TECHNICAL AND RESOURCE USE EFFICIENCY OF YAM PRODUCTION IN SOUTHERN TARABA STATE, NIGERIA.

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Abstract

The study analyzed the technical and resource use efficiency of yam production in southern Taraba state, Nigeria; specifically, the study estimated the technical efficiency of yam production in the study area, determinedthe factors influencing of technical inefficiency and the resource use efficiency of the respondents in the study area. A multistage purposive and simple random sampling were employed in the study. Stochastic frontier production function was used to analyze the data collected with the aid of structured questionnaire.The results of the analysis showed that the mean technical efficiency of the farmers was 0.85.This implies that on the average, output fall by 15% from the maximum possible level due to inefficiency. The result of the inefficiency model revealed that age (-0.46784273), household size (-0.35482490), education (-0.652), access to credit (-0.9386683) and farming experience(-0.59852977) were the significant factors that influenced technical inefficiency among yam farmers in the study area. Also, the result of the resource use efficiency estimate showed that production inputs were not efficiently utilized by the farmers in the study area. It is therefore recommended that since the yam farmers are not realizing their full production potential, there is a need for sustained improvements on performance through enhanced roles by the government in educating farmers.Government should initiate policies that will encourage the experienced yam farmers to remain on the farm while young educated ones are motivated to take up yam production to solve the problem of ageing yam farmers.Farmers should also be sensitized on the need to register with adult/continuing education centres to improve on their education which will facilitate their adoption of innovation for production efficiency. Government should make available credit facilities to farmers to enable improve their production efficiency.

Keywords: Technical efficiency, Yam, Southern Taraba, Resource-Use-Efficiency

INTRODUCTION

The food situation and conditions of Nigerian farmers are critical: Nigerian farmers are predominantly technically inefficient and resource-constrained poor farmers who are unable to produce adequate food for their families (Amaefula, Farquharson, Ramilan and Asumugha, 2018). Ekine and Okeke (2013) noted that yam production in Nigeria is substantially short and cannot meet the growing demand at its present level of use. Nigeria as a country is endowed with large expanse of arable land and other resources as well as favorable climate, however, she is yet to become self-sufficient in food production (Spore, 1993). Low productivity due to inefficiency in resource use among food crop farmers has been reported (Ibok, Idiong, Nsikan and Ekaette,2014).

Over the years, the farm hectare of yam production has been increasing with corresponding increases in the usage of inputs and this is attributed more to the large area planted with yam than increase in productivity (Nwosu and Okoli, 2010). The increase in output seems not to have been commensurable with those in input usage (Jonathan and Anthony, 2012). Consequently, there has been a decline in yam production in the country over the years with the area under cultivation and

total yam output declining (Ayanwuyi, Akinboye and Oyetoro, 2011). This is reflected in the fall in output percentage growth rate of yam from 45% in 2011 to about 18.6% in 2018 despite the increase in land devoted for the production of the crop from 1270 million hectares to 2742 million hectares within the quoted time interval (Shehu,Iyorlyer, Mshelia, and Jongur,2010). This declining trend may not be unconnected with production resources which areinefficiently utilized since increased productivity is directly related to production efficiency. Previous studies carried out on food crop production in Nigeria have shown that food crop farmers have low productivity because of inefficiency in resource use (Ibok et al., 2014).

Therefore, this study sought to re-explore yam farmers' production efficiencyby examining the technical and resource use efficiency of yam production in Southern Taraba State. The specific objectives were to determine the technical efficiency of yam production in the study area, determine factors that influence inefficiency among yam farmers and determine the resource-use-efficiency of yam production in study area.

Materials and Methodology

The study was conducted in southern Taraba State, Nigeria. Southern Taraba State is made up of five Local Government areas (Takum, Wukari, Donga, Ussa, and Ibbi) and one special Development Area (Yangtu). Thearea covers an areaof14,099Km^{2}land mass withapopulationofabout687,077peopleasat2006(National Population Commission,2006). It has a tropical wet and dry seasons, well drained alluvial soils and characterized by bothsavannahandrainforestvegetation.Itsdryseason lasts for a minimum of four months (December to March) while the wet season spans earlyMarchtolateNovemberinthesouth(Oruonye and Abbas, 2011).The population for this study was the entire yam farmers in the study area. From the preliminary research conducted in the study area, 1030 yam farmers were identified through cooperative membership by the researcher in the study area. Primary data were collected from selected yam farmers in nine villages located in three selected local government areas of southern Taraba, using structured questionnaire.Multistage purposive and simple random sampling procedures were employed in the selection of the study area and the respondents. In the first stage, Southern Taraba state was purposively selected based on its yam farming activities. In the second stage, three (3) local government areas (Donga, Takum and Wukari) were purposively selected from southern Taraba State based on their predominance in yam production in the area. In the third stage, three accessible yam producing communities were purposively selected from each of the selected local government areas based on concentration of yam farmers. In the last stage, farmers were selected using simple random sampling in proportion to the population of the farmers in each selected community. The Taro Yamane sample size formula was used to determine the sample size of 170 respondents and 159 questionnaires were retrieved and used for the analysis due to inappropriate response from the respondents. The Taro Yamane formula for sample size calculation used is presented as follows:

$$n = \frac{N}{(1+N\varepsilon^2)}$$

……..(1)

