PROFIT EFFICIENCY AMONG SMALL HOLDER IRRIGATED TOMATO FARMERS IN KEBBI STATE, NIGERIA.

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ABSTRACT

Profit efficiency refers to the extent at which a firm makes not only profit but its ability to maximize profit. The study examined the Profit efficiency and its determinants among Tomato farmers in Kebbi state, Nigeria. Data were collected from a sample of 160 farmers using the multistage sampling technique. A translog stochastic frontier profit function model was employed for the analysis in which profit efficiency effects are specified to be a function of socioeconomic variables estimated using the maximum likelihood method. The results of the analysis revealed that planting material, labour, fertilizer, herbicides and manure are the dominant variables that influenced profit efficiency in Tomato production with coefficient values of (11.735, 2.143, 10.629, 80.213 and -7.065), respectively. Analysed results revealed a wide variation in the estimated profit efficiencies, ranging between 0.03 and 0.67 with a mean of 0.56 suggesting that the best profit maximizing farmer operated barely above average frontier. The result also showed that age, amount of credit accessed and membership of association positively influenced profit efficiency of Tomato farmers while farming experience, farm size planting technology and seed variety influenced profit efficiency negatively. In order to increase profit efficiency in Tomato production the farmers need to increase farm size, use improved planting technology and improved seed variety.

Key words: Profit efficiency, Tomato, Farmers, Kebbi State, Nigeria

INTRODUCTION

Tomato (*Lycopersicon lycopersicon* Mill.) is one of the most widely cultivated vegetable crops grown in the world, giving growers income, expanding export potential and improving the supply of vitamins and minerals in human nutrition (Zhang, 2005). In Africa, highest yields are recorded in South Africa, (801,000 metric tonnes) Nigeria (410,000 metric tonnes) Sudan (216,000 metric tonnes) per hectare return (De Lonney, 2001) In Nigeria, tomato is widely cultivated around

Guinea Savannah mostly in the wet season and Sudan savannah in the dry season through irrigation schemes, where bulk of the produce comes from the Sudan zone (FAO, 1991; Chadha, 2005)

Tomato Production in Nigeria is considered to be important, not only as a food crop but even more as major source of income for rural households and is also considered as a main source of raw material for the tomato processing industries. The crop gains a wide range of popularity and acceptance where it holds a promise as source of raw material for puree (can tins) as tomapep along with culinary utilization in homes of most Nigerian families (IAR, 2003). Increased tomato production may improve food security and offer employment opportunity to the populace.

World tomato production in 2001 was about 105 million tonnes of fresh fruit from an estimated 3.9 million hectare. It is a relatively short duration crop and gives a high yield, it is economically attractive and the area under cultivation is increasing daily (Shankara *et al*., 2005). The crop grows well in irrigated condition which makes it one of the principal crops cultivated on *fadama* land. It is produced in large quantities in Kebbi State particularly in *fadama* (flood plain and low lying areas). The principal solution to increasing tomato production in the study area lies in raising the productivity of the crop by closing the existing yield gaps and providing the crop all through the season.

The urban farmer, like any other farmer, typically produce to satisfy household food needs or make profit or both. If the interest were in producing for consumption, the farmer would want to obtain the optimum from his/ her effort. If on the other hand, the farmer produces for the market, then the cost of production and the returns accruable to the farmer's effort become important measure of performance. Either of the two objectives of production requires efficient use of farm resources.

The question of efficiency in resource allocation in traditional agriculture is not trivial. It is widely held that efficiency is at the heart of agricultural production. This is because the scope of agricultural production can be expanded and sustained by farmers through efficient use of resources (Coelli, 1995). For these reasons, efficiency has remained an important subject of empirical investigation particularly in developing economies where majority of the farmers are resource-poor.

Profit from the system and an adequate return on investment are important considerations. Maximum yield may not be a sensible objective of the level of inputs required to produce high yield results in uneconomic returns. Efficiency in the use of financial resources in growing crops is an important factor. This can be expanded by emphasizing the need to market the crops in such a way as to maximize returns (Amaza and Olayemi, 2001)

Irrigation is the artificial application of water to the land or soil. It is used in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Additionally, irrigation has a few other uses in crop production which includes protecting plants against frost, suppressing weed growing in green fields and helping in preventing soil consolidation (Chadha, 2005). In most irrigated fields, farmers achieve better income by improving the production of vegetable crops. Tomato is one of the important vegetable crops grown by farmers mainly for market purpose. The study area has a tremendous potential for Tomato cultivation. Due to availability of ample irrigated farmland and the presence of relatively better market access as compared to other areas, many of the farmers in the area have engaged themselves in the cultivation of Tomatoes through irrigation. Little attention has been devoted in ascertaining the profitability as well as the profit inefficiency of the enterprise.

