

An analysis of technical efficiency of ginger crop production in Jaba local government area, Kaduna State, Nigeria

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ABSTRACT

Using a cross sectional data obtained through a multistage sampling technique, this study estimated the technical efficiency of Ginger crop production in Jaba Local Government Area, Kaduna State, Nigeria and further examined the factors that determined the differential in efficiency index. A total of 78 Ginger crop farmers in the study area were randomly selected for the study. The stochastic frontier production model was used in the analysis to determine the relationship between output and the level of input used in the study area. The empirical results revealed that farm size, planting materials, fertilizers and hired labour were statistically significant at 5% level while chemicals and family labour were not statistically significant. The estimated gamma parameters (γ) of 0.37 indicated that 37% of the total variation in total output was due to technical inefficiencies of the respondents. The mean technical efficiencies (χ) level was 0.68. It was therefore concluded that there is scope for increasing the technical efficiency of ginger crops production by 0.68% with the present technology. Therefore the study confirmed that increased land, planting material, fertilizer and hired labour can be used in the area by the farmers in ginger production.

Key words: Technical efficiency, Ginger production, stochastic production frontier.

INTRODUCTION

Nigeria is basically an agrarian economy with about 85% of the population depending on agriculture.

Agriculture has the highest poverty incidence rate (62.7%) among all occupational groups considered in the Nigerian Living Standard Survey (FOS, 2004). A high proportion (48.3%) of Nigeria's active population is involved in agriculture and this group also has the highest poverty depth (26.1%) and severity respectively. These poor outcomes were attributed to low productivity, poor agricultural produce price; hence poor farm income, inadequate infrastructure and limited access to credit and improved farm inputs (1)

Ginger is a herbaceous perennial grown as an annual for its spicy underground rhizomes or stems. The plant has fibrous roots that emerge from the branches rhizomes. It takes about 6 weeks for shoots to emerge after ginger planted. Vegetative growth is maximized until flowering begins in September – October flowering marks the beginning of rhizomes maturity and increasing fibrous tissue development(2). Nigeria produces an average of 50,000 metric tonnes of fresh weight ginger per annum(3). About 10% of the produce is consumed locally as fresh ginger while the remaining 90% is dried for both local consumption and export. According to(3), 20% of the dried ginger is consumed locally for various uses and 80% is exported. Traditionally, ginger is used in Nigeria for both medicinal and culinary (kitchen) purposes as well as in confectionery industry. Ginger (*Zingiber officinale*) belongs

to the family of Zingiberaceae. It is a slender perennial plant with thick and branched underground stem (rhizome). It is a spice grown across many climates in the world. Ginger is likely to have originated from India, where it is being cultivated in commercial level(4). Ginger was introduced to Africa and the Caribbean by the colonial masters; and it is now cultivated throughout the humid tropics. It got to Nigeria in 1927 and its cultivation started around Kwoi, Kubacha, Kafanchan and Kagarko areas of southern Kaduna State and around the neighbouring parts of Plateau State(5). In recent times, ginger cultivation has been introduced into south eastern and south western agricultural zones of Nigeria. Worldwide over 25 varieties of ginger are grown. Most varieties have not been properly characterized. Varieties differs in size of the rhizome, flavour, aroma, colour and fibre content. Ginger is throughout the world as a spice or fresh herb in cooking and a range of other value added products including flavouring in candies, beverages. Ginger is also used in traditional medicine to treat several ailments like motion sickness. Young rhizomes that harvested early are also used in pickles and confectionary. Nigeria was among the countries that the global production of ginger in 2008 was over 1.4 million metric tons (MT) and the major exporting country to US in 2007. According to the United Nations Food and Agriculture Organization (6). There are two major varieties of ginger grown in Nigeria which differ in the colour of their rhizomes namely, the reddish and yellow varieties. The yellow variety appears to be widely planted than the reddish variety. According to (7), the various cultivars available include UG1, UG2 and Maran. The UG1 (locally called Tafi giwa meaning elephant's foot type) yield higher than UG2 (Yatsun biri meaning monkey's finger type) which was reported to be more pungent. Ginger is usually cultivated vegetatively through its rhizome. Modern micro propagation is also being used where new plants are cloned from cells taken from a plant. The crop requires a good soil tilled for production of well shaped rhizomes (8). In southern Kaduna where ginger is extensively grown in Nigeria, beds are preferred for rain fed ginger production while planting on ridges is recommended for irrigated ginger. (8) recommended that rhizome for planting be cut into small pieces, each having at least 2 good buds or growing points and weigh 5 - 10 g. The recommended planting depth is 4 - 5 cm and distance of 20 by 20 cm to give a plant population of 250,000/ ha. It is expected that ginger should be planted early, March/April in the rainforest zone and April/May in the savannah zone of Nigeria to have enough rain for its 7 - 8 months of field life.

MATERIALS AND METHODS

The study area

The study was conducted in Jaba local government area. It lies between latitude 9°N and longitude 8°E. The local government shares boundaries with Zango Kataf local government area in the North, in the East by Jema'a Local government area, in the West by Kachia local government area and in the south by Kagarko and Nassarawa State. The population of Kaduna State is 6,066,562 people according to 2006 census and the population of Jaba is 61,000 people according to(9).

