Efficiency of Yam Production in Kwara State, Nigeria.

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Abstract: The study was carried out to investigate the efficiency of yam production in Kwara State, Nigeria. The objectives include among others, identification of technologies used by farmers, determine the efficiency of yam farming, determine the factors influencing the efficiency of yam production and identify the challenges faced by the farmers in yam production in the study area. A multi-stage sampling procedure was used to select the respondents within the state. Four Local Government Areas were purposively selected because of the predominance of yam production in the area. A total number of two hundred and forty (240) yam farmers were used for the study. Data were analyzed using both descriptive statistics such as frequency counts, percentages and mean and the inferential statistics such as stochastic frontier production function and allocative efficiency analysis. The result showed that male constituted a greater percentage (90.8%) of those involved in yam production in the state with the mean age of 52.5 years. The maximum likelihood estimation (MLE) technique was used to assess the efficiency of yam production. The findings revealed that all the estimated coefficient of the variables of the production function were positive except that of the quantity of herbicides used, this suggest that an additional unit of farm size, labour, quantity of seed yam and quantity of fertilizer usage will lead to 0.653, 0.007, 0.338 and 0.017 increase in the output of the yam respectively while an additional usage of herbicides will lead to 0.187 decrease in the output of the yam. The determinants of technical efficiency in the study area are education of the farmers, membership of farmers' organization, farming experience, farm size, labour, fertilizer application and access to extension services. The Return to Scale analysis which serves as a measure of resource productivity gave a value of 0.828 revealing that the variables were over utilized by the farmers in the study area. However, the study revealed that most of the farmers encountered financial problems, pest attack and poor climatic conditions. The study recommends that government should encourage young school's leavers and graduates to take to farming in order to increase yam production in the area. Government and non-governmental organization should engage the service of an extension agent and farm inputs should be subsidized.

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Introduction

Agriculture has been identified as a driver for vibrant economies in most developed nations of the world, the developing countries including Nigeria are not left behind in their quest to develop the sector as agriculture including farming and herding accounts for 23 percent of Nigeria's Gross Domestic Product and it engages 3 percent of the economically active population (Adejumolu 2006). Food consumption in Nigeria accounts for large percentage of household expenditure. It was estimated that about fifty percent (50%) of the total expenditure of household in Nigeria was on food consumption with an increment to seventy-two percent (72%). (CBN, 2003). The great majority of Nigeria's farm production comes from smallholders who use hoes and similar basic tools.

Root and tubers crops are among the most important groups of the staple foods in many tropical African countries which constitute the largest source of calories for Nigeria population (Olaniyan, Manyyoung and Oyewole 2001).

Yam is in the class of roots and tubers that is a staple of the Nigerian and West African diet which contributes more than 200 dietary calories per capita daily for more than 150 million people (Babeleye 2003), it contains 21 percent dietary fiber rich in carbohydrates. The fact that yam is mainly starchy has led to the disparagement of its protein content which is low compared to cereals. However, considering the quantities of yam (and other root crops) consumed daily, their protein contribution is often significant. Yam contains an appreciable amount of vitamins and minerals and may have a comparative production advantage in terms of energy yield per hectare over cereals produced in ecologically difficult condition.

Yam is widely consumed as boiled yam (as cooked vegetable) or fried in oil and then consumed. It is often pounded into a thick paste after boiling and consumed with soup. It is also processed into flour for

use in the preparation of the paste. Its medicinal use as a heart stimulant is attributed to its chemical composition which consists of alkaloids of saponin and sapogenin. (FAO, 2010) Apart from serving as food, it has a lot of industrial uses. It is used in production of all purpose-adhesive. The adhesives are used by producer of cartoons, packaging companies and leather and shoe producers. The all-purpose adhesive is produced with yam or cassava starch. Some industries particularly in Europe use yam flour in preparation of high quality biscuits, bread, cakes to mention but few. In Nigeria also, it is used in production of high quality bread and cakes. The yam chips and pellets can also play the same function as cassava chips and pellets in production of livestock feeds. Yam starch has a lot of industrial uses (FAO, 2010).

Method logy

Study Area: The study was carried out in Kwara State of Nigeria. The State is located in the North-Central geographical zone, and has a land mass of about 32,500 square kilometers (km^2). It is situated between latitude $6.50^0$and 11.50^0North of the equator and longitudes 2.80^0 and 7.50^0 East. The average temperature varies between 27^0C and 35^0C, while mean annual rainfall is between 1000mm and 1500mm. The climate and vegetation support cultivation of several crops like cassava, yam, rice, sorghum, and cowpea.