Where, n = sample size, N = population of yam farmers, and E = adjusted margin error (7%)

Stochastic Frontier Production (SFP) Analysis.

The econometric modeling of stochastic production efficiency frontier model independently proposed by (Aigner, Lovell, and Schmidt 1977) was used in the analysis of data. It is specified implicitly as:

$Y_i = f(X_i . \beta) + e_i$ ……..(2)

$e_i = V_i - U_i$

……..……..…… (3)

Where:

Y_i = quantity of output of the i^{th} farm,

X_i= vector of the inputs used by the i^{th} farm,

β = a vector of the parameters to be estimated,

e_i = composite error term,

V_i= random error outside the farmer's control and

$-U_i$ =technical inefficiency effects.

Stochastic Frontier Production Function Model used in the study is specified explicitly as follows:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 \quad (V_i - U_i)$$

…….....……...….(4)Where,

ln = the natural logarithm,

Y = output of yam (kg/ha),

β_0 = constant term,

β_1- β_5 = MLE coefficients,

X_1 = Quantity of yam setts (kg),

X_2 = Farm Size (ha)

X_3 = Total labour (hired and family) used (man-days),

X_4 = Quantity of herbicides/insecticides (litre)

X_5 = Quantity of fertilizer (kg),

V_i= random variability in the production that cannot be influenced by the farmer.

$-U_i$= deviation from maximum potential output attributable to technically inefficiency.

$$-U_i = \delta_0 + \delta_1 \ln Z_1 + \delta_2 \ln Z_2 + \delta_3 \ln Z_3 + \delta_4 \ln Z_4 + \delta_5 \ln Z_5 + \delta_6 \ln Z_6 + \delta_7 \ln Z_7 + \delta_8 \ln Z_8 \ldots$$

…….....(5)

Where:

$-U_i$ = inefficiency effects,

δ_0 = constant

δ_1-δ_8 = Parameters to be estimated

Z_1 = Gender of farmer (1= male, 0= female),

Z_2 = Age (years),

Z_3 = Household size (number of persons),

Z_4 = Education level (0= no formal, 6= primary, 12 = secondary, 16 = Tertiary),

Z_5 = Cooperative membership (years),

Z_6 = Access to credit (Yes = 1 and No = 0)

Z_7 = Extension visit (Yes = 1 and No = 0)

Z_8 = Farming experience (years)

Resource Use Efficiency (RUE)

For resource use efficiency, Marginal Factor Cost (MFCs) was compared with the Marginal Value Product (MVPs) and their ratios were calculated to decide on the efficiency of resource use. The efficiency ratio is given by the expression that follows:

$$r = \frac{MVP}{MFC}$$

……

……(6)

Where r = efficiency ratio, MVP = marginal value product of a variable input and MFC = marginal factor cost (price per unit input).The MVP was calculated using the following formula:

$$MVPxi = MPPxi * Py$$

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……..……(7)

Where: $MVPX_i$ = marginal value product of X_i, X_i = mean value of each of the inputs, Py= unit price of output and $MPPx_i$ = marginal physical product of X_i. When the translog production function in equation (3) is linearized and differentiated with respect to the input (X_i), the marginal physical product (MPP) can be obtained as follows:

$$MVP = MPP * P_y = \left(\beta_i * \frac{Y_i}{X_i}\right) * P_{yi}$$

……..…

……(8)

Y_i = Mean value of output, X_i = Mean value of inputs employed in the production of the yam output, MPP_x = Marginal physical product of input X_i, P_y = Unit price of yam output and β_i = the output elasticity of input X_i, which was also used as MPP for computation of efficiency ratio. The decision Rule is, if:

r =1, it implies that resources are used efficiently by groundnut farmers in the study area.

r > 1, it implies resources are under-utilized and increasing the rate of use of that resource will help increase productivity.

r < 1, it implies resources are over -utilized and reducing the rate of use of that resource will help improve productivity.

