjuvwuederhie, 2006d).

### CONCLUSION

Stochastic frontier production function was estimated for yam production in Yakurr LGA of CRS, Nigeria with planting materials, farm size, and labour found to be significant factors that influence yam output. The result revealed that technical efficiency in Yam production in the study area range from 54% to 99% with a mean of 79%. This implies that there were substantial opportunities to increase productivity and income generation through more efficient utilization of productive resources.
Central Bank of Nigeria.
Njoku, JE (1991) Factors influencing the adoption of improved oil palm production technologies by small holders in Imo State, Nigeria.
Research report No.2 Development policy centre Ibadan, Nigeria pp 1-85.


