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# Evaluation of Economics Efficiency of Yam Production in Wukari Local Government Area of Taraba State

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**Abstract**

Improving resource-use efficiency is essential for enhancing the profitability and sustainability of yam production. This study assessed the costs and returns and evaluated the technical and economic efficiency of yam production in Wukari Local Government Area, Taraba State, Nigeria. Primary data were collected from 120 yam farmers selected through a multistage sampling procedure and analyzed using net farm income analysis and stochastic frontier models. The results indicate that yam production was profitable, generating an average gross margin of ₦217,441.67, with a total variable cost of ₦628,830.25 and a return of ₦0.30 per naira invested. Seed represented the largest variable-cost component (49%), followed by labour (38%). The stochastic production frontier yielded a gamma estimate of 0.87, indicating that 87% of the composite-error variance was attributable to technical inefficiency. The economic efficiency analysis similarly attributed 92% of the observed variation to differences in farmers' economic efficiency. Farm size, seed quantity, fertilizer application, and labour positively influenced yam output, whereas agrochemical use had a negative association, suggesting possible overapplication or inappropriate use. Educational attainment, household size, farming experience, and age significantly reduced economic inefficiency, demonstrating the importance of farmers' socioeconomic characteristics and human capital. The study concludes that although yam production in the study area is profitable, considerable scope remains for improving technical and economic efficiency through more effective resource allocation, greater access to credit, and the adoption of improved farming practices. These findings provide empirical guidance for policies that prioritize subsidized production inputs, strengthened agricultural extension services, farmer education, and expanded credit access to improve the productivity and sustainability of yam production.

**Keywords:** Yam Production; Economic Efficiency; Technical Efficiency; Stochastic Frontier Analysis; Resource-Use Efficiency

## INTRODUCTION

Apart from cereals, yam (*Dioscoreaspp*) is the most important staple food in West Africa. It is among the most valuable root tuber in the tropic (Ani*et al.,* 2012). Yam is an annual crop and monocot plant. Yam has as many as 600 species out of which six are economically important staple species. These are: *Dioscorearotundata* (white yam), *Dioscoreaalata* (water yam), Dioscoreabulbifera (aerial yam), *Dioscoreaesculant* (chinese yam) and *Dioscoreadumetorum* (trifoliate yam). Out which *Dioscorearotundata* (white yam) is the most common species in Nigeria (Ebewore *et al.,* 2013). According to Onwueme *et al.,* (1991) Dioscorearotundata is grown on greater acresthan any other species of yam in world because of its storage ability, taste and the ability to mature faster than all other species.

Yam are grown in tropical regions and mostly produce in the savannah region of West Africa, where rainfalls are divided into wet and dry seasons (FAO, 1997). Yam is also grown in latin America and Caribbean countries like Colombia, Brazil, Cuba, and Jamacia (FAO, 2013). Nigeria is the largest producer of yams in the world, followed by Ghana, Cote D'Ivoire, Benin, Togo and Cameroon (FAO, 2013).

Yam is an important source of income for yam farmers. It is the goal of every farmer to make profit. Yam is among the major cash and most consumed food crops in west African countries like Nigeria (Gesellschaft Fur TechnischeZusammenarbeit GTZ , 1999) and ( Babaleye, 2003; National Bureau of Statistics, 2012). Its cultivation is very profitable despite high costs of production and price fluctuations in the markets (International Institute of Tropical Agriculture IITA, 2013). Y