RESULTS AND DISCUSSION

Technical Efficiency of the Yam Farmers

Results for the estimation of stochastic frontier production of yam in the study area are presented in Table 1 below. The Sigma-squared indicates the total amount of variance found in the model. Its estimated coefficient was positive and statistically significant at probability level ($p<0.05$). This indicates a good fit and correctness of the distributional form assumed for the composite error term. The gamma (γ) measures the effect of technical inefficiency on the observed output. The estimated coefficient was positive and statistically significant at probability level ($p<0.01$). This is consistent with the theory that true γ-value should be greater than zero. This implies that 42% of the variation in the output of yam was attributed to technical inefficiencies of the yam farmers in the study area. The log likelihood function was 0.638 which implied that inefficiency exist in the data set. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model.The mean technical efficiency for the respondents is 0.850 implying that, on the average, the respondents are able to obtain 85% of potential output from a given mixture of production inputs. Thus, in a short run, the technical efficiency of the farmers could be increased by 15% through efficient use of available resources. This shows that there is an efficiency gap but with scope for improvement in the study area. These results compare favorably with the findings of Akerele,Odojukan, Yangomodon, Olugbemi, Solana, Ilori and Fadipe (2019) who reported that there is observed efficiency gap from the optimum efficiency level among yam farmers in Nigeria with scope for increased efficiency.The estimated coefficients of farm size and labour were positive and significant at probability level of $p<0.10$. This means that a 1% increase in farm size and quantity of labourwould increase yam output by 0.28% and 0.47% respectively. This results compare favorably with similar findings conducted by Ibok et al. (2014) and Orewa and Izekor (2012).The coefficient of yam sett is positive and significant at $p<0.01$ probability level. This implies that, increasing the quantity of yam sett by 1% will amount to 0.43% increase in the output of yam. This result agrees with the finding of Abdullahi (2015) who reported a positive estimated coefficient of yam sett significant at 1% level in Niger State.The estimated coefficient of herbicide/insecticide is positive and significant at $p<0.05$ probability level. This implies that a 1% increase in quantity of herbicide/insecticide, will lead to 0.93% increase in the quantity of yam output. This is in agreement with the finding of Ani,Iorkaa and Ogebe(2013) who revealed in their study that quantity of herbicides/insecticides have significant influence on the output of yam. The estimated coefficient of fertilizerisnegative. This implies that an additional quantity of fertilizer will reduce the output of yam. This could be attributed to the high soil nutrient level of some parts of the study area. Zaku,Emmanuel, and Thomas (2011) reported that Wukari and Donga have relatively high soil nutrient which implied that excessive fertilizer use in the study area is likely to affect plant growth and yield.

Table 1. Results of MLE of Yam Production Efficiency

Variables	Parameters	Coefficients	Standard errors	t-ratio
Efficiency Variables				
Constants	β_0	0.29480316	0.10337222	2.851860501
Yam sett	β_1	0.43066999	0.14065301	3.0619323***
Farm size	β_2	0.26762507	0.14273894	1.8749264*
Labour	β_3	0.37125783	0.14476162	2.5646150**
Herbicide/insecticide	β_4	0.93187236	0.45696661	2.0392570**
Fertilizer	β_5	-0.31033175	0.16931041	-1.8328317*
Variance parameters				
sigma-squared	δ^2	0.24665719	0.12876098	1.9156206**
Gamma	γ	0.42334281	0.19719581	2.1468144**
Log likelihood		0.638		
Mean efficiency		0.84720175		

Note: ***P<0.01, **P<0.05, *P<0.10 and NS = Not Significant.

Factors Influencing Technical Inefficiency of the Yam Farmers

The factors influencing inefficiency were determined by using the estimated δ-coefficients associated with the inefficiency model as presented in Table 2 below. Age, household size, education, access to credit and farming experience of the farmers were negatively related to technical inefficiency. The coefficients of age, household size and educational level were all negative and significant at p<0.05 probability levels which implies reduction in technical inefficiency of the farmers. These findings are consistent with the results of similar studies conducted by of Ekunwe, Henri-Ukoha and Emmanuel (2018), Orewa and Izekor (2012) and Gideon, Abubakar and Gbanha (2015). The estimated coefficient of access to credit is negative and significantly related to technical inefficiency at 10% level of significance. This implies that yam farmers who had access to credit had lower inefficiency in yam production than their counterparts who did not access credit. This finding agrees with Nuhu (2016) who reported a negative relationship between access to credit and technical inefficiency and also noted that credit is an important component of agricultural production, the absence of which poses severe constraints to agricultural development.The estimated coefficient of farming experience was negative and significant at p<0.01 probability level which implies that as farmers' years of farming increases, inefficiency decreases. This result is in line with the findings of Orewa and Izekor (2012) and Abdullahi (2015) for yam farmers in Edo and Niger state respectively, who reported that with increased years of experience, farmers' efficiency increases and they become more specialized.