Given the recent and previous government economic policy that aims at improving farm productivity of high value crops of which tomato is one of such crops with export potential, detailed and systematic empirical studies on the production of tomato particularly in the study area are scarce or non-existent. Moreover, despite the production potential due to favourable weather conditions, availability of irrigation water vis-a-vis high improved disease resistant varieties of the crop and dire demand at both local and national market levels, the question why the output is so low is mysterious to policy makers and economists. This might be due to lack of necessary technical and managerial production skills, perishable nature of the crops among other reasons. According to Abang *et al.* (2004), evidence of low productivity in vegetable production was observed because of inefficiency in resource use. If Nigeria's Agricultural policy goal of diversification of production and export is to be achieved within the shortest possible time, it would require shifting the farmers from traditional (semi-subsistence) farming practices to cash crop production. Hence, governments Agricultural development policies that aims at promoting the participation of smallholder farmers in the production and marketing process need to focus on identifying factors that affect households production decisions and profit efficiency.

In an environment that produces tomato where technology introduction and increasing inputs are hardly possible, the identification of the extent of resource use efficiencies in production of the crop, given the existing technology and input levels are crucial and relevant. Since improving resource use efficiency is an alternative and less costly means of increasing productivity. It is against this backdrop and the importance of tomato in the Nigerian economy that this study was directed to examine the profit efficiency of small holder irrigated Tomato farmers in Kebbi State, Nigeria with a view to finding answers to the following research questions.

i. What is the profit efficiency level of Tomato production in the study area?

ii. What are the determinants of profit efficiency among Tomato farmers in the study area?

Conceptual framework

The conceptual framework for the study was based on the concept of the technical efficiency of resource utilization and the concept of production by Coelli et al., (1998). Technical efficiency shows the success of a farm enterprise, as it indicates ability of a farm to produce maximum output from a set of input mix (Fakayode, 2009). Figure 1.1 illustrates the concept of a feasible production set which is the set of all inputs-output combination that are feasible. This set consists of all point between the production frontier, 0F and X-axis. The points along the production frontier define the efficient subset of this feasible production set. Point A represents an inefficient point whereas points B and C represent efficient points. A firm operating at point A is inefficient because technically it could increases output to be level associated with the point B without requiring more input.