Efficiency is concerned with the relative performance of the processes used in transferring given inputs into outputs. (Farrel, 1957) identified three types of efficient which are technical, allocative and economic efficiency. The production of yam in West Africa has been declining partly because the tuber which is the source of food is also the source of planting material and this compels the farmers to retain materials for next year production (Welch, 2003). Inefficiency in yam production has been attributed to militating factors such as disease and pest attack, low soil fertility, shortage of finance to carry out the necessary farming activities, high cost of inorganic fertilizer and poor knowledge of farm management (Agwu *et al.,* 2005). More importantly, lack of Appropriate pricing for yam tubers, non-availability of improved yam setts/seed to increase farmers productivity, decline in productivity owing to marginal lands, inefficiency in the allocation of existing resources and increasing labour demand all tend to discourage the production of yam in recent times. There are postharvest losses due to the ignorance of farmers storing yams beyond the natural storage time (generally shorter than 12 months) which reduces the quality of yam resulting in the fall in price of the yam tubers (Andreas, 2003). In view of this the broad objectives of the study seeks to evaluate the economics efficiency of yam production in Wukari Local Government area of Taraba state. The specific objectives were to: estimate the costs and returns of yam production of respondents; and evaluate the technical and economic efficiencies in yam production among participating farmers in Wukari Local Government area.

## METHODOLOGY

### Study Area

The study area is Wukari Local Government Area of Taraba State. Wukari Local Government Area is situated in the southern part of Taraba State. It is slightly over two hundred Kilometers away from Jalingo the state capital. The local Government is bounded by Plateau in the North, Benue state in the southwest. The Local Government has a total land area of 4,308 $km^2$ and the National Population Figure of 2006 put the population at 241,546, (Samuel, 2018). Wukari was created in 1976 and is divided into 10 political wards namely: Puje, Avyi, Tsokundi, hospital, Rafin-Kada, Chonku, Kente, Jibu, Bantaje and Akwana ward. Wukari is the headquarters of Wukari Local Government area. It is located between latitudes $7^0 51'$N to $7^0 85'$N and longitudes $9^0 46'$E to $9^0 78'$E of the Greenwich meridian, (Samuel, 2018). It is marked by dry and rain seasons. The rain season commences in April, and lasts till October. While the dry season lasts from November to March. The average rainfall is 1.350mm. The harmattan; dry, cold and dusty wind is the driest period and occurs from the months of December to February with humidity put at 13 per cent.

**Sources of Data**

The targeted population for the study comprised of yam farmers in Wukari, Taraba State, Nigeria. Data for this study was collected mainly from primary source. This was done manually through the administration of structured questionnaire to the respondents. Questionnaire administration was done by the researcher and some research assistants who were carefully selected and trained.

**Sampling Technique**

Multi-stage sampling techniques were adopted for this study. A pre-research survey carried out in the study area, revealed that yam farmers are more populated in the five selected wards of the study area. Hence the purposive selection of Puje, Jibu, Kente, Tsokundi and Rafin-kada wards is the first stage because of predominance of yam farmers in the areas. In the second stage, twenty (20) villages were selected from the five (5) wards, four (4) villages from each ward. Finally simple random sampling technique was used to select twenty four (24) farmers from each ward, which give a total of one hundred and twenty (120) respondents.

**Method of Data Analysis**

Net farm income analysis was used to achieve objective ii, The stochastic production functions were used to achieve objective iii.

**Model Specification**

$$NFI = TR - TC \quad \ldots\ldots(1)$$

Where;

NFI= Net farm income

TR= Total revenue

TC= Total cost

$$TC = TVC + TFC \quad \ldots\ldots(2)$$

**The stochastic production function is specified thus:**

$$Y_i = f(x_i; \beta) + e_i \quad \ldots\ldots(3)$$

$$ei = vi - ui \text{......} (4)$$

Where;

Yi = Quantity of output of the ith farm

xi = Vector of the inputs used by the ith farm

β = A vector of the parameters to be estimated

ei = Composite error term

vi = Random error outside farmers control

ui = Technical inefficiency effects

The explicit form of stochastic production frontier is specified as:

$$\ln Y = \beta o + \beta 1 \ln X1i + \beta 2 \ln X2i + \beta 3 \ln X3i + \beta 4 \ln X4i + (Vi - Ui) \text{......} (5)$$

Where;

ln = The natural logarithm

Y = Output of yam (kg)

βo = Constant term

β1-β4 = Regression coefficients

X1 = Quantity of yam seed (kg)

X2 = Quantity of fertilizer (kg)

X3 = Total labour used (man day)

X4 = Quantity of agrochemical (litres)

Vi = Random variability in the production that cannot be influenced by the farmer.