Table 2: Results of MLE of Yam Production inefficiency

Variables	Parameters	Coefficients	Standard errors	t-ratio
Inefficiency Model				
Constant	δ_0	-0.33900637	0.12526762	-2.706257012
Gender	δ_1	0.44814821	0.31336077	1.4301350^{NS}
Age	δ_2	-0.46784273	0.22483072	-2.0808666**
Household size	δ_3	-0.35482490	0.28004401	-1.9707676**
Education level	δ_4	-0.65231204	0.29096706	-2.2418759**
Cooperative Association	δ_5	0.16164924	0.54901506	0.2944349^{NS}
Access to credit	δ_6	-0.93866826	0.50114190	-1.8730588*
Extension visit	δ_7	0.49248636	0.34971660	1.408244^{NS}
Farming experience	δ_8	-0.59852977	0.17247732	-2.1966223***

Note: ***P<0.01, **P<0.05, *P<0.10 and NS = Not Significant.

Resource Use Efficiency of the Yam farmers

The resource-use-efficiency of the yam farmers was measured by the ratio of the marginal-value-productivity (MVP) of each input used to their respective prices. The MVP for each input was determined by multiplying the MPP of each input by the mean price of the groundnut output. The resource-use efficiency for four production inputs were measured. They are: yam sett, labour, herbicide/insecticide and fertilizer. Resource-use-efficiency for land was not considered because land is a fixed input and its adjustment depends on long term profitability. The results of the resource-us-efficiency estimations are presented in Table 3 below. The results revealed that all the variable inputs under consideration were not efficiently used in production by the yam farmers. The efficiency ratio (r) of yam setts, labour, herbicide/insecticide and fertilizer were 1.6163, 0.096, 0.1165 and -0.332 respectively. This connotes that yam sett was under-utilized while, labour, herbicide and fertilizer were over-utilized by the farmers in the study area. The implication is that farmers in the study area did not utilized production resources efficiently. This result agrees with the findings of Darius (2017) and Buhari, Yahaya and Hashim (2018) who reported that farmers are inefficient in their resource use in their respective studies.

Table 3. Estimated Efficiency ratio of Yam Production.

Resources	MPP	P_y(₦)	MVP (₦)	MFC (₦)	$r = \frac{\quad}{\quad}$	Decision rule
Yam sett (X_1)	0.431	150	64.65	40	1.6163	Under-utilized
Labour (X_3)	0.371	150	55.65	580	0.096	Over-utilized
Herbicide/Insecticide (X_4)	0.932	150	139.8	1200	0.1165	Over-utilized
Fertilizer (X_5)	-0310	150	-46.5	140	-0.332	Over-utilized

Source: Field Survey, 2019.

CONCLUSIONS

Yam farmers were inefficientin their use of inputs.The attainment of an averagetechnical efficiency of 85% indicated thatefficiency of the farmerscould be increased by 15% through adjustment in production inputs. Age,education, household size,access to credit and farming experience were found to have significant effect on the efficiency of the farmers by reducing their technical inefficiency.

POLICY RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

I. Government should initiate policies that will encourage the experienced yam farmers to remain on the farm while young educated men and women are motivated to take up yam production to solve the problem of ageing yam farmers.

ii. Also, there is need for sustained improvements on performance through enhanced roles by the government in educating farmers through extension agents since yam farmers are not realizing their full production potential. This can be achieved by addressing the factors responsible for

iii. the inefficiency. These include a more increased use of yam sett and reduced use of labour, herbicide/insecticide and fertilizer inputs given the prevailing state of technology.

iv. Government should make available and accessible,credit facilities to farmers to enable production efficiency.

v. Education was found to have a significant effect on the technical efficiency of the farmers, that is, it reduced the technical inefficiency of the yam farmers; therefore, government should also assist by improving the educational status of the farmers through adult education and literacy campaigns. Farmers should also be encouraged and sensitized on the need to register with adult/continuing education centres to improve on their education which will facilitate their adoption of innovation useful for production efficiency.

REFERENCES

Abdullahi, M. (2015). Profitability and efficiency of yam production among smallholder farmers in selected local government areas of Niger State, Nigeria. Unpublished M.Sc thesis, Department of Agricultural Economics and Rural sociology, ABU Zaria.

Aigner, D. C., Lovell, C. A. K and Schmidt, P. (1977). Formulation and Estimation of Stochastic Frontier Production Function Models. Journal of Econometrics, 6: 21-31.

