PAT Dec, 2017; 13 (2): 1-7 ISSN: 0794-5213
Online copy available at www.patnsukjournal.net/currentissue
Publication of Nasarawa State University, Keffi

Determinants of Profit Efficiency Among Ginger Farmers In Southern Kaduna, Nigeria: A Stochastic Profit Frontier Model Approach

Umar[1*], H.S., Jabo[2], M. S. M. and Yahya[3], K

1. Department of Agricultural Economics and Extension, Faculty of Agriculture, Nasarawa State University Keffi, PMB 135, Shabu-Lafia Campus, Nigeria
2. Department of Agricultural Economics, Usmanu Danfodiyo University, Sokoto P.M.B 2346, Sokoto State, Nigeria
3. Department of agricultural Economics and Extension, Faculty of Agriculture, Kebbi State University of Science and Technology Aliero, PMB 1144, Nigeria

* Corresponding author: umarhsuleiman@yahoo.com Mobile line: 08142473022

Abstract
The study was designed to measure profit efficiency and its determinants among ginger farmers in Southern Kaduna. A multi-stage sampling technique was used to select 205 ginger farming households. A structured questionnaire was used to collect data for 2016/2017 cropping season. A stochastic Profit frontier model was used to analyze the data. Results show that the mean of profit efficiency score among ginger farmers was 0.88. The determinants of profit efficiency among ginger farmers were household size, education and farming experience. Farmers' age was found to have negative relationship with profit efficiency among farmers. The actual profit of ginger production per hectare was ₦4,570,922, while profit lost due to inefficiency was ₦455,850/ha. The potential profit of ginger farmers in the study area was ₦5,026,773/ha. In order to attain profit efficiency frontier and recover the lost profit, it is recommended that ginger farmers should organize training and learn experience about best ginger production practices from profit efficient farmers and extension officers. Besides, efforts should be made towards enhancing education of the farmers in the area.
Keywords: Ginger farmers, profit efficiency, determinants

Introduction

Ginger is widely used in Nigeria as medicinal, culinary and confectionery. As result of its medicinal and economic importance, ginger production is taking prominent attention among farmers, particularly in Southern part of Kaduna State, which is ranked as the highest ginger producing region in Nigeria. Ginger production is a profitable enterprise in Nigeria, and about 10% of the production is consumed locally as fresh ginger while the remaining 90% is dried for both local consumption and export (Folorunso and Adenuga, 2013). The export of ginger account for 80% of aggregate national production. In the international market, Nigerian ginger is rated high because of its pungency and high level of oleoresin oil, which is the active ingredient attractive to the ginger industry.

The aggregate national output of ginger has been on steady increase since 1990. Figure 1 shows that ginger production level increased from 42,000 tonnes in 1990 to about 497, 000 tonnes in 2013; an increase of about 92% . However, there was a sharp reduction in the national output of about 83% in 2014 compare with the preceding year due mainly to price shock witnessed in 2013. Based on the available price data, there was producer price instability in ginger enterprise. For example, Figure 2 shows that the producer price of ginger increased from ₦34,900 per tonne in

1994 to the peak price of ₦100,666 per tonne in 1998. This shows an increase of about 180% within the span of four years. However, the price declined by 45% from ₦100,666 per tonne in 1998 to ₦69,362 per tonne in the year 2000.

