International Journal of Food and Agricultural Economics
ISSN 2147-8988
Vol. 1 No. 2 pp. 39-52

EFFICIENCY OF GINGER PRODUCTION IN SELECTED LOCAL GOVERNMENT AREAS OF KADUNA STATE, NIGERIA

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Abstract

This study examined the profitability and efficiency of small scale ginger production in selected Local Government Areas of Kaduna State using data collected through personal interview schedules with structured questionnaire. Results from the study showed that majority (96.0%) of ginger farmers are male with an average age and farming experience of 42 and 27 years respectively. Majority of the respondents (82.5%) are married and possess an average farm size of 3.09hectares. The average household size is 7 and up to 46% of them acquired secondary education. The results also revealed that labor, seed, fertilizer and capital inputs were significant in explaining the output. The mean technical efficiency of 0.799 indicate that an average ginger farmer in the study area will enjoy an output increase of 18.55% if management techniques are improved and he attains the level of the most efficient ginger farmer. Among the various factors affecting inefficiency, farm size and extension contact accentuated inefficiency while access to credit suppressed inefficiency. This might be an indication that the two parameters that encouraged inefficiency were over-employed. Hence, in order to attain the production frontier of the most efficient farmer, farm size should be scaled down or additional quantity of other inputs should be employed. Price fluctuation, unavailability of farm input, poor remunerative price and poor access to credit are the major constraints faced by ginger farmers in the study area. There is need for policies aimed at encouraging extension education, commercial farming, access to credit, and transport facilities.

Keywords: *Small Scale farmers, inefficiency factors, technical efficiency, access to credit*

1. Introduction

Ginger (*Zingiberofficinale*) is an herbaceous perennial plant belonging to the order *Scitamineae* and the family *Zingiberaceae*. It is a root crop and a typical herb extensively grown across the world for its pungent aromatic under-ground stem or rhizome which makes it an important export commodity in world trade (NEPC,1999; Erinle,1989; Ajibade&Dauda, 2005). Ginger's origin is not well established though it is generally thought to be a native of Asia, where it was first cultivated. It was also cultivated in the tropical regions of America. Ginger was introduced to Europe by Arab traders from Indian the first century AD. The Arabs also took the plant from India to East Africa in the thirteenth century while the

Portuguese took it to West Africa and other part of the tropics in the sixteen century. Ginger was introduced to Nigeria in 1927. The spice was known in Germany and France in the ninth century and had become common in trade as pepper by the thirteenth century. The plant is now cultivated in different parts of Nigeria, though the major producing areas include Kaduna, Nassarawa, Sokoto, Zamfara, AkwaIbom, Oyo, Abia and Lagos states although southern Kaduna still remain the largest producers of fresh ginger in Nigeria in Kachia, Jabba, Jama'a and Kagarko Local Government Areas (KADP, 2000, KADP, 2004;Bernard, 2008). The varieties produced in Nigeria are 'Taffin*Giwa*' and '*YatsunBiri*' which is higher in monoterpene and oil, giving a more pungent aroma and pungency. Therefore it is usually preferred for the production of oils and oleoresins (KADP, 2000; ITC, 2007,Chukwu&Emehuite, 2003).Nigeria ranked first in terms of the percentage of total hectares of ginger under cultivation but her contribution to total world output is too low compared to other countries. This can be attributed to the fact that most of production is undertaken by smallholder and traditional farmers with rudimentary production techniques and low yields. In addition, the smallholder farmers are constrained by many problems like the farmers do not see it as a business enterprise, therefore are not adequately focused on profit maximizing motive(Federal Ministry of Agriculture, 1993 in Goni& Baba 2007).Therefore, Emmanuel (2008) opined that Nigeria has the potential to expand production in a medium to long-term investment strategy that can develop into self-sufficient industry (FAO,2010).