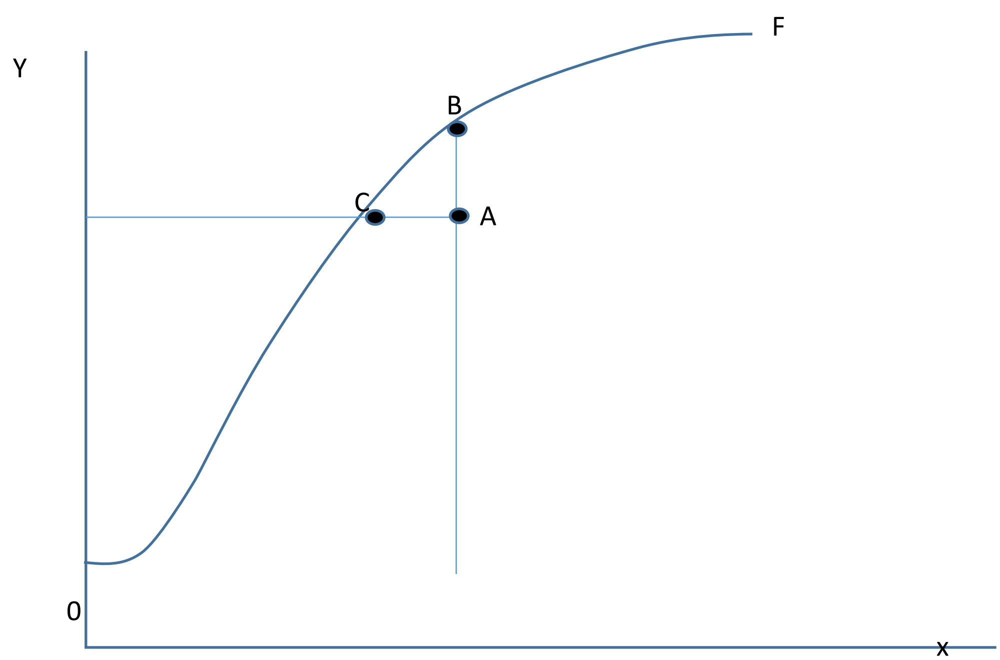


Figure 1.1 Production Frontiers and Technical Efficiency

Source: Coelli et al., 1998

Model specification

To any empirical research, the decision to select a functional form is very important because the selected functional form can significantly affect the parameter estimates (Kebede, 2001). The most two common functional forms of stochastic frontier model generally used are: Cobb-Douglas and Trans-log functional forms. Cobb-Douglas functional form is very easy to adopt but it imposes a severe restriction on production elasticity to be constant and the elasticity of input substitution to be unitary. On the other hand, Trans-log functional form is known to be less restrictive, permitting for the combination of square and cross product terms of the exogenous variables with the view of having goodness of it of the model.

Means Production Function Specification

This research employed trans-log stochastic production function model specified as follows:

$$Iny_j = \alpha_0 + \sum_{i=1}^{n} \alpha_i Inx_i + \frac{1}{2} \sum_{i=1}^{n} \alpha_{ii} Inx_{\frac{2}{i}} + \sum_{i=1}^{n} \sum_{k=1}^{k} \alpha_{ik} Inx_k + \varepsilon_j$$

Where: γ_i is output of producer j, x_i is vector of inputs used by producer j, $\alpha_0, \alpha_i, \alpha_{ii}$ *and* α_{ik}

is a vector of unknown technology parameters, j is j-th farmer where j- 1,2,3, …, 600 and i is i-th input where i – 1,2,…, n. The composed error term is $\varepsilon_j = v_i - u_i$. Where v_i captures the effect of pure noise in the data attributed to measurement error, extreme weather conditions etc and u_i is one-sided error that captures the inefficiency effects.

Inefficiency model specification

Following the specification in equation above, the linear technical inefficiency model is specified as follows:

$$u_i = \delta_o + \sum_{r=1}^{15} \delta_r W_{rj}$$

Where $u_i's$ are inefficiency effects, δ_o and δ_r's are estimated coefficients of technical inefficiency model and W_r's are vectors of I producer technological/socioeconomic variables that consists of age, years spent in school, farming experience, farm size, Amount of credit accessed, household size, gender, planting technology seed variety etc.