Ui = Deviation from maximum potential output attributable to technical inefficiency.

$$Ui = \delta 0 + \delta 11nZ1 + \delta 2\ln Z2 + \delta 3\ln Z3 + \delta 4\ln Z4 + \delta 5\ln Z5 + \delta 6\ln Z6 + \delta 7\ln Z7 \text{......} (6)$$

Where;

Ui = Technical effects of individual yam farmer

Z1 = Age of farmer (years)

Z2 = Number of years spent on formal education (years)

Z3 = Farm size (in hectare)

Z4 = Number of years in yam farming (years)

Z5 = Number of extension visits (number visit)

Z6 = Household size (number)

Z7 = Amount of credit (₦)

δ0 = Constant

δ1-δ7 = Parameters to be estimated.

### Economic Efficiency

The product of technical efficiency (TE) and allocative efficiency (AE) provides the index of economic efficiency (EE).

$$EE = TE * AE \qquad (7)$$

$$TEi = Yi/Y^* = \exp(vi\text{-}ui)/\exp(vi) = \exp(-ui) \qquad (8)$$

Where;

TEi = Technical efficiency of farmer i,
Yi = Observed output from farm i and
Y* = Frontier output.

$$AE = Y^*/Yi = \exp(vi)/\exp(vi\text{-}ui) \qquad (9)$$

Where;

AE is the allocative efficiency of farmer i,

Y* = Frontier output; and
Yi = Observed output from farm i

## RESULTS AND DISCUSSION

### Costs and Returns Analysis

The viability of an enterprise is indicated by the amount of profit realized per period of time, (Man 2015). Profit is the difference between the monetary value of goods produced and the cost of the resources used in their production. The amount of revenue realized and operating cost of a business venture determines how much gain or loss the enterprise can achieve within a certain period. The profitability analysis which was used to achieve objective i is shown in Table 1

Total Variable Cost is the operating costs of the respondent which are the day-to-day cost incurred for producing yam. The Total Variable Cost (TVC) incurred by the respondents averaged N628,830.25 and the fixed cost incurred by the respondents at an average N20,412.37 with an average gross Income (GI) of N846,271.92 which resulted in a Gross Margin (GM) of N217,441.67. Labour was sourced from both family and hired. Consequently, the imputed cost of labour used for family labour equals the prevailing wage rate of hired labour. Hence, labour cost accounts for 38% of the TVC, while seed, fertilizer and agrochemicals costs account for 49%, 6% and 8% respectively for the yam farmers in the study area. The analysis revealed that seed is the most used variable among the respondents. This conforms to the study of According to Man, (2015), where seed cost dominates the Total Variable Cost of yam production in the study area.

**Table 1. Average Costs and Return (in Naira) for Yam Production in the study area**

| Variable | Value (₦) |
|---|---|
| Yam revenue | 846,271.92 |
| VARIABLE COST | |
| Cost of seed yam | 308,607.42 |
| Cost of labour (land preparations) | 230,810.11 |
| Cost of herbicide | 516,32.02 |
| Cost of fertilizer | 377,80.70 |
| Cost of harvesting | 846,271.92 |
| Cost of transportation | 62,591.23 |
| Total variable cost (TVC) | 628830.25 |
| FIXED COST | |
| Cost of land | 13,324.56 |
| Cost of cutlass | 597.43 |
| Cost of hoes | 1081 |
| Cost of head pan | 805 |
| Cost of warehouse | 4,604.38 |
| Total fixed cost (TFC) | 20,412.37 |
| Total cost of production (TC=TVC+TFC) | 649,242.62 |
| Gross margin (GM-TVC) | 217,441.67 |
| Net farm income (TR-TC) | 197,029.30 |
| Return per naira invest (RNI=NFI/TC) | 0.30 |