Efficiency measurement is useful in determining the magnitude of the gains that could be achieved by adopting improved production technology. Efficiency in resource allocation has a far-reaching impact on the observed farm output level. The presence of shortfall in efficiency means that output can be increased without using additional conventional inputs and new technology. (Zhu, 2000; Tauer, 2001; Rahman, Ajayi& Gabriel,2002; Armagan, 2008).Farmers possess the potential to achieve both technical and allocative efficiency in farm enterprises but inefficiency may arise due to a variety of factors some of which are beyond the control of the farmers (Ogunniyi,2008; Rahman*et al.*, 2002). In addition, inefficiency in production on the part of the farmers has variously been implicated as forces militating against ginger production. Factors such as technical knowledge constrained increased food supply, export and poverty reduction. This may be attributed to high inefficiencies because farmers lack access to information on efficiency, and low literacy levels limiting interpretation of such information to guide them in commercial production.

Several efforts have been made to improve ginger production in Nigeria since 1988however there has been high fluctuation of output. The increase experienced since then is too low to make a meaningful change in the income and standard of living of the farmers (FAO, 2010). While several researches have been concentrating on some of the immediate causes of low output, it seems that deeper issues and causes have not been discussed. It is therefore important to examine the profitability of ginger production and the various production techniques in other to proffer solution on how it could be improved through efficient use of available resources. It is in view of this that this study was designed to evaluate the profitability and efficiency of small scale ginger farmers in selected Local Government Areas of Kaduna state. The specific objectives of the study are to describe the socio–economic characteristics of small-scale ginger farmers, determine their costs and returns and technical efficiency as well as the determinants of technical efficiency and describe the constraints of ginger production in the study area.

2. Theoretical and Conceptual Framework

Farrell (1957) provided the impetus for developing the literature on empirical estimation of efficiency which led to a better understanding of its concept. He proposed that the efficiency of a firm consisted of three components i.e. technical, allocative and economic. An economically efficient firm operates on both the frontier function and the expansion path. Early studies focused primarily on technical efficiency using a deterministic production function. However, this approach has an inherent limitation on the statistical inference on the parameters and resulting efficiency estimates. In order to overcome this deficiency Aigner, Lovell and Schmidt(1992) and Meeusen and Broeck(1997) developed the stochastic frontier production function for estimating farm level technical efficiency as shown in equation (1).

$$Y\ i = f\,(Xi;\,\beta) + \varepsilon i, \qquad i = 1,2,n \tag{1}$$

Where Y_i= output, X_i= actual input vector, β = vector of production function and ε = error term that is composed of two elements, i.e. $\varepsilon = V_i - U_i$ where V_i= symmetric disturbances which is iid and $N(0,\sigma^2 v)$ while U_i= one-sided error term that is independent of V_i and $N(0,\sigma^2 u)$. Following Jondrow, Lovell, Materov and Schmidt (1982), the estimation of technical efficiency was further defined by the mean of the conditional distribution of inefficiency term U_i given ε as shown in equation (2).

$$E(Ui/\mathcal{E}i) = \quad \frac{\sigma u\,.\,\sigma}{\sigma}\,.\,[\frac{f(\mathcal{E}j\lambda\sigma)}{1-F(\mathcal{E}i\lambda\sigma)}]\,\frac{\mathcal{E}i\lambda}{\sigma} \tag{2}$$

Where $\lambda = \sigma_u/\sigma_v$, $\sigma^2 = \sigma^2_u + \sigma^2_v$ while f and F represents the standard normal density and cumulative distribution function respectively evaluated at $\varepsilon_j\lambda/\sigma$. The farm –specific technical efficiency is defined in terms of observed output (Y_i) to the corresponding frontier output (Y*) using the available technology derived from the result of equation (3):

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{E(Y_i|U_iX_i)}{E(Y_i|U_i=0,X_i)} = E(\frac{-U_i}{\varepsilon_i})(3)$$