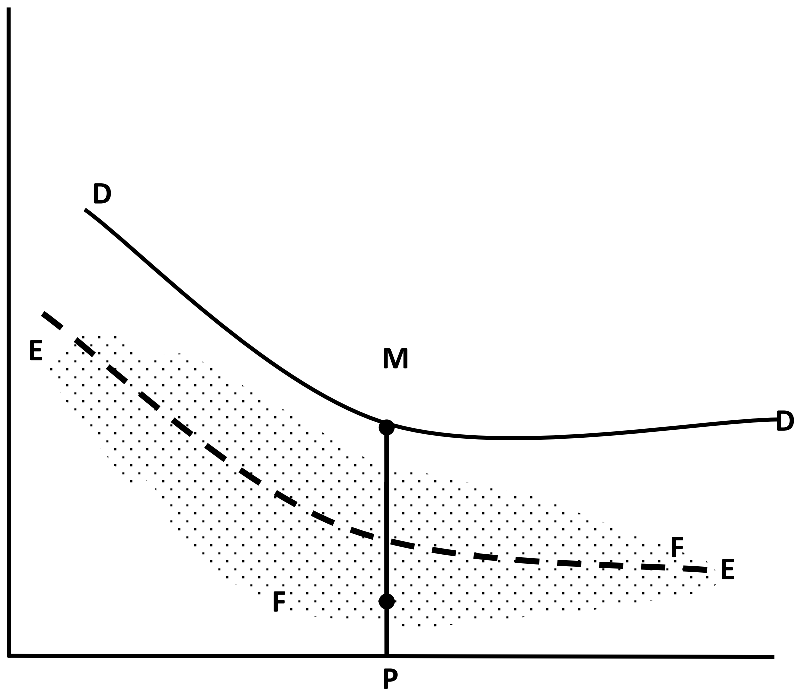
Concepts of Profit Efficiency

Based on the concept in Ogunniyi (2008), the question of how to measure efficiency has received considerable attention in economic literature. A profit function is an extension and formalization of the production decision taken by a farmer. According to production theory, a farmer is assumed to choose a combination of variable inputs and outputs that maximize profit subject to technology constraint (Sadoulet and De Janvry, 1995). Following the work of Farrell (1957), efficiency can be defined as the ability to produce a given level of output at lowest cost. The concept of efficiency has three components: technical, allocative and economic. Technical efficiency is defined as the ability to achieve a higher level of output, given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficiency decisions by using inputs up to the level at which they marginal contribution to production value is equal to the factor cost. Technical and allocative efficiencies are components of economic efficiency (Abdulai and Huffman, 1998).

Lau and Yotopoulos (1971) and Yotopolous and Lau (1973) therefore popularized the use of the profit function approach, in which farm – specific prices and levels of fixed factors are incorporated in the analysis of efficiency. The advantage of using this approach is that input and output prices are treated as exogenous to farm household decision making, and they can be used to explain input use.

Adesina and Djato (1996) defined profit efficiency as the ability of a firm to achieve potential maximum profit, given the level of fixed factors and prices faced by the firm. Aigner et al (1977), however, showed that profit function models do not provided a numerical measurable of firm-specific efficiency and popularized the use of the translog production frontier approach. The stochastic frontier approach has gained populatirty in firm-specific efficiency studies. Example of recent application includes (Ali and Flinn, 1989; Kumbhakar and Bhattacharyya, 1992; Ali et al, 1994).

Figure 1 shows the stochastic profit frontier function adopted from Ali and Flinn (1989). The stochastic profit frontier function is an extension of incorporating of incorporation of the farm specific level prices leads to the profit function approach formulation Ali and Flinn, 1989; Wang et al, 1996). A production approach to measure efficiency may not be appropriate when farmers face different prices and have different factor endowment (Ali and Flinn, 1989). Hence the use of stochastic profit functions to estimate farm specific efficiency directly (Ali and Flinn, 1989; Ali et al, 1994; Wang et al, 1996). The profit function approach combines the concepts of technical, allocative and scale inefficiency in the profit relationships and any errors in the production decision translate into lower profits or revenue for the producer (Rahman, 2003). Profit efficiency is defined as the ability of a farm to achieve highest possible profit given the prices and levels of fixed factors of that farm and profit inefficiency in this context is defined as the loss of profit from not operating on the frontier (Ali and Flinn, 1989).



Normalized input price given fixed price given fixed resources P_1/Zj

Source: Ali and Flinn, 1989

Figure 1: Frontier MLE Stochastic Profit Functions

In the context of frontier literature, DD in figure 2 represents profit frontier of farms in the industry (the best practice firm in the industry with the given technology. EE is the average response function (profit function) that does not take into account the farm specific inefficiencies. All farms that fall below DD are not attaining optimal profit given the prevailing input and output prices in the product and the input markets. They are producing at allocatively inefficient point F in relation to M in figure 1. Profit inefficiency is defined as profit loss of not operating on the frontier. In figure 1, a firm operating at F, is not efficient and its profit inefficiency is measured as FP/MP (Ali and Flinn, 1989; Sadoulet and De Janvry, 1995).

In agriculture, a farmer has to pay attention to relative prices of the inputs such that the production is undertaken at the point where the isoquant is tangent to isocost line. If that is not done, economic efficiency is not achieved. The farmer may be able to achieve technical efficiency but not allocative efficiency. This inefficiency could arise from a number of sources, which include access to appropriate information in a timely manner or lack of skills to take advantage of modern agricultural inputs. Basically, what is being referred to here is the managerial ability of the farmer. The farmer should be able to make decisions that lead to optimal utilization of resources and this requires accurate information on availability of the new varieties, the inputs, and access to markets.

