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Resource Productivity and Technical Efficiency of Small Scale Groundnut Farmers in Taraba State, Nigeria

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Abstract
This study which was carried out in Taraba State, Nigeria investigated the resource productivity and technical efficiency of groundnut farmers in the State. Data for the study were obtained using a structured questionnaire administered to a total of 270 small scale groundnut farmers. Farm size, seed, family labour and use of agrochemicals were the factors that affected the technical efficiency of the farmers. In the case of allocative efficiency, farming experience, literacy level and family size were found to be significant. The level of profit made by the farmers was influenced by costs of seed, labour, transport and storage. The average scores for technical, allocative and economic efficiencies were 0.77, 0.70 and 0.54 respectively. The groundnut farmers were, therefore, not economically efficient. Improvement in their efficiency levels requires that attention be given to their costs of operation and their socioeconomic characteristics.
Keywords: Productivity, Technical, Allocative, Economic, Efficiency

1.0 Introduction

The agricultural sector occupies a significant place in nearly all economies worldwide (Reddy, Ram, Sastry & Devo, 2004). According to the Food and Agricultural Organization (FAO, 2003) the contributions of agriculture to the gross domestic product (GDP) in the UK was two percent, three percent in the USA, four and five percent respectively in Canada and Australia but as high as 40 percent in Nigeria within the same period. In spite of the recent re-basing of Nigeria's GDP agriculture still plays a dominant role in the nation's economy providing employment for more than 65 million of her citizens in 2013 alone (FMARD, 2013).

Four sub-sectors within the agricultural sector in Nigeria can be clearly delineated comprising of the crops, livestock, fisheries and forestry sub-sectors as the leading contributors to the nation's GDP with the crops sector accounting for 85% of the overall contributions of the sector (NBS, 2010). The growth performance of the sector is, therefore, largely driven by the performance of the crops sub-sector (CBN, 2010).

Groundnut (Arachis hypogea linaus) is one of the most popular crops in the crops sub-sector in Nigeria. According to Ntari, Waligar, Ramouch, Masters and Ndejunga (2005) groundnut production in Nigeria started way back in 1912 in response to high world prices for the crop. Nigeria reached her peak in groundnut production of 1.6 million metric tonnes in 1973 but production declined by half in less than a decade due to the combined effects of two important events (Ntari et al, 2005). First, the drought of 1974/75 growing season accompanied by aphids infestation wiped out more than 750,000 hectares of groundnut fields. Secondly, the coincidence of oil boom which occurred within the same period offered farmers alternative sources of income making many groundnut farmers to abandon their fields in droves.

Groundnut is the 13th most important food crop, fourth in oil seed crops and third most important world's source of vegetable protein after soybean, rapeseed and cotton seed (FAO, 2006; FAS, 2010). The seed (kernel) contains 40 – 50% fats, 20 – 50% protein and 10 – 20% carbohydrate (FAO, 2006). About 80% of edible groundnut produced in Nigeria is roasted for further processing into snacks food and peanut butter (GSP NEWs, 2004). It can be crushed for oil and other by-products including animal feeds (Beghin, Dip, Matthey and Sewadah, 2003). Groundnut is also good source of minerals such as phosphorus (P), calcium (Ca), magnesium (Mg) and potassium (K) as well as vitamins E, K and B (RMRDC, 2004).

Groundnut production in Nigeria is dominated by small scale farmers who cultivate between one and three hectares of farms often using traditional tools and equipment and not earning appreciable incomes from farming (Usman, 2006). Due to the limited capacities of these small scale farmers their outputs are usually poor and their production efficiencies have remained below optimum (RMDC, 2007). These farmers have also been reported to lack access to technologies such as improved seeds, fertilizers and herbicides (Michael, 2011).

Inspite of Nigeria's fertile soils, large expanse of arable land as well as suitable climatic factors, all of which favour groundnut production, the nation's output of the crop has declined over the years leading to a shortfall of over 90% of the quantum of groundnut required for local consumption (FAO, 2006). This calls to question the efficiency of use of available technologies by groundnut farmers in the country. An underlying premise is that if farmers, most especially the small scale category, are not efficient in the use of existing technologies, then efforts designed to improve efficiency would be more effective than introducing new technologies as a way of improving output (Shapiro, 1983 as citied in Iduma, 2006).