3. Methodology

The study was carried out in Jama'a, Jabba, Kachia and Kagarko Local Government Areas which lies between $9^0 11'$ and $10^0 11'$ N and longitudes $7^0 10'$ and $8^0 30'$E and located at the southeast part of Kaduna Stateas shown in Fig. 1 (Kaduna State Ministry of Agriculture, 2007).The common ethnics in the area are Bajju, Jaba, Adara, Koro, Ham, Kanikon, Kagoma and Gbagi. The climate is generally characterized by alternating dry and wet seasons. The rain fall usually starts in April and ends early November, while the dry season sets in mid-November and ends in March. Ginger is normally planted in March and harvested in November. The bulk of agricultural production in these zones is under-taken by small scale farmers most of whose labor force, management and capital originate from the household. The main crops grown in the area includes maize, millet, sorghum, rice, sorghum, yam, cocoa yam and ginger.

Purposive and random sampling procedures were employed in selecting the respondents for this study. Southern Kaduna region was purposively selected based on a *priori* knowledge that it is a ginger producing area. Four Local Government Areas i.e. Jamai, Jabba Kachia and Kagarko Local Government Areas (LGAs) were also purposively selected from the 11 Local Government of Southern Kaduna because of the concentration of ginger farmers there (KADP,2004). In consultation with the Kaduna State Agricultural Development Project (KADP) Office and the District Heads, a list of 100 villages in which ginger production is predominant was made from the previously selected LGAs. Finally, 20% of the listed villages were randomly selected and 10 ginger farmers were randomly selected from a list of farmers in the chosen villages given a total number of 200 respondents.

Primary data used for this study were collected during June and August 2012 and concerned the 2011 farming season. The data were collected through personal interview schedules with ginger farmers using a structured questionnaire. Data were collected on socio-economic characteristics and input – output data. Both descriptive and inferential statistics, the gross margin analysis, costs and returns analysis and the stochastic frontier production function were employed to analyze the data.

4. Models Specification

The Gross Margin (GM) and Net Farm Income(NFI) were used to determine the costs and returns, specified as in equations (4) and (5) (Mohammed, 2008).

$$GM = GI - TVC \quad (4)$$

Where: GM = Gross Margin, GI = Gross Income

TVC = Total Variable Cost

$$NFI = GM - TFC \quad (5)$$

Where: NFI = Net Farm Income, GM = Gross Margin, TFC = Total Fixed Cost.

Figure 1. Map of Kaduna state, Nigeria showing the study area in grey shading.

The Cobb-Douglas stochastic frontier production function for estimating technical efficiency is specified in equation (6).

$$In\ Y = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + \beta_5 InX_5 + \beta_6 InX_6 + V_i - U_i \quad (6)$$

In = The natural logarithm
Y = Value of Output (N)
X_1 = Farm size (ha)
X_2 =Total labor in man-days (family and hired labor in man/days)
X_3= Planting materials (Seed) (kg)
X_4= Fertilizer (kg)
X_5= Agrochemicals (Liters)
X_6 = Capital inputs (these include depreciation on fixed cost items such as hoes, cutlasses, digger etc., interest payment on borrowed capital, rent payment etc.). This was estimated using the straight line method given as shown in equation (7).

$$Depreciation = \frac{Initial\ cost - Salvage\ Value}{Life\ Span} \quad (7)$$

β_0= Intercept
$\beta_1 - \beta_5$ = Regression coefficient or Parameters to be estimated.
V_i = Error term measuring errors not under the control of farmers
U_i = Error term measuring errors under the control of farmers.
This determinants inefficiency (U_i) of ginger farmers is specified in equation (9).

$$Ui = a_0 + a_i Z_1 + a_2 Z_2 + a_3 Z_3 + a_4 Z_4 + a_5 Z_5 + a_6 Z_6 + a_7 Z_7 + a_8 Z_8 + e_i (9)$$

WhereZ_1 =farm size (ha)
Z_2 =marital status
Z_3 = Household size (numbers)
Z_4 = Age (years)
Z_5 = Number of years spent in formal education
Z_6 =access to credit (₦)
Z_7 = Number of extension contact
Z_8 = Farming experience (years)
e_i = Error term.
a_0= intercept or constant
a_1-a_8 = parameters to be estimated.
(Coelli, 1995, Coelli, 1996, Coelli and Battesse, 1996)