Sampling Technique and Sample Size: A multi-stage sampling procedure was employed. In the first stage, four (4) Local Government Areas (LGAs) were purposively selected out of the sixteen local government Areas in Kwara State. The second stage of sampling involves random selection of four communities from each Local Government Area. In the last stage, fifteen yam farmers were randomly selected from each community. Summarily a total of two hundred and forty (240) yam farmers were sampled for the study.

Sources of Data: Primary data was used. Primary data was collected by the researcher through field survey using structured questionnaire schedule which elicits responses from yam farmers. Primary data collected include socio-economic characteristics of the respondents, such as age, sex, household size, educational background, etc. Others were based on technologies adopted in yam production, factors influencing efficiency of yam production.

Data Analytical Techniques: The data analytical tools used in this study comprised both descriptive and inferential statistics such as stochastic frontier production function. While descriptive statistics was used to analyze the socio economic characteristics of the farmers in the study area, the technologies adopted in yam production and the problems faced by the farmers in yam production in Kwara State. Stochastic frontier function was used to determine the efficiency of yam farming and also to determine the factors influencing efficiency of yam production in Kwara State.

Technical Efficiency: The stochastic frontier model used by Abedullah, Shahzad and Khalid, (2007), Piu and Odjuvwuederhie (2006) and Ogundele 2003 was used to determine the technical efficiency effect on output maximization. The multiplicative stochastic production function is of the form:

$Y_i = f(Xk; \beta)\varepsilon i$

i=1……n; k=1……..k,

Where

Y_i = observed output of yam for the ith farm

F ($x_i\beta$) = a suitable functional form such as Cobb-Douglas

Xk =vector of the input used by the farmer (or cost of inputs)

β=vector of unknown parameters to be estimated

ε_i =an error term.

$TE_i = \exp(-u_i)$, so that $0 \leq TE_i \leq 1$.

$Yi = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + v_i - u_i$

Where the subscript i (i=1….. 240);

Y = the logarithm of yam produced in aggregate (₦)

X_{1i} = logarithm of the farm size (hectares)

X_{2i} = logarithm of the quantity of labour used (in man-days);

X_{3i} = logarithm of the quantity of yam seed (kg);

X_{4i} = logarithm of the quantity of herbicide used (litres)

X_{5i} = logarithm of the quantity of fertilizer used (kg);

V_i = random error term with normal distribution N (0, σ2)

U_i = a non- negative random variable called technical inefficiency associated with the farmer.

Allocative Efficiency Analysis: According to Chukwuji *et al*. (2006) allocative efficiency analysis is done by estimating a Cobb-Douglas function using Ordinary Least Squares (OLS), followed by

computing the value of marginal products (MVP) for each factor of production, which is then compared with the marginal input cost (MIC).

Cobb Douglass function is given as:

Log $Y = b_0 + b_1 \text{Log}X_1 + b_2 \text{Log}X_2 ..... + b_n \text{Log}X_n + e$

Where,

Log Y = output of the *ith* farm in Kg

Log X_1 = farm size

Log X_2= Family labour in man-day's used in production

Log X_3 = quantity of yam seed in Kg.

Log X_4= quantity of herbicide

Log X_5= quantity of fertilizer

B_o = Intercept

B_{is}= coefficients estimated

Results and Discussion

Socio- economic characteristics of the respondents.

The analysis of socio economic characteristics of the respondents is presented in Table 1. The study revealed that the respondents were mainly male with majority of them married and relatively old people with about 70 percent having ages more than or equals 50 years with mean age of about 53years and with large household sizes. This has a positive implication for farming activities as farmers count more on their experience than educational attainment in order to increase their productivity. It also revealed that the majority of the respondents are relatively literate in the study area. The farm size of the respondents revealed that 78.7% cultivated less than one hectare of farmland. On the other hand, only 2% cultivated 1 – 1.5 hectares while 19.3% cultivated more than 1.5hectares of farmland. With this, it reveals that all the farmers interviewed from the study area are subsistence in nature hence, their ability to access credit and accessibility to farm implements may be limiting. The mean farming experience was about 15 years showing that majority of the beneficiaries are well experienced in their farming activities and have more practical knowledge acquired overtime which may lead to improvement in their production activity. From the table, it was also revealed that about 58% of the respondents had access to credit facility. The result also revealed that about 57% of the respondents belong to social organization. Higher educational attainment will assist farmers in accessing available credit in the study area.