The producer price instability can encourage crowd-out of resources in ginger sector thereby affecting income and production level negatively. Also, the capacity of farmers to attain production frontier and ensuring sustainable production is a function of profit margin, which is determined by prevalent inputs and output prices. Some factors operate to trigger upward or downward trend in farm level profit and its efficiency. Identifying these factors and their magnitude effects on farm level profit and profit efficiency become imperative for the sector as previous studies channeled their efforts at examining productive efficiency of ginger farms by focusing exclusively on the technical efficiency component (Mailumo *et al.,* 2014; Folorunso and Adenuga, 2013; Ayodele and Sambo 2014). Hence, little or no attention has been given to measuring profit efficiency and its determinants of ginger farmers in the study area even though prices of output and inputs are known. The consideration of physical productivity such as technical efficiency of ginger farms are important evaluation and understanding of production efficiency, however knowledge of profit efficiency can guide policy makers and farmers themselves toward taken decision that can guarantee or negate sustainable ginger production. Hence, in the present study, effort is made to bridge the knowledge gap by focusing on economic or profit efficiency in the study area. Therefore, the objective of this study is to measure the profit efficiency and its determinants in ginger production.

Methodology

The study was conducted in the Southern Kaduna. The climate is predominantly tropical with two distinct seasons (dry and wet seasons). The Zone is predominantly agrarian with over 75 percent of the active population engaged in farming as their primary occupation. Ginger is the major cash crop grown in the region with Kachia, Jaba, Kagarko, Jema'a and Zangon Kataf Local Government Areas as the major areas of production in the State.

The target population for this study is ginger farmers in Southern part of Kaduna State. A multi-stage sampling technique was used to collect the sample of ginger farming households: the first stage involved a purposive selection of two Local Government Areas (LGAs) namely: Jaba and Kachia. The selection of the duo was due to relatively high concentration and intensity of ginger production. The second stage involved a purposive selection of three villages from each of the LGAs. This amount to 6 villages selected namely: Nok, Kuryas,Fai, Jaban kogo, Yarbung 1 and Sabon Sarki (Table 1). In the third stage, ginger farmers were proportionately drawn based on the list of ginger farming households from each village as shown in Table 1. Finally, 205 ginger farmers were randomly selected for the study.

Primary data were collected through structured questionnaire administered on ginger farming household head. Data collected included socioeconomic characteristics of the ginger farmers: age, educational status, farming experience, household size, farm size etc. Data on ginger output and farming inputs, namely: fertilizer, seed, agrochemical and labour as well as their prices were also collected.

Stochastic Profit Frontier Model:

The Stochastic Frontier Analysis (SFA), which provide the structural basis for estimating stochastic profit function, specifies the functional relationship between output and inputs and decompose the stochastic term into random error as well as inefficiency term. The random error is characterized by symmetric distribution with zero mean and a constant variance, while the inefficiency term is assumed to follow an asymmetric distribution with half-normal or two-parameter gamma distribution. This approach is usually apply in the functional form specification for the cost, profit, or production relationship among inputs and outputs.

Farm profit is measured in term of Gross Margin (GM) which equals the difference between Total Revenue (TR) and Total Variable Cost (TVC) per hectare. Profit efficiency is defined as the ability of a farm to attain maximum profit or operating on the profit frontier given inputs prices and fixed factors. It is the ratio of actual profit and the maximum potential Profit. Profit inefficiency can be considered as loss of profit for not operating at frontier.

The standard profit function presupposes that the market for inputs and output is perfectly competitive and that ginger farmers and input traders are both price takers. This assumption underline the present study. This implies that given the input and output prices, the ginger farmer maximizes profit by adjusting the quantum of inputs employment and output scale.

The normalized actual stochastic frontier profit function of i-th farm is expressed as follows:

$\pi_i = \pi_{/P=} f(P_i, X_i) \exp(v_i - u_i)$ ……………………………………………………………..1

Where, π_i is the normalized actual profit of the i-th farm; P_i is the vector of normalized input price of the i-th farm; X_i is the vector of the fixed-input of the i-th farm; P is the out price, which serve as a factor for normalization; $(v_i - u_i)$ is composite error term: v_i are random variables assumed to be identical independently distributed (iid) ~ $N(0, \sigma^2_v)$, which capture the effects of statistical noise; u_i are non-negative random variables accounting for profit inefficiency and are assumed to be iid ~ $N(0, \sigma^2_u)$ with truncation at zero distribution.