5. Results and Discussion

5.1. Socio-economic and demographic factors

The socio-economic profile of the respondents is presented on Table 1. The profile indicate that the mean age of ginger farmers is 42 years with a greater percentage of them being married (82.5%) men (96%). The result also shows that majority of the farmers (46.0%) acquired up to secondary education. On the average, ginger farmers had a farming experience of 27 years with household size of 7 members. The results further revealed that ginger farmers cultivated 3.09 hectares of land on the average. The results conforms generally to earlier research in Nigeria e.g. Abu (2009), Emmanuel (2008), Alibi and Aruna (2006), Alabi (2003), Olufe (1998), Rahman *et al.*, (2002) and Alumu (2005) although the farm size is slightly higher than what has been reported for Niger State e.g. Nmadu, Onu and Tanko (2011). The results are also a clear indication that farming enterprises in this community are family-based hence the low level of technology involved in ginger production. In this regard, research should be intensified to evolved new technologies that are adequately tailored towards the social structure of the farmers. Access to credit, extension services and education must be continuously expanded in a manner that will make it easy for farmers to easily comprehend improved technologies and possess enough resources to adopt them.

Table 1.Distribution of the Respondent Based on their Socio-Economic Characteristics

Variable	Frequency	Percentage
Age range		
21 – 30	50	25
31 – 40	54	27
41 – 50	46	23
51 – 60	21	10.5
61 – 70	19	9.5
>70	10	5
Total	200	100
Mean	42	
Gender		
Male	192	96
Female	8	4
Total	200	100
Marital Status		
Married	165	82.5
Single	26	13
Widow	1	0.5
Divorced	3	1.5
Separated	5	2.5
Total	200	100
Level of Education		
Quranic	4	2
Primary Education	42	21
Secondary Education	92	46
Technical College	5	2.5
Adult Education	10	5
College of Education	21	10.5
College of Agriculture	3	1.5
Polytechnic	7	3.5
University	6	3
None of the above	10	5
Total	200	100
Farming Experience (Years)		
1 - 10	19	9.5
11 – 20	57	28.5
21 – 30	54	27

31 – 40	38	19
41 – 50	15	7.5
>50	17	8.5
Total	200	100
Mean	27	
Household Size		
01-Feb	48	24
3 – 5	34	17
6 – 8	55	27.5
9 – 11	30	15
12 – 14	24	12
>14	9	4.5
Total	200	100
Mean	7	
Access to Credit		
Yes	6	3
No	194	97
Total	200	100
Extension Education		
Yes	45	22.5
No	155	77.5
Total	200	100
Co-operative Society		
Yes	24	12
No	176	88
Total	200	100
Farm Size		
0-1.99	20	10
2-2.99	65	32.5
3-3.99	41	20.5
4-4.99	33	16.5
5-5.99	16	18
>5.99	25	12.5
Total	200	100
Mean	3.09	

Source : Field Survey (2011)

5.2. Cost and return analysis

The profitability of ginger production enterprise was examined using cost and return analysis as presented on Table 2. Results show that the Total Variable Cost(TVC) was higher than the Total Fixed Cost (TFC) per hectare associated with ginger production. However, a Total Cost (TC) per hectare of NGN286597.59 was incurred in ginger production and a Net Farm Income (NFI) of NGN351783.54 was earned. The results further showed that the average rate of returns was 97 kobo which is similar with the finding of Kantiok (2007). This is an indication that the production of ginger is profitable in the study area but there is room for more efficient utilization of resources for ginger production.

Table 2.The Average Costs and Returns per hectare of ginger produced in the study area.