Technologies Used by Yam Farmers: Table 2 revealed the various technologies utilized by farmers. It shows that 35 percent of the yam farmers used improved yam varieties on their farm, 58.3 percent used selective herbicides for controlling weeds on their farms, 61.7 percent used different methods of land preparation, 70 percent used various pests and disease control, 74.6 percent used improved plant spacing, while 62.1 percent of the farmers used fertilizer and 77.9 percent of the farmers used agrochemical on their farms. This implies that most of them used agrochemical in controlling weeds and also they used standard plant spacing. Education attainment and length of farming experience might have enabled them to be aware of these various technologies used.

Table 1: Analysis of socio economic characteristics of the respondents.

Item		Frequency	Percent
Sex			
Male		218	90.8
Female		22	9.2
Age			
15-25		3	1.3
26-35		32	13.3
36-45		51	21.3
46-55		78	32.5
56-65		54	22.5
>65		22	9.2
Mean	52.5		
Marital Status			
Single		16	6.7
Married		209	87.1
Widow (er)		8	3.3
Divorced		7	2.9
Educational Status			
No formal		13	5.4
Primary		45	18.8
Secondary		95	39.6
Tertiary		86	35.8
Household Size			
<5		71	29.6
6-10		151	62.9
11-15		17	7.1
>15		1	0.4
Mean	10		
Farming Experience			
<5		40	16.7
6-10		64	26.7
11-15		27	11.2
16-20		37	15.4
>20		72	30.0
Mean	15		
Access to Credit			
Yes		139	57.9
No		101	42.1

Source: Field Survey, 2017.

Table 2: **Technologies Used by Yam Farmers**

Species	Frequency	Percent
Improved yam varieties	84	35
Selective herbicides	140	58.3
Different methods of land preparation	148	61.7
Pests and diseases control	168	70
Improved plant spacing	179	74.6
Application of fertilizer	149	62.1
Application of agrochemical	187	77.9

Source: Field Survey, 2017.

Allocation Efficiency: In order to test the efficiency, the ratio of marginal value product (MPV) to the Marginal Factor Cost (MFC) for each input is computed and tested for its equality to 1. The results in table 3 indicate that all the resources were inefficiently utilized as the marginal value products for farm size, labour; seed yam, fertilizer and herbicide were greater than their factor prices. The allocative efficiency indices of the resource (AE1>1) of farmer's were underutilized. The resource under-utilization established may not be unconnected with the limited access to farm resource usually faced by farmers in Nigeria. In order to increase the level of resource use by the farmers, however, there is the need not to only extend farm credit and subsidize the cost of farm inputs such as labour and fertilizer the farmers engaged in yam production, but they should also be allowed to have increased access to farm land to enable them expand the scope of their farm sizes.

Table 3: Estimates of Allocation Efficiency for Yam Inputs

Variables	MVP	MFC (P)	AEI = MVP / MFC
Farm size (hectares)	2752.09	2300	1.20
Labour (man/days)	17030	381	44.69
Quantity of seeds yarn (kg/ha)	2751.27	80	34.39
Quantity of herbicide used (liters/ha)	1950	1700	1.15
Quantity of fertilizer used (kg/ha)	2938.14	2000	1.46

Source: Field Survey, 2017.

Estimation of Technical Efficiency in Yam Production: Table 4 show the results of the maximum likelihood estimates of the stochastic frontier production function of yam farmers in the study area. From the results, estimates of the parameters of the stochastic frontier production model revealed that all the estimated coefficients of the variables of the production function were positive except that of quantity of herbicide. This suggests that an additional unit of farm size, labour, quantity of seed yam and quantity of fertilizer will lead to an increase in the output of yam. While an additional unit of quantity of herbicide will lead to declines in the output of yam.

Return to scale analysis: The return to scale (RTS) analysis which served as a measure of resource productivity is given in Table 5. The RTS parameter (0.828) was obtained from the summation of the coefficients of the estimated inputs (elasticities) which indicated that yam production in the study area was in Stage 2 of the production, meaning that these variables were over-utilized. The RTS reported in this study was very close to the value of 0.84 reported by Ogundari and Ojo, (2005) in a study on examination of technical, economic and allocative efficiency of smallholder farmers in Osun State, Nigeria.