Efficiency in groundnut production is vital to improved output of the crop by small scale farmers. For this to occur there is the need for judicious use of available resources. Since increased output is directly related to efficient use of resources it is, therefore, necessary to know how the productivity of these small holder groundnut farmers can be raised with concomitant reduction in their levels of inefficiency.

Previous studies on the technical efficiencies of small scale farmers provide a variety of results. Lau and Yotopoulous (1971) using the profit function equation found that small scale farms attained higher productivity than larger farms in India. Sahidu (1974) adopted Lau – Yotopoulous model to sample wheat farms in India and came up with a contrary conclusion showing large and small farms exhibiting equal level of productivity. Khan and Maki (1979) using Lau – Yotopoulous model in Pakistan observed, however, that large farms were more efficient than small farms. Using a normalized profit function and stochasitic frontier function, Ajibefun, Battese & Darnmola (2002) and Mbata (1988) showed that large farm size enhanced productivity among farmers in the dry savannah and humid forest agro-ecological zones of Nigeria. Other studies point to the socioeconomic characteristics of small scale farmers themselves as the major determinants of their technical and resource use efficiency (Ajibefun, 2006; Daramola and Falusi, 2006; Shehu and Mshelia, 2007; Okitoju and Arene, 2010 and Mamman, Agbo and Ebe, 2014). Other studies in Nigeria which isolated farm specific characteristics as major determinants of efficiency include Giroh and Adebayo (2009); Michael 2011) and Omolahim and Ibrahim (2011). Some studies focused specifically on the technical efficiencies of groundnut farmers (Tashikalma, 2010) considered resource poverty as the main reason for technical inefficiency. Whether these findings are true of groundnut farmers in Taraba State, Nigeria, it is yet to be confirmed.

In view of the strategic importance of the crop, groundnut, in Nigeria as a major source of vegetable oil and protein there is the need to investigate the resource productivity and technical efficiency of groundnut farmers. In doing so, the socio-economic characteristics of these farmers as well as the size of their holdings need to be investigated with respect to their effects on the efficiencies of the farmers. Constraints to the achievement of optimal technical, allocative and profit efficiencies of groundnut farmers need also to be investigated and documented. Taraba State with 75% of her 54, 475 square kilometers of arable land suitable for groundnut production (TADP, 2012) and favourable weather with average annual rainfall of above 500mm and abundant sunshine provides a suitable environment for this study.

2.0 Theoretical Framework

This paper is anchored on the theory of production as postulated by Farrel (1957), Olayide and Heady (1982) and Oji (2002). The theory of production is concerned with the relative efficiency with which activities that lead to transformation of inputs to outputs are performed (Baumol, 1977). Measurement of efficiency in production has received considerable attention in economic research since Farrel (1957) defined it as the ability to produce a given level of output at a lower cost. Presently, the three major aspects of efficiency in agricultural production namely: technical, allocative and economic efficiencies have been widely studied and documented. Technical efficiency is the ability to achieve a higher level of output, given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost. Economic efficiency is the product of technical and allocative efficiencies.

This study dwelt majorly on the investigation into the technical and allocative efficiencies of small scale groundnut farmers in Taraba State, Nigeria. The profit and stochastic functional form and the approaches used by Nganga, Kungu, de Ridder and Herrero, (2001) were used to determine both the technical and allocative efficiencies of these small scale farmers.

The level of efficiency of a particular farmer is usually characterized by the relationship between observed production and some ideal or potential production (Green, 1997, 2000 and 2003). The measurement of the farmer – specific efficiency is based upon deviation of observed output from the best production or efficient production frontier. If a farmer's actual production point lies on the frontier, it is perfectly efficient. If it lies below the frontier then it is technically inefficient, with the ratio of actual to the potential defining the level of efficiency of the individual farmer. Thus, efficiency values range between 0 and unity. The more the efficiency score approaches unity the more efficient the farmer.