Costs and returns	Costs(NGN[1]/ha)	% of total cost
(A) Variable costs		
Herbicide	6723.82	2.35
Fertilizer	49691.36	17.34
Manure	6449.57	2.25
Improved Seeds	75449.21	26.33
Hired Labour	115805.60	40.41
Tractor Hiring	179.54	0.06
Transportation	21261.75	7.42
Sub-total	275,560.81	
Output	4105.38	
AVC/ha = Sub-TVC/output	67.13	
(B) Fixed costs		
Hoes	1812.47	0.63
Axes	453.94	0.16
Matched	896.76	0.31
Basket	92.56	0.03
Knapsack Sprayer	4392.69	1.53
Basins	1458.46	0.51
Digger	1338.63	0.47
Knife	591.27	0.21
Sub-total	11036.78	100.0
Output	4105.38	
AFC/ha = Sub-TFC/output	2.69	
(C) Total Cost		
Variable cost + fixed cost	286597.59	
ATC/ha = TC/Output	69.82	
(D) Gross Income (GI)		
Gross Margin (GM)= GI-TVC	362820.32	
Net Farm Income(NFI)		
Gross Margin-Total Fixed Cost	351783.54	
Average rate of returns on Gross margin	0.97	

Source: Computed from survey data, 2011

5.3. Stochastic frontier production function

The maximum likelihood estimates of the stochastic frontier production function and inefficiency parameters of the sampled ginger farmers in the study area are presented on Table 3. Results of the technical efficiency model indicated that the estimated sigma squared (σ^2) was statistically significant at 1% indicating that the model was well specified and estimated (Idiong,2006; Nandi, 2011;Udo&Etim, 2008). The results also revealed that out of the explanatory variables included in the model, only four namely, labor, seed, fertilizer and

[1]USD =NGN160

capital inputs were the significant in the production function. The determinants of technical efficiency in the study area include farm size, extension education and access to credit. While the production factors generally conformed to expectation, the inefficiency factors behaved differently. Farm size and extension education accentuated inefficiency while access to credit decreases inefficiency. The finding suggests that the farm size under ginger cultivation seems to be larger than what the farmers can effectively manage probably due to poor access to extension education and services or a situation whereby other production inputs are not adequately and efficiently employed. In either case, ginger farmers should be encouraged to either scale down the farm size to the level of the most efficient farmer or put additional quantities of other inputs like fertilizers and agro-chemicals. Access to credit reduces inefficiency; therefore, appropriate policies that will ensure expanded access to credit should be pursued and ginger farmers should use co-operative and farmers organizations as well as other financial services effectively.

Table 3.Maximum Likelihood Estimates of parameters for the measurements of Technical Efficiency of Ginger Farmers

Variables	Coefficients
Production Factors	
Intercept	1.647*(1.658)
Farm size (X_1)	0.118(0.262)
Labour (X_2)	2.464***(3.560)
Seed (X_3)	0.598*(1.868)
Fertilizer (X_4)	0.091*(1.972)
Agrochemicals(X_5)	-0.069(-0.134)
Capital Inputs(X_6)	0.478***(8.937)
Inefficiency Factors	
Constant	-0.015(-0.015)
Farm Size	4.721***(2.622)
Marital Status	-0.049(-0.111)
Household Size	-0.018(-0.168)
Age	-0.908(1.191)
Level of Education	0.025(0.395)
Access to Credit	-0.023***(-2.724)
Extension Contact	0.075*(1.899)
Farming Experience	0.016(0.368)
Diagnostic Statistics	
Sigma Squared	0.564
Gamma	0.312***(5.606)
Log-Likelihood	-220.837***(8.827)
LR test	1.323

NB: Values in parenthesis are t-ratios, ***P<0.01, **P<0.05, *P<0.10
Source: Survey analysis/computer printout of Frontier 4.1

5.4. Frequency Distribution of Technical Efficiency

The frequency distribution of technical efficiency of the ginger farmers in the study area is presented on Table 4. The technical efficiency level ranges from0.51 to 1.00 with mean of 0.799 and minimum and maximum technical efficiencies of 0.563 and 0.98. A greater proportion of the respondents (62%) fall in the range 0.91 – 0.981.There is no farmer that operated on the frontier which is a confirmation of the earlier assertion on the factors affecting inefficiency. This results indicate that an average ginger farmer in the study area will enjoy an increase in output of up to 18.55% if resources are more efficiently utilized, particularly, farm size and access to extension education, and the frontier is attained.

