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Technical Efficiency and Productivity of Yam in Kogi State Nigeria

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Abstract: The study examined the technical efficiency and productivity of yam in Kogi States of Nigeria. Specifically the study examined the socioeconomic characteristics of yam producers in Kogi State, determined the technical efficiency and productivity of yam farmers in the study areas and made recommendations on ways of improving the efficiency of yam production in Kogi State. Primary data were collected using a set of structured questionnaire from 200 selected Agricultural Development Programme (ADP) contact yam farmers from the State. A multi-stage sampling technique was used in selecting the farmers. The first stage was a purposive sampling of 5 Local Government Areas (LGAs) each from Kogi States. The LGAs selected were Omala, Ofu, Ankpa, Dekina and Ida. This was based on the high concentration of the population of yam producers and the availability of market for yam products. The second stage involved a simple random sampling of 5 villages from each LGA and 8 yam farmers from each village. In all 200 yam farmers were interviewed by trained enumerators. Out of the 200 only 144 copies of the questionnaires were found adequate and used in the analysis for the study. Data collected were analyzed using descriptive statistics such as mean and standard deviation, as well as the stochastic frontier production function. Results from the study showed that on the average more males (98.6%) were involved in yam production as compared to 1.4% in the case of female. The mean age of farmers was 53 years. The average years of schooling by farmers was about 4 years suggesting that the farmers were not well educated. The average farming years was 25 years. In terms of cropping pattern all the farmers practiced sole yam cropping. Their average farm sizes were 0.97 ha. The technical efficiency of the farmers in the State varied. The technical efficiency of farmers varied from 0.05 to 0.95 with a mean of 0.62, while only about 23% of the farmers had technical efficiencies exceeding 0.80. The results also showed that yam production was profitable in State with net profit of N 108,299.67 ha^{-1}.

Key words: Technical efficiency, productivity, stochastic frontier, yam production, Kogi State Nigeria

INTRODUCTION

Yam is a highly valued staple food crop in Nigeria with the bulk of it consumed as fresh tuber. Sub-Saharan Africa currently produce about 90% of the worlds total yam output while the rest is grown in the West Indies and parts of Asian, South and Central America. Over 600 yam species are currently grown all around the world but only three species are known to be grown in West Africa. The species are (*Dioscorea rotundata*) white yam (*Dioscorea cayenesis*) yellow yam and (*Discorea alata*) water yam, (IITA, 1998). In Nigeria the species cultivated are *D. rotundata* (Okaka *et al*., 1991), *D. cayenesis* (yellow or guinea yam) and *D. alata* (Okaka and Anajekwu, 1990). It is estimated also that 4 million hectares of land is cultivated with yam the world over of which about 69% of this cultivated land is in Nigeria (FAO, 2005). Yam production in Nigeria has more than tripled over the past forty years, from 6.7 million tons/year in 1961 to 27 million tons/year in 2001. This increase in output is attributed more to the large area planted to yam than with increased productivity. Though the area cultivated to yam is still being increased, production growth rate has declined tremendously from the average of 27.5% between 1986 and 1990 to 3.5% in the 1996-99 periods. Decline in average yield per hectare has been more drastic; it dropped from 14.9% in 1986-90 to -2.5% in 1996-99. The observed productivity decline in Nigeria represents a major challenge to increasing yam production and its availability as food in the country (CBN, 2002; Amegbeto *et al*., 2002). The objectives of this study are to examine the socioeconomic characteristics of yam farmers in Kogi State Nigeria, to determine the return to scale and technical efficiency of yam farmers in the study area.