Constraints Affecting Yam Production among Farmers: Table 6 presents the constraints/problems facing yam farmers in Kwara State. From the Table, a high percentage (75.8%) of the farmers identified financial problem as their major problem. Other problems confronting the farmers as identified include pest attack, poor storage facilities, and high labour cost, poor infrastructure, herdsmen's attack and poor climatic condition. These constraints limit the quantity of yam production in the study area, the implication is that as long as these constraint remains production capacity may not grow beyond subsistence level thereby resulting to production inefficiency.

Table 4: Maximum likelihood estimates of the stochastic frontier

Variables	parameter	Coefficient	Standard Error	t-ratio
Constant	β_0	5.393***	0.295	18.281
Farm size (hectares)	X_1	0.653***	0.083	7.862
Labour (man/days)	X_2	0.007	0.128	0.055
quantity of yam seeds (kg)	X_3	0.33 8***	0.050	6.76
quantity of herbicide used (liters)	X_4	-0.187**	0.074	-2.530
quantity of fertilizer used (kg)	X_5	0.017 *	0.068	0.250
Inefficiency model				
Constant	Ui	2.605***	0.623	4.181
Age (years)	Z_1	-0.020**	0.009	2.22
Farming experience (years)	Z_2	0.015	0.009	1.667
No of years spent in school (years)	Z_3	0.009	0.021	0.428
Household size (number of person)	Z_4	0.109***	0.037	2.946
Access to extension agent (Access 1, otherwise 0)	Z_5	0.347*	0.205	1.693
Cooperative membership (Year)	Z_6	0.003	0.015	0.2
Access to credit (Access 1, otherwise 0)	Z_7	0.409**	0.181	2.259
Variance Parameters				
Model variance (Sigma squared)	σ^2	0.39**		2.048
Variance ratio (Gamma)	Γ	0.780***		52.265
Log likelihood				48.711
Observation				240
Minimum value	0.51			
Maximum value	0.97			
Mean value	0.73			

***, ** and * is significant at 1%, 5% and 10% level of significance
Source: Field Survey, 2017

Table 5: Return to scale analysis

Variables	Elasticity
Farm size (hectares)	0.653
Labour (man days)	0.007
Quantity of yam seeds (kg/ha)	0.338
Quantity of herbicide used (liters/ha)	-0.187
Quantity of fertilizer used (kg/ha)	0.0 17
Return to Scale	**0.828**

Source: Field Survey, 2017.

Table 6: Constraints of Yam Farmers in Kwara State

Variables	Frequency	Percentage
Financial problem	182	75.8
Pest attack	173	72.1
Poor storage facilities	68	28.3
High cost of labour due to inadequate use of heavy machine	105	43.8
Poor infrastructure	30	12.5
Indiscriminate cattle grazing	70	29.2
Poor climatic condition	92	38.3

Multiples responses
Source: Field Survey, 2017.

Conclusion

The study revealed that yam farmers in Kwara State were men dominated and majority are literate. They belong to cooperative organization and they have access to credit facilities.

The technologies mostly practiced by the farmers are, use of agrochemical, improved planting space and pest and disease control. Farm size, labour, quantity of fertilizer use, quality of seeds yam and use of fertilizer has positive effect on the technical efficiency of yam production. While the quantity of herbicides has a negative influence. Yam production in the study is in the second stage of production.

The variables that were found to influence technical efficiency positively include educational levels of farmer in terms of years spent in formal schooling, number of years of experience in yam farming, farmers' membership in farmer association, farm size of yam, labour, use of fertilizer and extension services on yam production. Household size, age and herbicides were found to influence technical efficiency negatively. The leading constraints to yam production in the study area are financial problem, pests attack and poor climatic conditions.

Recommendations

From the results of this research work, the study therefore recommends the followings:

- Farmers should engage the service of an extension agent in the study area so that they can have access to agricultural information to increase production.
- Since most farmers in the study area are small scale farmers, they should be encouraged to have large scale farm ownership with increased technologies usage in the area of mechanization should be employed to increase production and efficiency of yam farmers in the area.
- More farmers should be encouraged to belong to cooperative organization so that they can have access to loan which tends to improve the efficiency of yam production in the study area.
- Government and non-governmental agencies should collaborate to subsidize farm inputs to farmers.

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