$u_i=\delta_0+\sum_{i=1}^{K}\delta_i Z_i + \varepsilon_i$ i=1,2,….,n ……………………………………………..2

Where, δ_0 and δ_i are unknown parameters; Z_i is the vector of explanatory variables of the profit inefficiency.

Following Sadiq and Singh (2014), Trong and Napasintuwong (2015), and Yahya *et al*., (2016), the profit efficiency of the i-th farm in stochastic frontier functional form is derived as a ratio of the predicted or actual profit (π_i) to the frontier profit (π^*_i) given the price of variable inputs and amount of fixed-input employed by the i-th farm. Mathematically, it is expressed follows

Profit efficiency (π_{Ei}) $=\frac{\pi}{\pi_i^*}=\frac{F(P_i, X_i)\exp(V_i-\mu_i)}{F(P_i, X_i)\exp(V_i)}$ ………………………………. ………..3

$= \exp(-\mu_i)$

By substitution,

$=\exp(-\delta_0+\sum_{i=1}^{K}\delta_i Z_i + \varepsilon_i)$ ……………………..………………4

Where, π_{Ei} takes the value between 0 and 1. If $u_i = 0$, a farm performs on the frontier, obtaining potential maximum profit. If $u_i > 0$, a farm operates inefficiently and loses some profit.

Equations 1 and 2 can be explicitly specified in Cobb-Douglas Model as follows:

$\ln\pi_i = \beta_0 + \beta_1 lnP_{labor} + \beta_2 lnP_{agroch} + \beta_3 lnP_{fert} + \beta_4 lnP_{seed} + \beta_5 \ln fsize + (V_i - U_i)$ …………5

Where, π_i = normalized profit (₦) for ith farmer, P_{labor} = normalized price of labour (₦/man-day), P_{agroch} = normalized price of agrochemical (₦/litre), P_{fert} = normalized price of fertilizer (₦/kg), P_{seed} = price of seed (₦/kg), fsize = area of land cultivated (ha), β_0-β_5 = estimable parameters, In = natural log,

The explicit form of equation 2, which account for respondents' socioeconomic features as determinants of profit inefficiency is specified as follows:

$u_i=\delta_0+ \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4$ ………………………………………………….6

Where, u_i= technical inefficiency of the ith farmer, Z_1= age of ith farmer (year), Z_2 = household size of the ith farmer (Number), Z_3 =Years of formal education of the ith farmer, Z_4= years of farming experience of the ith farmer in maize production, $\delta_0 - \delta_4$ = parameters to be estimated. The relationship between the variance of the random errors (σ^2_v) and that of the profit inefficiency effect (σ^2_u) as well as overall variance of the model (σ^2) can be presented as $\sigma^2 = \sigma^2_v + \sigma^2_u$. This measures the total variation of profit from the frontier which can be attributed to profit inefficiency (Battese and Corra, 1977). However, Battese and Coelli (1993) provided log likelihood function after replacing σ^2_v and σ^2_u with $\sigma^2 = \sigma^2_v + \sigma^2_u$, thereby estimating gamma (γ) as $\gamma= \sigma^2_u/ (\sigma^2_v+\sigma^2_u)$. The gamma ($\gamma$) with values between 0 and 1 represents the share of inefficiency in the overall residual variance. A value of γ close to 1 suggests the existence of profit inefficiency, whereas a value of 0 can be interpreted as no evidences in the existence of profit inefficiency. The stochastic profit frontier function and the inefficiency model are simultaneously estimated using FRONTIER 4.1.