MATERIALS AND METHODOLOGY

Study Area and Location

The study was carried out in Kebbi State, Nigeria. The choice of Kebbi State was based on the fact that it is one of the major states involved in irrigated tomato production. Kebbi State is located in the north-western part of Nigeria and occupies a land area of about 36,229 square kilometres with a population of about 3,630,931 (NPC, 2006). Projecting this population to 2018 to be increasing at an annual population growth rate of 2.38%, the state has an estimated population of about 4,938,066 people. The State lies between latitudes $10° 05^1$ and $13° 27^1$N of the equator and between longitudes $3° 35^1$ and $6° 03^1$E of the Greenwich. This area is characteristic of Sudan savannah sub-ecological zone with distinct wet and dry seasons. Soils are ferruginous on sandy parent materials evolving from sedentary weathering of sandstones.

Over two- third of the population are engaged in agricultural production, mainly arable crop alongside cash crops with animal husbandry. The major crops cultivated include sorghum, millet, maize, cowpea, sweet potato, rice, vegetables and fruits. Cash crops grown here include soybeans, wheat, ginger, sugarcane, tobacco and gum-arabic.

Sampling Design and Data Collection

The study was conducted in Kebbi State which is purposively selected due to its importance in tomato production. The sampling method used is the multi-stage sampling technique. The State was divided in to four according to Kebbi State Agricultural Development Project (ADP) zones, namely Argungu, Bunza, Yauri and Zuru Zones. In the first stage, two Local Government Areas (LGAs) were purposively selected from each of the ADP zones where irrigated tomato production operates mainly in the state. Secondly, from each of the LGAs, two leading villages noted for irrigated tomato production were purposively selected giving a total of sixteen villages and from each village ten tomato producers were randomly selected through snow ball technique. Thus, a total of 160 irrigated tomato farmers were interviewed for the study.

Primary data were generated for this study through a farm management survey using cost route approach. The primary data was collected from the rural households through the use of pre- tested and well trained ADP enumerators under the supervision of the researchers. The household socioeconomic characteristics and input- output data constituted the bulk of the data collected.

Translog Stochastic Frontier Profit Function Model

The transcendental logarithmic model was used to achieve profit efficiency and the determinants of profit efficiency in the study. This allows analysis of interaction among variables.

The explicit form of the model is specified as follows:

$Ln\,\pi^* = \beta_o + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 Ln X_3 + \beta_4 Ln X_4 + \beta_5 LnX_5 + \beta_6 Ln X_6 + \beta_7 LnX_7 + ½ \beta_{11} Ln X_1^2 + ½ \beta_{22} LnX_2^2 + ½ \beta_{33} LnX_3^2 + ½ \beta_{44} Ln X_4^2 + ½ \beta_{55} Ln X_5^2 + ½ \beta_{66} Ln X_6^2 + ½ \beta_{77} LnX_7^2 + \beta_{12} LnX_1 LnX_2 + \beta_{13} LnX_1 In X_3 + B_{14} LnX_1 LnX_4 + \beta_{15} LnX_1 LnX_5 + \beta_{16} LnX_1 LnX_6 + \beta_{17} LnX_1 LnX_7 + \beta_{23} LnX_2 LnX_3 + \beta_{24} LnX_2 LnX_4 + \beta_{25} LnX_2 LnX_5 + \beta_{26} LnX_2 LnX_6 + \beta_{27} LnX_2 LnX_7 + \beta_{34} LnX_3 LnX_4 + \beta_{35} LnX_3 LnX_5 + \beta_{36} LnX_3 LnX_6 + \beta_{37} LnX_3 LnX_7 + \beta_{45} LnX_4 nX_5 + \beta_{46} Ln X_4 LnX_6 + \beta_{47} LnX_4 LnX_7 + \beta_{56} LnX_5 LnX_6 + \beta_{57} LnX_5 LnX_7 + \beta_{67} LnX_6 LnX_7 + Vi - Ui.$ …………..……………………………………………………………………… (1)

Where,

Ln = Logarithm to base e

π^* = Normalized profit in Naira per tomato farm, defined as gross revenue less variable costs divided by output price.

β_o = Intercept/constant term

β_1-β_{67} = Parameters to be estimated

X_1 = Normalised price of planting material, defined as price of planting material divided by output price.

X_2 = Normalised price of labour, defined as price of labour divided by output price.

.X_3 = Hectares of land cultivated (in hectares)

X_4 = Normalised price of fertilizer, defined as price of fertilizer divided by output price.