MATERIALS AND METHODS

The study was carried out in the Eastern part of Kogi State a major yam producing areas in Nigeria. Kogi State is made up of twenty (20) L.G.A. (namely; Adavi, Ajaokuta, Ijumu, Bassa, Dekina Idah, Ankpa East Yagba, West Yagba, and Kogi. Others are Ofu, Okehi, Okene, Olamaboro, Olale igalometa Ibaji Ogori/Mongongo and Mopamuro). The L.G.A selected for the study are; Omala,

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Dekiha, Idah, Ankpa and Ofu. Based on the 1991 Census the State has a Population of 2,099,046 people made up of 1,055964 males and 1,043,082 females. The State is blessed with suitable ecological and climatic conditions and this is attested to by the wide variety of crops grown in the area such as yam. Geographically the state lies between longitude 6 and 9° East and latitude 4 and 7° North of the Greenwich Meridian.

A multi stage sampling technique was adopted in selecting yam producers within the yam producing areas. The first stage was a purposive sampling of five Local Government Areas (LGA) out of nine in Kogi East. This was based on the population of yam producers and the availability of market for yam products. The second stage involves a simple random sampling of five villages from each LGA and 8 ADP contact farmers from each village. In all 200 farmers were interviewed using enumerators who administered structured questionnaires, however only 144 questionnaires were suitable for analysis.

Descriptive statistics (Mean, Standard deviation etc.) was used to analyse the socio-economic characteristics of the farmers in the study area. 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 that can be achieved from a set of inputs given the technology available to the farm. The production technology of the farmers was specified by the Cobb-Douglas frontier production function defined by,

$$\log Y = \beta_0+\beta_1\log X_1+\beta_2\log X_2+\beta_3\log X_3+(Vi-Ui) \quad (1)$$

Where

Log = Natural logarithm.
Y = Value of yam produced in Naira/ha
X_1 = Area cultivated with yam (Hectare)
X_2 = Cost of planting materials (Seed yam)/ha
X_3 = Labour cost in Naira/ha
β_0, β_1, β_2 and β_3 = Regression coefficients
Vi = Are random variables which are assumed to be independent of μi, identical and normally distributed with zero mean and constant variance $N(0,\sigma_V^2)$.
Ui = Which are non-negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be independent of Vi such that U is the non-negative truncated (at zero) of half normal distribution with $|N(0,\sigma_U^2)|$. (Coelli, 1994) and (Battese and Coelli, 1995).

The inefficiency of production, Ui was model in terms of the factors that are assumed to affect the efficiency of production of the farmers. Such factors are related to the socioeconomic variables of the farmers. The determinant of technical inefficiency is defined by:

$$\mu = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} \quad (2)$$

Where:

Z_1 = Gender
Z_2 = Age
Z_3 = Marital status
Z_4 = Family size
Z_5 = Educational level
Z_6 = Farming experience
μ = Technical inefficiency
δ_i = Inefficiency parameters

These variables are assumed to influence technical efficiency of the farmers. Also the gamma ($Y = \delta^2/\delta^2 s$) and Sigma squared (δ^2) which is a summation of U and V variance was determined. The Maximum Likelihood Estimate Method using the computer FRONTIER version 4.1 was used to estimate the parameters of the stochastic Frontier Production function (Coelli, 1994).

RESULTS AND DISCUSSION

Socio-economic characteristics of farmers: The results revealed that 98.6 and 2.4% of respondents are male and female, respectively. The mean age of farmers is 53 years and in terms of family size, an average of 9 persons per family was recorded. The average year of formal education of farmers in the study area was about 4 years (3.9 years). This mean statistics shows that farmers in the study area have less education. The average farming experience for yam farmers was 25 years. This shows that farmers from Kogi State have long been involved in the yam business (Table 1).

Efficiency: The results revealed that the all independent variables (Farm size, planting materials and Labour) have positive signs. The OLS functions for farm size and planting materials were statistically significant at 5 and 1% levels of significance, respectively. Also, the MLS functions for farm size and planting materials were statistically significant at 1% level of significance. The results obtained from the stochastic production function as shown by the Ordinary Least Squares (OLS) and the Maximum Likelihood Estimate (MLE) for yam production in Kogi State is presented in Table 2. The sign of the coefficient of the variable in the inefficiency model is very important in explaining the observed level of technical efficiency of the farmers. A negative coefficient implies that the variable has the effect of reducing technical inefficiency. While a positive coefficient has the effect of increasing technical inefficiency.