The local government is marked with distinct dry and wet seasons. The dry season is between November to March while the wet season fall between April – October. The vegetation of the area of study is guinea savannah. The major occupation of the inhabitants of the local government is farming. Majority of the farmers practice small-scale agriculture and other occupation involved in, include fishing, hunting weaving, trading and many others etc. Jaba local government area is endowed with abundant natural resources such as hills, streams, natural grass land, dam and economic trees. Crops grown in the area include: sorghum, millet, maize, yam, rice, cocoyam, groundnut, acha, beans, ginger, cassava, soya bean, sweet potatoes, Beni-seed and sugar cane. During the dry season, farmers in Jaba local government area are involved in the production of vegetables such as cabbage, spinach, tomatoes and pepper.

Sources of data and sampling procedure

A multistage sampling technique was used for this study. This included a purposive random selection of two local Government areas from the entire local governments in the state who are the major ginger producing areas. From these two Local Governments, Jaba Local Government area being the highest ginger producing of the two was selected for this study. Jaba Local Government area consists of fifteen districts from which 5 was randomly selected. Eighty five questionnaires were randomly distributed among these Five wards which are Nok, Fada, daddu, Chori, and Forgye.

Primary data was collected from farmers through a set of structured questionnaires which was administered to ginger producing Farmers in the study area. The questionnaire was designed to elicit relevant information necessary to enable the stated objectives to be achieved which include socio-economic characteristics of ginger farmers, production variables which include farm size, labour, planting stock, land preparation, fertilizer application,

weeding, harvesting, processing, storage and also the cost involved in carrying out the various operations as well as the economic return per hectare per annum.

Analytical technique

The stochastic production function model was adopted for the study and is specified as follows:

$$Y_i = f(X_i, \beta) + \varepsilon_i \dots\dots\dots(i)$$

$$\varepsilon_i = (V_i - U_i)$$

Where Y_i is output, X_i is input, β is a vector of parameter to be estimated. The disturbance term ε_i consist of two components V_i and U_i where $V_i = N(0, \sigma^2)$ and U_i is a one sided error term. The two errors V_i and U_i are assumed to be independently distributed. The term V_i is the symmetrical component and permits random variation of production across farms; while it also captures factors outside the control of the farmer. A one-sided component ($U_i \geq 0$) reflects technical efficiency relative to the stochastic frontier. If $U_i = 0$, production lies on the frontier. If $U_i > 0$, production lies below the frontier and is inefficient. Following(10), the Technical Efficiency (TE) of the individual farmer is calculated as the expected values of V_i conditional on $\varepsilon_i = V_i - U_i$. Technical efficiency is then calculated as:

$$TE = \exp(-\varepsilon/U_i); \dots\dots\dots(2)$$

So that $0 \leq TE \leq 1$.

The empirical model of the stochastic production frontier is specified as;

$$\ln Q_i = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + V_i - U_i \dots\dots\dots(3)$$

Where;

Q_i = Total value of farm output (in Naira) from i -th farm.

X_1 = Farm size in hectares (Ha)

X_2 = Seed/planting materials (Kg).

X_3 = Quantity of Fertilizers used in kilograms (Kg)

X_4 = Quantity of chemicals used (Kg)

X_5 = Family labour (Mandays)

X_6 = Hired Labour (Ha)

β_0 = intercept

β_{ij} = vector of production function parameters to be estimated $i=1, 2, 3, \dots, n$ farms;

$j=1, 2, 3 \dots m$ inputs.

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

μ_i = the deviation from maximum potential output attributable to technical inefficiency.

The variance of the random error δv^2 and that of the technical inefficiency effect δu^2 and the overall variance of the model are related as follows:-

$$\delta^2 = \delta v^2 + \delta u^2 \dots\dots\dots(4)$$

$$\gamma = \delta u^2 / \delta^2 \dots\dots\dots(5)$$

Equation (5) measures the total variation of production (output) from the frontier which can be attributed to technical or allocative inefficiency (11). The δ^2 and γ , coefficients are the diagnostic statistics that indicate the relevance of the use of the stochastic frontier function and the correctness of the assumptions made on the distribution form of the error term.

RESULTS AND DISCUSSION

Technical efficiency and associated inefficiency factors

Table i: Maximum Likelihood Estimates of Cobb-Douglas Stochastic frontier production function.

Variable	Coefficient	Std. Error	t-ratio
Constant	0.275	0.887	2.756***
Farm size	0.392	0.207	2.892***
Planting material	0.654	0.209	2.117**
Fertilizer	0.291	0.215	3.352***
Agro-chemical	0.143	0.129	0.110NS
Family labour	0.358	0.81	0.190NS
Hired labour	0.344	0.16	2.334***
Inefficiency model			
Constant	-0.275	0.308	0.893NS
Age	-0.42	0.195	0.215NS
Education	-0.362	0.319	0.413NS
Farm size	-0.188	0.127	2.476**
Farming Experience	0.211	0.204	1.029NS
Household size	-0.792	0.171	4.634***
Membership of farmers' group	-0.68	0.535	3.305***
Extension contact	0.14	0.285	2.140**
Credit access	-0.98	-0.812	2.822***
Gender	0.21	0.234	1.110NS
Variances			
Sigma squared	1.153	0.284	
Gamma	0.374	0.105	
Loglikelihood function	-56.37	-0.128	

Figures in parenthesis are t-values. *indicates values are significant at 5% level and below.