*Source: Field Survey, 2025*

## Measurement of efficiencies

### Estimated technical efficiency of the respondents

The result presented in Table 2 shows the gamma statistics of 0.87, implying that 87% of the changes in the output are attributable to respondents' inefficiency factors. Therefore, the hypothesis that the parameter estimate of = 0 is strongly rejected. The significant level of the gamma indicates the presence of one- sided error component, vi in the model specified. Due to the presence of this one-sided error component, the traditional response function estimated by the Ordinary Least Square cannot represent the data adequately. Thus, the stochastic frontier function estimated by the Maximum Likelihood Estimation procedure is best fitted for the data. Therefore, the second null hypothesis, which specifies that the inefficiency effects are not stochastic, is also rejected. The positive and significant (10%) coefficient of the Sigma-square (σ2) indicates the correctness of the specified assumption of the distribution of the component error terms. The generalized likelihood ratio statistics -152.7154 which exceeds the critical chi-square value at 1% level of significance.

**Farm size (x1):** The estimated coefficient was 0.3799. This positive effect of farm size on yam output implies that a 5% increase in the size of farm holding will lead to an increase in output of yam by 0.3799%. The coefficient of farm size was significant at 5% level of probability, indicating the relevance of farm size on yam production in the study area.

**Quantity of seed (x2):** The coefficient of seed used positively affects output with a value of 0.0023. The implication of this positive effect is that if quantity of seed used increases by 10%, output will rise by 0.0023% of yam production. Production of yam cannot be embarked upon if seed is not involved in the production process; hence, quantity of seed used was significant in yam production at 10% probability level.

**Quantity of fertilizer (x3):** The estimated coefficient 0.0051 of the variable was positive. This implies that, 10% increase in quantity of fertilizer other things being equal will only lead to 0.1394%. This is in line with the finding of Man, 2015 who found the coefficient of fertilizer to be positive and significant at 10% level in his measurement of technical efficiency of yam farmers in Niger State Nigeria.

**Labour used (x4):** The estimated coefficient was positive 0.0042 related to output. This implies that a 10% increase in the quantity of labour *ceteris paribus,* will increase yam output by 0.0042%.

**Volume of agrochemicals (x5):-** The coefficient for volume of agrochemicals was negatively signed -0.0013 and significant for the production of yam by the respondents. The implication of the result is that as the volume of agrochemicals used for the production of yam increases by a litre, the quantity of yam produced decreases. The sign was not as expected because use of agrochemicals reduces drudgery in farm operations such as weeding and clearing as well as increase quantity of output produced stemming from control of pests and diseases.

**Table 2 : Technical Efficiency of Respondents**

| Variables | Coefficient | Standard error | t-ratio |
|---|---|---|---|
| Constant ($B_0$) | 9.1635 | 0.6872 | 11.999** |
| Farm ($X_1$) | 0.3799 | 0.1476 | 5.061** |
| Quantity of seed ($X_2$) | 0.0023 | 0.0435 | 1.864* |
| Quantity of fertilizer ($X_3$) | 0.0051 | 0.1548 | 0.456 * |
| Labour used ($X_4$) | 0.0042 | 0.1236 | 1.978* |
| Volume of agrochemicals ($X_5$) | -0.0013 | 0.0701 | -2.411** |
| **Variances** | | | |
| Sigma-squared ($6^2$) | 19.8672 | 15.1751 | 1.741* |
| Gamma (Y) | 0.8732 | 0.0076 | 116.121*** |
| Log likelihood function | -152.7154 | | |
| LR test | 48.7848 | | |

n=114
Log likelihood = m-152.7154***
***, ** and * significant at 1%, 5% and 10% levels respectively

## Estimated economic efficiency of the respondents

Economic efficiency indicates the economic status of the respondents. The result presented in Table 3 is the product of technical and allocative efficiencies. The positively significant value of the sigma-square conforms to the expectation of the data being fit into the model of the stochastic function. The gamma coefficient of the economic efficiency lies between 0 and 1 as expected (0.92987). This implies that about 92% of the variations in the economic status of the respondents are attributable to differences in their economic efficiencies. This implies that economic inefficiency significantly contributes to the production of yam in the study area**.** Hence**,** the hypothesis that gamma = 0 is rejected. The included production variables show both positive and negative signs. Farm land, seed and fertilizer revealed positive effect on economic efficiency of the respondents.