Results and Discussion

The parameter estimates of stochastic Cobb-Douglas normalized profit function and determinants of profit inefficiency as well as variance-parameter are presented in Table 2. The estimated value of gamma (γ), which is 0.96 and closer to 1, is significantly different from zero. This confirms existence of high level of inefficiency in ginger production. The value of gamma also implies that 96% of variation in the actual profit from the frontier profit among the farms was mainly due to the farmers' inefficiencies rather than random factors. The estimated coefficients of normalized profit function were positively related with the profit margin. This results negates competitive market theory. In competitive market, both input and product prices are determined by the market force; so the market actors including farmers are price takers. Based on this condition, it is expected that input prices namely labour, agrochemical, fertilizer and seed prices should be negatively related to the profit margin, such that additional increase in the prices of any of the inputs would trigger increase cost of production thereby decreasing the profit margin. However, positive signs of coefficients of input prices could be attributed to the nature of ginger production scale. Table 2 shows that ginger production in the area is characterized by increasing return to scale. This implies that additional cost of production by proportionate increase all the inputs level would result in greater ginger output and by extension greater profit margin. Table 2 also shows that increase in farm size by 1% would result in the rise of profit margin by 0.11%. This result is supported by the finding of Sadiq and Singh (2015).

Hypothesized factors of profit inefficiency in ginger enterprise meet expectation expect for farmer's age (Table 2). Ginger farmers' household size, education and farming experience contribute to their profit efficiency in the study area. This implies that increase in the size of household or increase in the year of education as well as farming experience would certainly reduce the profit inefficiency among ginger farmers in the study area. Similarly, Sadiq and Singh (2015) observed that education and farming experience enhance profit efficiency among maize farmers. Table 2 also shows that as ginger farmers aging, their profit efficiency decreases. This could be attributed to the fact that the older the farmer, the less tendency to adopt least cost combination of inputs. This result tallied with that of Sadiq and Singh (2015).

Table 3 shows the maximum profit efficiency score obtainable as 0.98, while the least was 0.23. The mean of the profit efficiency score was 0.88. The mean of actual profit of ginger production per hectare in the study area was ₦4,570,922, while the potential profit per hectare of ginger was ₦5,026,773. The profit loss per hectare of ginger due to inefficiency was ₦455,850, which constitute about 10% of the actual profit gained on the average. The coefficient of variation of profit efficiency was 10% (Table 3). This implies high convergence of individual farmers' profit efficiency to the mean.

Conclusion and Recommendation

The estimated coefficients of normalized profit function were positively related with the profit margin. Positive signs of coefficients of input prices could be attributed to the nature of ginger production scale. The mean of profit efficiency score among ginger farmers was 0.88. The determinants of profit efficiency among ginger farmers were household size, education and farming experience. Farmers' age was found to be reducing the profit efficiency among farmers. The actual profit of ginger production per hectare was ₦4,570,922, while profit lost due to inefficiency was ₦455,850/ha. The potential profit of ginger farmers in the study area was ₦5,026,773/ha. In order to recover the lost profit, it is recommended that ginger farmers should organize training and learn experience about best ginger production practices from well-performed farmers. Besides, afford should be made towards enhancing education of the farmers in the area.

References

Ayodele, T.J. and Sambo, B.E. (2014). Ginger (Zingiber Officinale Roscoe) production efficiency and constraints among small scale farmers in southern Kaduna. *Nigeria Journal of Agricultural Science*. 6(8): 141-148

Battese, G. E., Corra, G .S. (1977). Estimation of a Production frontier model: with Application to the Pastoral Zone of Eastern Australia. *Australian Journal of Agricultural and Resource Economics,* 21(3): 169-179.

Battese, G. E., Coelli, T.J. (1993). A stochastic frontier production function incorporating a model for technical inefficiency effects. Working paper in econometrics and applied statistics, No.69, Department of Econometrics, University of New England, Armidale pp.22

FAO (2017). Food and Agricultural Organization. Accessed from www.faostat.org., on 10-15th September.

Folorunso, S. T. and Adenuga, K.M. (2013). An analysis of technical efficiency of ginger crop production in Jaba Local Government Area, Kaduna State, Nigeria. *Advances in Applied Science Research.* 4(5):85-90

Kaduna State Agricultural Development Project – KADP (2017). Production of ginger. An extension guide. Kaduna State, Agricultural Development Project, Kaduna.