X_5 = Annual depreciation on fixed inputs (₦). These include; depreciation charges on machinery, implements/equipment, tools, repair and operating expenses, interest charges on borrowed capital, rent on land irrigation charges, tractor hiring costs.

X_6 = Normalised price of herbicides, defined as price of herbicides divided by output price.

X_7 = Normalised price of manure, defined as price of manure divided by Output price.

Vi = Normal random errors which are assumed to be independently and identically distributed having zero mean and constant variance

Ui = Profit inefficiency effects, are independently distributed and arise by truncation (at zero) the normal distribution with mean Ui and Variance δ^2.

The parameters of the stochastic frontier profit function was estimated by the method of maximum likelihood using computer program FRONTIER version 4:1 (Coelli, 1994).

The effect of technical inefficiency in the variation of output will be determined following Jondrow *et al.* (1982) drawing a relationship for the inefficiency index to that of general error as follows:

٢ = $(\lambda^2/1+\lambda^2)$. ……..…………………..……………………………………………(2)

Where Ui is specified as:

Ui = $\delta_o + \delta_1 z_1 i + \delta_2 z_2 i + \delta_3 z_3 i + \delta_4 z_4 i + \delta_5 z_5 i + \delta_6 z_6 i + \delta_7 z_7$…. (3)

Ui = Profit inefficiency

Z_1 = Age of the farmers in (years)

Z_2 = Number of years spent in school (years)

Z_3 = Farming experience in (years)

Z_4 = Farm size (hectares)

Z_5 = Amount of credit accessed (#)

Z_6 = Household size

Z_7 = Dummy variable for gender (1 for male, 0 for female)

Z_8 = Dummy variable for membership of association (1 for membership, 0 otherwise)

Z_9 = Planting technology (1 for transplanting, 0 for otherwise)

Z_{10} = Seed variety (1 for improved, 0 for otherwise)

δ - δ_{10} = Unknown parameters estimated.

RESULTS AND DISCUSSION

Summary Statistics:

Table 1 presents the summary statistics of variables for the frontier estimation. The mean value of Tomato produced was #362, 670.00 per half hectare. Comparing this value with the total cost of production (#216, 900.00) shows that the production of Tomato in the area was profitable. A net returns of #145,770 further confirms this assertion.

The farmers are well educated with about 9 years in school. The respondents are relatively young with a mean age of about 47 years with a 10.01 standard deviation. The family size of 9 is considered moderate considering the tendency for Nigerian households to have a large family size who could serve as labourers on their farms.

Table 1: Summary statistics of variables for Tomato production in Kebbi State, Nigeria

Variable	Mean	Standard Deviation
Revenue	362, 670	1240.78
Planting Material	15, 210	140.03
Labour Cost	142, 560	213.40
Cost of Land	9, 350	89.22
Fertilizer	21, 000	189.76
Depreciation on Equipment	1, 280	5.35
Cost of Herbicides	9, 000	77.48
Cost of Manure	18, 500	59.87
Age	47	10.01
Family Size	9	5.60
Years of Schooling	10	4.70

Source: Field survey, 2018

Parameter Estimates of the Stochastic Frontier Profit Function

Results in Table 2 indicate the sigma squared value of 0.009 and variance ratio of 0.879 and are significant at 1% level, respectively. This parameter estimate ascertains the goodness-of-fit and the correctness of the specified distributional assumptions of the composite error term.