Table 4. EfficiencyIndicesof Ginger Farmers in the Study Area.

Efficiency Level	Frequency	Percentage
0.51 - 0.60	2	1.0
0.61 - 0.70	7	3.5
0.71 - 0.80	19	9.5
0.81- 0.90	48	24.0
0.90 - 1.00	124	62.0
Total	200	100.0
Minimum Efficiency	0.563	
Maximum Efficiency	0.981	
Mean Efficiency	0.799	

Source: Computed from frontier 4.1 MLE/Survey data, 2011

5.5. Constraints Faced by Ginger Framers

The percentage distribution of respondents according to the constraints they faced in ginger farming is presented on Table 5. The most important constraints faced by the respondents are frequent price fluctuations and poor remunerative prices. With low capital, very little value addition is carried out before the harvest is sold and that probably accounted for the constraints.

Table 5. Distribution of the Respondents According to the Constraints Faced in Ginger Farming

Constraints	I		II		III		IV		V	
	F	%	F	%	F	%	F	%	F	%
Poor remunerative price	107	53.5	93	46.5	0	0	0	0	0	0
Inadequate storage facilities	18	9	113	56.5	15	7.5	45	22.5	9	4.5
Lack of Access to Credit	80	40	113	56.5	3	1.5	3	1.5	1	0.5
Lack of Market For the Product	21	10.5	69	34.5	42	21	57	28.5	11	5.5
Unavailability of Farm Inputs	135	67.5	56	28	4	2	4	2	1	0.5
Incidents of Pest And diseases	33	16.5	111	55.5	18	9	32	16	6	3
Pilfering/theft	30	15	113	56.5	15	7.5	37	18.5	5	2.5
Poor access road &transport facilities	79	39.5	95	47.5	9	4.5	15	7.5	2	1
Lack of Access to Improve Varieties	28	14	82	41	17	8.5	60	30	13	6.5
Inadequate rainfall	0	0	5	2.5	2	1	36	18	156	78
Frequent price Fluctuations	148	74	52	26	0	0	0	0	0	0

I=Very Important, II=Important, III=Not Sure, IV=Not Important, V=Not Very Important
Source: Field Survey 2011

One of the key factors in value addition is storage which is near absent in most farming communities. Efforts at providing cost effective storage facilities will reduce these constraints. Other important constraints are lack of access to credit and unavailability of farm inputs; this is in spite of the earlier finding that access to credit reduced the inefficiency of the farmers. But credit is needed to procure other farm inputs which they claimed was unavailable. Therefore credit plays a very pivotal role if the farmers are to improve their efficiency and operate on the frontier (Alamu, 2005; Ezeagu, 2006).

6. Conclusion

The study indicated that ginger-based enterprises are profitable in the study area with a profit of 97k to every NGN1 invested in ginger production. The study has further shown that ginger farmers in the study area are predominantly men who are highly technically efficient but are not fully efficient as a result of some certain inefficiency factors. Individual levels of efficiency range between 0.51 and 0.981 with mean technical efficiency of .799. On the average, operating at a full technical efficiency level, ginger farmers will enjoy an output increase of 18.55%. Important factors indirectly related to technical efficiency are farm size, extension education and access to credit. Increase in farm size and extension contact reduces technical efficiency while more access to credit increases technical efficiency in ginger production. In view of these, research should be intensified to evolved new technologies that are adequately tailored towards the social structure of the farmers. Access to credit, extension services and education must be continuously expanded in a manner that will make it easy for farmers to easily comprehend improved technologies and possess enough resources to adopt them. In addition, ginger farmers should be encouraged to either scale down the farm size to the level of the most efficient farmer or put additional quantities of other inputs like fertilizers and agro-chemicals into ginger production and they should use co-operative and farmers organizations as well as other financial services effectively.

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