Mailumo, S., Dawang, C., Okeke-Agulu, K (2014). Increasing production efficiency of ginger for poverty alleviation in Kaduna state, Nigeria: A stochastic frontier approach. *International Journal of Development and Sustainability.* 3 (7): 1468-1476

Sadiq, M. S. and Singh, I. (2015). Application of stochastic frontier function in measuring profit efficiency of small-scale maize farmers in Niger State, Nigeria. *Journal of Agricultural Economics, Extension and Rural Developmen*t, 3(1):229-239

Trong, P.H. and Napasintuwong, O. (2015). Profit Inefficiency among hybrid rice farmers in Central Vietnam. *Agriculture and Agricultural Science Procedia*, 5: 89 – 95

Yahaya, K., Shamsudin, M. S., Radam, A. and Abd. Latif, I. (2016). Profit efficiency among paddy farmers: a Cobb-Douglas stochastic frontier production function analysis. *Journal of Asian Scientific Research*, 6(4): 66-75

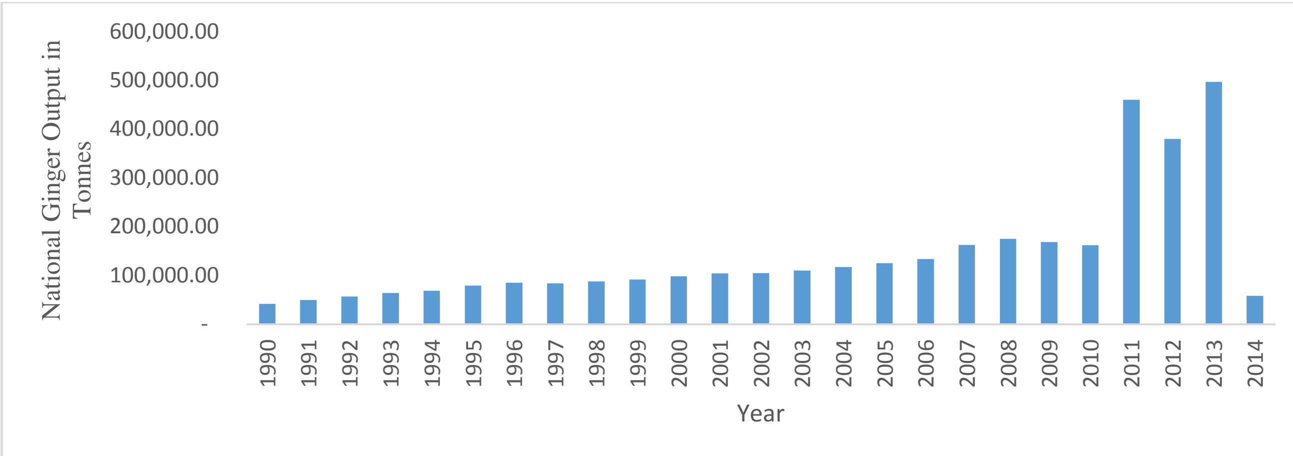

Fig 1: Ginger Output in Nigeria
Source: FAO (2017)