Akerele, E.O., Odojukan, D.M., Yangomodon, O.D., Olugbemi, M.T., Solana, C.I., Ilori, A.R., and Fadipe, M.O. (2019). Productivity efficiency of yam farmers in Oyo State, Nigeria. IOSR-Journal of Agriculture and Veterinary Science, 12(11), 30-40.

Ani, D. P., Iorkaa, J. T. And F.O. Ogebe (2013). Technical Efficiency of Yam Production in Ukum Local Government Area, Benue State, Nigeria. IOSR Journal of Agriculture and Veterinary Science, 7(2), 14-19.

Amaefula, A., Farquharson, R., Ramilan, T. and Asumugha, G.N. (2018). Evaluation of yam-based production enterprises in Nigeria. Nigerian Agricultural Journal, 49(1), 260-265.Ayanwuyi, E., Akinboye, A. O. and Oyetoro, J.O. (2011). Yam production in Orire Local Government Area of Oyo State, Nigeria. Farmers Perceived Constraints.World Journal of Young Researchers, 1(2), 16-19.

Buhari, A.K., Yahaya, K. and Hashim, T. (2018). Resource use efficiency in yam production in Kebbi State, Nigeria. International Journal of Current Research, 10(12), 76260-76263

Darius, M. (2017). Economics of maize production in Northern Taraba State, Nigeria. An Unpublished M.Sc Thesis, Department of Agricultural Economics and Extension, Taraba State University, Jalingo.

Ekine, D.I and Okeke, Elsie (2013). Influence of socio economic characteristics on profitability of yam production in Etche local government area of Rivers State, Nigeria. Journal of Agriculture and Social Research (JASR), 13(1), 1-8.

Ekunwe, P. A., A. Henri-Ukoha and R. Emmanuel (2018). Technical Efficiency and Return to Scale in Yam Production in Tai Local Government Area of Rivers State, Nigeria. Advances in Research, 15(2): 1-9

Gideon, D., Abubakar, M.D. and Gbanha, A.S.B. (2015). Resource use efficiency among smallholder groundnut farmers in Northern Ghana region, Ghana. American Journal of Experimental Agriculture, 6(5), 290-304.

Ibok, O.W., Idiong, C.I., Nsikan, E.B. & Ekaette, S.U. (2014). Food Security and Productivity of Urban Food Crop Farming Households in Southern Nigeria. Journal of Agricultural Science, 2(3), 1-12.

Jonathan, R. and Anthony, D. B. (2012). Resource Use Efficiency in Yam Production in Taraba State, Nigeria. Journal of Agricultural Sciences, 3(2), 71-77.

National Population Commission (2006). Nigeria Population Census Figures, 2006 Abuja, Nigeria. NPC Publication

Nuhu, N. (2016). Economic analysis of maize production in Soba local government area of Kaduna State, Nigeria. Unpublished M.Sc Dissertation, Department Of Agricultural Economics And Rural Sociology Faculty Of Agriculture, ABU Zaria. Pp 67-69Nwosu, C.S., and Okoli V.B.N. (2010). Economic analysis of resource use by Wase yam farmers in Owerri Agricultural Zone of Imo state, Nigeria. Proceedings of 44th Annual Conference of Agricultura Society of Nigeria held in Ladoke Akintola University, 18-19 October 2010.

Oruonye, E. D., and Abbas, B. (2011). The Geography of Taraba State. Natures Gift to the Nation. LAMBERT Academic Publishing Ltd.P. A. Ekunwe, A. Henri-Ukoha and R.Emmanuel (2018). Technical Efficiency and Return to Scale in Yam Production in Tai Local Government Area of Rivers State, Nigeria. Advances in Research, 15(2), 1-9

S.I. Orewa and O.B. Izekor (2012): Technical efficiency analysis of yam production in Edo state: A stochastic frontier approach. International Journal of Development and Sustainability. Volume 1 (2): 516-526Shehu, J. F., Iyorlyer, J. T., Mshelia, S. I. And Jongur, A. A. (2010). Determinant of yam Production and technical efficiency among yam farmers in Benue State, Nigeria. Journal of social sciences, 2(4), 143-148.

Spore (1993) CTA'S Bimonthly Bulletin of the Technical Centre for Agricultural and Rural Cooperation, No. 45 June, 1993, Wageningen, The Netherlands.

Zaku, S.G., Emmanuel, S. A. and Thomas, S.A. (2011): Assessing the level of soil nutrients: a case study of Donga, Ibi and Wukari farmlands in Taraba State, Nigeria. Agriculture and Biology Journal of North America. 2(1): 101-108.