The positive relationship of these variables to economic efficiency implies that an increase in the use of these variables by 5% would result to an improvement in the economic status of the respondents. The combination of larger farm holdings and application of fertilizer to yam would lead to increased output vis-a-vis income of the respondents. On the other hand, agrochemical and labour were negatively signed, implying a negative effect on economic efficiency of the respondents. If volume of agrochemical and labour used for the production of yam are increased by 1%, economic efficiency would decrease. This sign which is against *a priori* expectation could be deviation from inappropriate utilization of the inputs by the farmers this findindsPius, *et at.,* (2006), on Determinants of Yam Production and Economic Efficiency Among Small-Holder Farmers. All the production variables were found to be significant at various levels of probability for economic development of the respondents.

The estimated parameters for educational level, household size, farming experience and age were negative and significantly related to economic inefficiency at 5% except farming experience which was significant at 1% level of probability. This implied that increase in educational level, household size; farming experience and age would reduce economic inefficiency. The coefficient obtained for amount of credit was negative and significant at 5% whereas the coefficient for membership of cooperative organization was also negative but not significant membership of cooperative organization was not significant because majority (84.2%) of the respondents did not belong to any cooperative organization.

**Table 3: Economic Efficiency of Respondents**

| Variables | Coefficient | Standard error | t-ratio |
|---|---|---|---|
| Constant | 34.4958 | 7138.921 | 37.7175 |
| Farm land | 0.001 | 0.0088 | 11.5781** |
| Seed | 0.0038 | 0.0049 | 3.8913** |
| Fertilizer | 0.0041 | 0.0094 | 0.8573* |
| Agrochemical | -0.0713 | 0.0071 | -8.7118*** |
| Labour | -0.0044 | 0.0041 | -9.6316*** |
| Constant | -133.8715 | 108.1547 | -1.1414 |
| Educational level | -0.0055 | 0.0007 | -9.1039** |
| Household size | -0.1092 | 0.0144 | -7.3151** |
| Age | -0.0421 | 0.0410 | -1.1598** |
| Farming experience | -0.0268 | 0.0006 | -47.0021*** |
| Amount of credit | -0.0038 | 0.0014 | -1.9699** |
| Cooperative society | -0.0030 | 0.0052 | -0.4999 |
| Sigma-squared | 149.3981 | 78.5547 | 1.9501** |
| Gamma | 0.92987 | 0.0005 | 2398.6570*** |
| Log likelihood Function | -158.0098 | | |
| LR test | 478.10 | | |

n=114
Log likelihood = m-158.0098***
*** ** * significant at 1%, 5% and 10% levels respectively

## CONCLUSION

This study evaluated the economic efficiency of yam production in Wukari Local Government Area of Taraba State, revealing that yam farming is a profitable agricultural enterprise with a gross margin of ₦217,441.67 and a return per naira invested of 0.30. The analysis demonstrated that seed cost constitutes the largest variable expense (49%), followed by labour (38%), indicating that these inputs are critical determinants of production costs. The stochastic frontier analysis revealed a technical efficiency coefficient (gamma) of 0.87, indicating that 87% of output variations are attributable to inefficiency factors, while the economic efficiency analysis showed that 92% of variations in farmers' economic status result from differences in economic efficiencies. Significant factors positively influencing yam output include farm size, quantity of seed, fertilizer application, and labour, while agrochemicals showed a negative relationship, suggesting potential overuse or improper application. Socioeconomic factors such as educational level, household size, farming experience, and age were found to reduce economic inefficiency, highlighting the importance of human capital development. The study concludes that despite the profitability of yam production, there remains substantial room for improvement in technical and economic efficiencies through better resource allocation, access to credit, and adoption of improved farming practices. Policy interventions should therefore focus on providing subsidized inputs, particularly quality seed yams and fertilizers, strengthening extension services, and promoting farmer education to enhance productivity and sustainability of yam production in the study area.

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