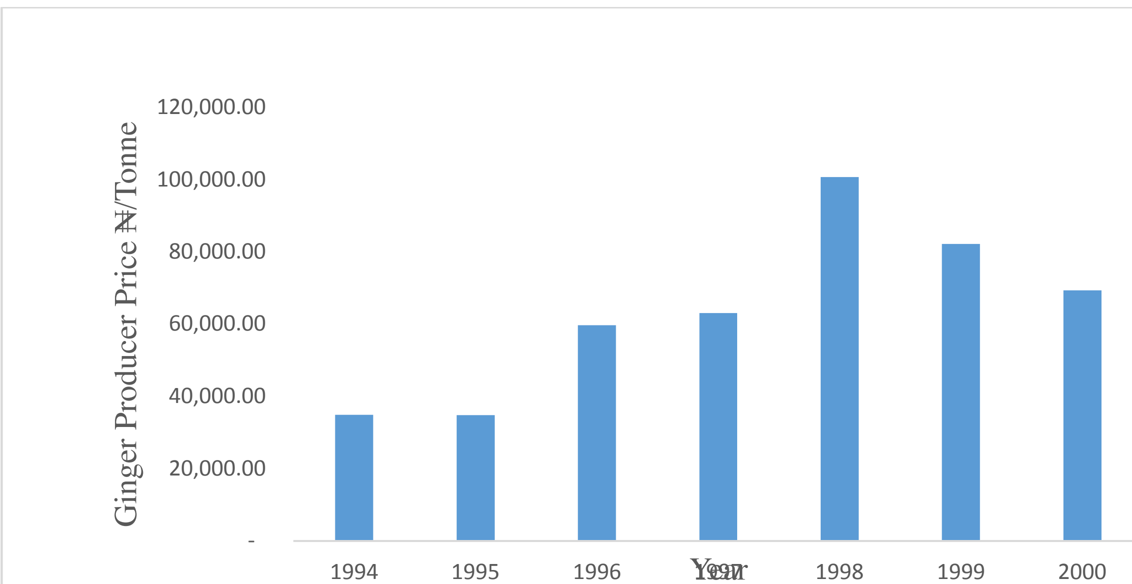

Fig 2: Producer Price of Ginger in Nigeria
Source: FAO (2017)

Table 1: Distribution of ginger farming households in the sampled villages

LGAs	Villages	Sample frame	Proportionate Selection (%)	Random Selection
Kachia	Jaban kogo	180	14	25
	Yarbung 1	210	16	34
	Sabon sarki	240	19	46
Jaba	Nok	200	16	32
	Kuryas	219	18	39
	Fai	190	15	29
Total	6	1239		205

Source: KADP (2017)

Table 2: Parameter estimates of Cobb-Douglas stochastic frontier profit function and determinants of profit inefficiency

Variable	Parameter	Coefficiet	Std. Error	T.ratio
Intercept	β_0	8.143	0.496	16.41***
Average Price of labor	β_1	0.677	0.063	10.75***
Average Price of agrochemical	β_2	0.100	0.062	1.61*
Average Price of Fertilizer	β_3	0.054	0.021	2.57***
Average Price of seed	β_4	0.066	0.028	2.36**
Farm Size	β_5	0.110	0.031	3.55***
Intercept	δ_0	-7.914	2.046	-3.87***
Age	δ_1	2.936	0.678	4.33***
Household size	δ_2	-0.845	0.221	-3.83***
Education	δ_3	-0.220	0.060	-3.66***
Farming experience	δ_4	-0.920	0.164	-5.60***
Variance-Parameter	$\sigma^2 = \sigma^2_v + \sigma^2_u$	0.229	0.031	7.44***
	$\gamma = \sigma^2_u / (\sigma^2_v + \sigma^2_u)$	0.957	0.010	98.51***

Source: Estimated data collected through field survey data (2017)

Note: *, ** & ***= statistical significance level of 10%, 5% & 1% respectively

Table 3: Means of actual profit and potential profit per hectare

Variable	Minimum	Maximum	Mean	Std. Deviation	Coeff. Variation (%)
Profit Efficiency	0.23	0.98	0.88	0.09	10
Actual Profit/Ha	₦128,875	₦8,810,000	₦4,570,922	1009031	22
Profit loss[a]/Ha	₦33,873	₦1,294,823	₦455,850	199558	44
Potential Profit[b]/Ha	₦162,748	₦9,017,494	₦5,026,773	916696	18

Source: Estimated data collected through field survey data (2017)

a=Profit loss b = Actual profit + (1-Profit efficiency in naira)