Table 1: Mean statistics of socioeconomic variables of yam farmers in kogi state

Variables	Kogi state
Gender	
Male	142 (98.6)
Female	2 (1.4)
Age (years)	53
Family size (persons)	9
Farming experience (years)	25
Education (years)	3.9
Marital status	
Married	140 (97.2)
Single	4 (2.8)

Figures in parenthesis are percentages

Table 2: Stochastic estimation of production function for kogi states

Variables	Parameter	OLS estimate	MLS estimate
Constant	β_0	4.32 (3.815)	9.16 (10.824)
Farm size (X_1)	β_1	0.63 (3.815)*	1.24(11.611)**
Planting material (X_2)	β_2	0.60 (9.574)**	0.29 (5.99)**
Labour cost (X_3)	β_3	0.07 (1.525)	0.03 (0.68)
Inefficiencyparameters			
Constant	δ_0		2.13 (0.94)
Gender (Z_1)	δ_1		-2.06 (-2.20)*
Age (Z_2)	δ_2		-0.04 (-2.41)*
Marital status (Z_3)	δ_3		1.89 (0.96)
Family size (Z_4)	δ_4		0.03 (0.61)
Education (Z_5)	δ_5		0.02 (0.57)
Farming Experience (Z_6)	δ_6		-0.04 (-1.15)
Variance parameter			
Sigma squared	σ^2		1.01 (2.08) *
Gamma	γ		0.98 (77.25) **
Log likelihood	λ		-86.81
Mean efficiency			0.62

Figures in parenthesis are t-ratio; *Significant at 5% level; **Significant at 1% level

Table 2 reveals that age and farming experience contributed negatively to farmers' inefficiency. This means that farming experience and age will lead to decline in technical inefficiency. This result has also confirmed a priori expectation. More experienced farmers are expected to have higher level of technical efficiency than less experienced farmers. While gender, family size, marital status and education contributed positively to farmers inefficiency. Only Gender and Age were statistically significant at 5% level of significant.

The sigma square (σ^2) is statistically different from zero at 1% level thus gives credibility to the goodness of fit of the model from the MLE as well as the correctness of the specific distributional assumption of the composite error term (V-U). The variance ratio ($\gamma = \sigma^2/\sigma^2 s$) estimated was 0.98 at 1% level. This infers that 98% of the variation in yam output among the farmers in Kogi State was due to differences in their technical efficiencies.

Range of technical efficiency: Looking at the distribution minority of the farmers in Kogi State can be said to be more technically efficient (Table 3). The range shows that 23.5% of the farmers in Kogi State fall within the 81-90% range of technical efficiency. The technical efficiency of farmers in Kogi State shows that yam farmers were not technically efficient. Technical efficiency of yam producers in Kogi States was computer as shown in Table 2.

Table 3: Range of technical efficiency (%) in Kogi states

Range	Kogi state (Frequency)
01-10	2 (1.4)
11-20	7 (4.9)
21-30	19 (13.2)
31-40	6 (4.2)
41-50	13 (9.1)
51-60	11 (7.6)
61-70	26 (18.1)
71-80	18 (12.5)
81-90	24 (23.5)
91-100	8 (5.5)

Figures in parenthesis are percentages

Table 4: Elasticity and return to scale

Variables	Elasticity yam
Land	0.63
Labour	0.60
Planting material (seed yam)	0.07
Return to scale	0.30

Return to scale and productivity: The return-to-scale parameter indicates what happen to yam output as inputs are increased simultaneously. The results of the data analysis from the stochastic estimate showed that yam production is in the stage II of the production process with return to scale of 0.30. This indicates a positive decreasing return to scale. Table 4 shows the elasticity and return to scale of yam in the study area.

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