Table 2: Maximum Likelihood Estimate of Profit Frontier Function

Production factor	Parameter	Coefficient	Standard error	t-ratio
Constant term/intercept	β_0	916.64	1.216	8.480***
Planting material	β_1	11.735	1.897	4.225***
Labour	β_2	2.143	0.308	6.726***
Land	β_3	-7.82	0.651	-0.776
Fertilizer	β_4	10.629	0.157	7.160***
Depreciation	β_5	-18.665	0.001	-1.099
Herbicides	β_6	80.213	1.124	3.438***
Manure	β_7	-7.065	1.060	-4.122***
Squared terms				
Planting material x Planting material	β_{11}	17.599	1.067	57.965***
Labour x Labour	β_{12}	11.724	1.980	1.277
Land x Land	β_{33}	2.832	1.556	1.800*
Fertilizer x Fertilizer	β_{44}	44.317	1.608	0.211
Depreciation x Depreciation	β_{55}	0.001	1.700	0.060
Herbicides x Herbicides	β_{66}	9.269	1.055	7.971***
Manure x Manure	β_{77}	6.409	1.079	8.005***
Interaction among inputs				
Planting material x Labour	β_{12}	-32.525	1.958	-13.993***
Planting material x Land	β_{13}	45.334	1.162	14.667***
Planting material x Fertilizer	β_{14}	-19.058	0.884	-19.875***
Planting material x Depreciation	β_{15}	20.450	2.011	7.411***
Planting material x Herbicides	β_{16}	-120.125	1.701	-27.260***
Planting material x Manure	β_{17}	19.327	1.007	18.004***
Labour x Land	β_{23}	-62.886	1.210	-18.900***
Labour x Fertilizer	β_{24}	47.791	1.318	23.443***
Labour x Depreciation	β_{25}	-0.029	2.066	-7.002***
Labour x Herbicides	β_{26}	114.211	0.974	249.040***
Labour x Manure	β_{27}	-14.317	2.102	-42.554***
Land x Fertilizer	β_{34}	81.300	1.789	5.233***
Land x Depreciation	β_{35}	0.001	0.003	-1.313
Land x Herbicides	β_{36}	61.440	1.203	1.221
Land x Manure	β_{37}	-104.129	3.008	-7.901***
Fertilizer x Depreciation	β_{45}	-70.111	1.667	-4.406***
Fertilizer x Herbicides	β_{46}	-22.834	2.015	5.068***
Fertilizer x Manure	β_{47}	17.551	1.996	2.170**
Depreciation x Herbicides	β_{56}	0.050	0.012	14.009***
Depreciation x Manure	β_{57}	0.047	0.019	2.200**
Herbicides x Manure	β_{67}	60.366	1.081	1.951*
Diagnostic statistics				
Log likelihood function		178.400		
Sigma square (δ°)		0.009	1.021	12.216***
Gamma		0.879	0.007	3244***
LR test		154.436		

Source: Survey data, 2018: Computer printout of Frontier 4.1

Asterisk ***, ** and * implying significant at 1, 5 and 10% levels respectively

The variance ratio/the gamma (r = 0.879) which signifies that, the unexplained influences by the profit function are the major sources of the random errors, indicate also that, 87.9% of the variation in Tomato production is attributed to profit inefficiency. This confirms the presence of one sided error component in the model that makes the average function inadequate in representing the data. The coefficient of the first order terms for costs planting material (11.735), labour (2.143), fertilizer

(10.629) and herbicides (80.213) are positive and significant at 1% level respectively. On the other hand, manure (-7.065) had negative and significant relationship with profit at 1% level of probability. The negative sign recorded against the slope coefficient of manure indicated that the variable reduces profit inefficiency (increases profit efficiency). This is a sign that this resource was not efficiently allocated. It means increasing this variable will lead to a corresponding increase in profit efficiency. The findings is in disagreement with that of Oladeji *et al* (2017) who found that profit decreases with more years of experience. Results from the table also indicate that coefficients of herbicides, planting material and fertilizer were the largest, signifying their importance in influencing profit efficiency in Tomato production in the study area. This indicates that a 1% increase in herbicides, planting material and fertilizer, will lead to 80.21, 11.74 and 10.63% decrease in profit efficiency, respectively. Most of the interaction terms (2^{nd} order coefficients) were statistically significant at the conventional significance levels (1. 5 and 10%), implying the suitability of the Translog function (Okoye and Onyenweaku, 2007). Among the second order terms, the coefficients of the square term for planting material, herbicides and manure were significant at 1% probability level respectively. However, coefficient of land was significant at 10% probability level. The results from the table also revealed that these coefficients had positive values and their t-ratios suggesting that these squared resources need to be increased in order to operate at an economic level of efficiency at profit maximization level. The implication is that these squared variables have not been utilized up to their optimal economic efficiency levels. Coefficients of interaction between planting material x labour, planting material x land, planting material x fertilizer, planting material x depreciation, planting material x herbicides, planting material x manure, labour x land, labour x fertilizer, labour x depreciation, labour x herbicides, labour x manure, land x fertilizer, land x manure, fertilizer x depreciation, fertilizer x herbicides and fertilizer x manure showed a strong relationship at 1% level of probability and depreciation x herbicides and depreciation x manure showed significance at 5% levels while herbicides x manure is significant at 10% levels. This means that increasing a unit of these interaction terms for positive coefficients would lead to a corresponding increase in tomato production while increasing a unit of these interaction terms for negative coefficients would lead to a corresponding decrease in profit efficiency.