+ A negative sign on a socio-economic parameter indicates a positive impact on efficiency

Maximum Likelihood Estimates of the stochastic frontier production function for ginger production in the study areas are presented in Table i. The variance parameter estimate σ^2 and γ for ginger farmers are 1.153 and 0.374. They are all significant at 5% level of significance. The sigma squared σ^2 indicates the goodness of fit and correctness of the distributional form assumed for the composite error term while the gamma γ indicates the systematic influences that are unexplained by the production function and the dominant sources of random error. This means that the inefficiency effects make significant contribution to the technical efficiency of ginger farmers in the study area. The estimated gamma γ parameter of 0.89 for ginger farmers and 0.374 means that about 37 percent of the variation in the value of farm output of ginger farmers was due to differences in their technical efficiencies. Thus, the hypothesis that the coefficient of $\gamma = 0$ is rejected. The result shows that inefficiency effects were present and significant. This was confirmed by the test of hypothesis using the Log Ratio Test. The Log likelihood Ratio for this group is, 25.76 while the critical value of the chi-square at 5% level of significance with 11 degrees of freedom $\chi^2(5\%,11)$ is 19.68, which is less than the calculated value. The estimated coefficients of all the parameters of production function are positive for the farmers except the coefficient for farm size which is negative. The total value of farm output increases by the value of each of the positive coefficients as the value of each variable increases by one unit while for negative coefficients, the total value of output decreases by the value of each negative coefficient as the value of such variable increases by one unit. The result of the stochastic frontier production function model is discussed as follows;

Analysis of the inefficiency model contained in table 13 ginger production shows the signs and significance of the estimated parameter coefficients in the inefficiency model have important implications on the technical efficiency of ginger producers in the study area. The contributions of ginger farmers' socio-economic characteristics of age, level of education, household size and farming experience as well as farm size, membership of cooperative society, access to credit, extension contact and gender were studied. The variables of the inefficient model as shown in group, extension contact and access to credit, have the expected negative signs and significant at 5% for ginger farmers. This implies that the technical efficiency of ginger farmers will increase with increase in the above variables.

Coefficients of age farm size, household size and gender were positive for the ginger farmers. However, the coefficients of farm size and household size were significant for the ginger farmers, and the coefficients of age was

significant and gender was not significant for farmers. The significant of these coefficients implies that ginger production will increase farmers with large family size, farm size and relatively older in age experience lower technical efficiency.

Farm size (α_1): The coefficient of farm size was found to be negative and significant at 5 percent level for the ginger farmers in the study area. The result could mean that it is not possible to expand ginger production activity in the study area. Statistically, the magnitude of the coefficient of farm size for both groups show that total value of ginger output is elastic to land area cultivated. If farm size is increased by 10percent, total value of ginger output level will decrease by less than proportionate margin of 3.9 percent for the farmers.

Planting materials (α_2): The coefficient of planting materials was positive and significant at 5 percent level for the ginger farmers. This implies that planting materials are important in ginger production. If planting materials are increased by 10percent, value of farm output will increase by 6.54 percent. The implication of this is that the value of farm output is relatively elastic to planting materials and farm output can be significantly increased by increasing the use of planting materials. This may be due to the presence of improved seedlings from improved variety of ginger in the study area.

Fertilizer (α_3): The production elasticity with respect to fertilizer is 0.29 for ginger farmers. By increasing the quantity of fertilizer by 10 percent value of farm output will increase by 2.9 percent for this group of farmers. The estimated coefficient of fertilizer is positive and significantly different from zero.

Chemicals (α_4): The coefficient of chemical use was positive but not significant at 5 percent level for ginger farmers. The production elasticity with respect to chemical is 0.14. By increasing the quantity of chemical use by 10 percent value of farm output will only increase by 1.4 percent for these farmers. The coefficient for chemical is not significant possibly due to the low level of use reported by the farmers.

Family Labour (α_5): The coefficient of family labour had a positive sign for these farmers and is not significantly different from zero at 5% level of significance. This shows that family labour is counter-productive to farmers in the study area. This is in line with (12).

Hired Labour (α_6): The coefficient of hired labour was significant and had a positive sign for ginger farmers. This shows the importance of hired labour in ginger farming in the study area. This is in line with several studies that have confirmed the importance of hired labour in farming. Studies by (13) and (12).

CONCLUSION

The results of the study show that RTEP participants were technically efficiency in the use of inputs than non-participants. The problems encountered by RTEP farmers in the study area were lack of credit, high cost of input, Lateness in the supply of these inputs and inadequate of markets. The problems encountered by the RTEP management are attitude of the farmers to change, inadequate financial commitment, inadequate knowledge of marketing and record keeping.

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