Profit Efficiency Estimate

Table 2 shows the predicted profit efficiency of Tomato production ranging between 0.03 and 0. 67 with a mean of 0.56. The minimum efficiency of 0.03 shows gross inefficient utilization of resources while the best economically efficient farmer operated barely above average frontier. There is a wide gap between the profit efficiency level of best and the worst farmers. To bridge the gap, the average farmer needs a cost saving of 16.42 percent that is (1-0.56/0.67%) to attain the frontier level of the most economically efficient farmer in the study.

The least economically efficient farmer will however, experience efficiency gain of about 95.52 percent that is (1-0.03/0.67%) to be able to attain the level of the most economically efficient farmer in the study. Given the fact that none of the Tomato farmers operated on the frontier (efficiency ratio is less than one), it depicts that more than the profit maximizing level of the input was employed. This is in consonance with the study by Oladeji *et al.*, (2017) in their study on vegetable production in Ogun State, Nigeria. .

Table 3: Frequency distribution of profit efficiency for Tomato farmers in the study area

Profit Efficiency	**Frequency**	**Percentage (%)**
0.01-0.20	06	3.75
0.21-0.30	12	7.50
0.31-0.40	18	11.25
0.41-0.50	40	25.00
0.51-0.60	82	51.25
0.61 and above	02	1.25
Total	160	100.00
Mean Profit efficiency	0.56	
Standard Deviation	0.19	
Minimum Profit efficiency	0.03	
Maximum Profit efficiency	0.67	

Source: Field Survey, 2018

Determinants of Profit Efficiency

The result in Table 3 indicates that the coefficients of age, amount of credit accessed and membership of association are positive and statistically significant at 1%, 1% and 5% level of probability respectively. This implies that as farmer's age increases his level of efficiency decreases while credit non -availability connotes more loss in profit efficiency. As credit is made more available to farmers, they tend to secure more inputs timely thus leading to more increase in profit efficiency. However, the coefficients for farming experience, farm size, planting technology and seed variety are negative and significant at 1%, 10%, 1% and 1% respectively. These tally with the apriori expectation. In a one- step stochastic frontier estimation, the parameter for a negative sign of a variable in the Z – vector implies that the corresponding variable would reduce profit inefficiency (or increase efficiency). On the contrary, a positive Z – variable is interpreted as potentially having a negative influence on efficiency (Brummer and Loy 2000; Coelli *et al*., 2005)

Table 4: Determinants of profit efficiency in Tomato production, Kebbi State, Nigeria.

Variable	**Parameter**	**Coefficient**	**Standard error**	**t-ratio**
Intercept	Z_0	2650.246	1.054	-10.594***
Age	Z_1	41.997	2.330	7.040***
Years spent in school	Z_2	2.156	1.908	1.043
Farming experience	Z_3	-118.453	3.106	-2.602***
Farm size	Z_4	-100.201	1.212	-1.810*
Amount of credit accessed	Z_5	420.514	1.074	5.756***
Household size	Z_6	2.250	1.355	1.296
Gender	Z_7	221.008	2.803	1.047
Membership of association	Z_8	143.993	1.758	2.245 **
Planting technology	Z_9	-132.907	1.711	-2.100**
Seed variety	Z_{10}	-322.764	1.089	-5.775***

Source: Computer printout of Frontier 4.1

***, **, * are significant levels at 1, 5 and 10% respectively.

CONCLUSION

Based on the revealed results of the study it can be concluded that Tomato farmers were able to realise profit to the tune of #145,770. Although the farmers were not maximizing profit. An estimated mean profit efficiency of 56% suggests that the best profit maximizing farmer operated barely above average frontier. The results suggested that profit will be enhanced with increase in planting material, herbicide, manure, improved planting technology and improved seed variety among others.

ACKNOWLEDGEMENT

The Authors wish to appreciate and acknowledge the kind gesture of Tertiary Education Tetfund, Nigeria for its sponsorship of this research without which this article would not have been set for publication.

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