3.0 Materials and Methods

3.1 The Study Area

The study was conducted in Taraba State, Nigeria. The State which is within the Middle Belt Region of Nigeria has a population of 2, 300, 736 people (NPCo, 2006) and occupies a land area of 54, 475 sq kilometers. The state is divided into 16 local government areas (LGAs). The annual average rainfall varies from 500 mm in the northern part to 1000mm in the southern part of the State (TADP, 2013). The state is largely agrarian with major crops produced consisting mainly of groundnut, maize, rice, sorghum and millet and livestock including poultry, rabbits, pigs and cattle.

3.2 Sampling Procedure

The sampling plan followed the pattern laid down by the Taraba State Agricultural Development Programme (TADP) which divided the state into four agricultural zones: zones 1, 2, 3 and 4. The first stage was random selection of three out of the four agricultural zones. Zones 1, 2 and 3 were therefore, selected. In the second stage three LGAs were randomly selected from each of the three zones giving a total of nine LGAs. In the third stage three major groundnut producing villages were purposively chosen from each of the selected LGAs giving a total of 27 villages. In the fourth stage a list of major groundnut farmers in the 27 villages was compiled and from this list a total of 270 groundnut farmers were randomly selected for the study.

3.3 Analytical Techniques

The objectives of the study were achieved using the stochastic frontier production function, the stochastic cost function and the profit function models. The empirical models were specified as below:

3.3.1 The Empirical Stochastic Frontier Production Model

The stochastic frontier production model was independently proposed by Aigner et al., (1977) and Meeusen and Van den Broeck (1977). It employs a Cobb – Douglas production function to simultaneously estimate the random disturbance term (V) which is outside the control of the production unit and the inefficiency effect (U_i) as proposed by Battese et al., (1996)

The farm frontier production function can be written as:

$Y_i = f(X_i, \beta) \exp(V_i - U_i)$ - - - - - - - (3.1)

Where:

Y is the quantity of agricultural output X is a vector of input quantities and β is a vector of parameters.

The corresponding cost frontier as used by Ogundari et al., (2006) can be derived analytically as

$C = g(P_i\, Y_{ii}\, \gamma) + V_i + U_i$ - - - - - (3.2)

Where:

C is the total production cost, P is a vector variable of input prices, g is a suitable functional form, V_i is the value of output in kg and γ is the parameter to be estimated.

By using Shephard's Lemma (Bravo-Ureta and Reigner, 1991), the minimum cost input demand equation is obtained i.e. $\frac{\partial C}{\partial P_i} = X_i\,(P_i Y_i \emptyset)$ - - - - - - - - - - (3.3)

Substituting equation (3.1) and equation (3.2) into equation (3.3) yields the economically efficient input vector X_e. The technically efficient input vector can be used to compute the cost of the technically efficient (X_t. P) and the economically efficient (X_e. P) input combinations associated with the firm's observed output. The cost of farm's actual operating input combination is given by X_a'.P.

These three cost measures are the basis for computing the following technical, economic and allocative efficiency indices as explained by Bravo-Ureta and Reigner, (1991).

$TE = Yi/Y^* = f(X_i\beta)\exp(V_i - U_i) f(X_i\,\beta)\exp(V_i)$ - - - - 3.4

$TE = \exp(-U_i)$ so that $0 \leq TE \leq 1$ - - - - - - 3.5

Variance parameters $\delta^2 = \delta^2 + \delta^2$ - - - - - - 3.6

$Y = \delta^2/\delta^2 v$ so that $0 = y \leq 1$ - - - - - - 3.7

The empirical model for Taraba small scale groundnut farmers is given by:-

$\text{In } Y_{ij} = \beta_0 + \beta_1 \ln X_{ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + \beta_6 \ln X_{6ij} + \beta_7 \ln X_{7ij}$ - 3.8

Where:

Subscript ij refers to the j^{th} observation of the i^{th} farmer
In = logarithm to base e
Y = Output of the groundnut farmer (Kg grain equivalent) per/ha
X_1 = Farm size (in hectares)
X_2 = Quantity of seed used (in kg/ha)
X_3 = Family labour used in production (in man-days/ha)
X_4 = Hired labour used in production (in man-days/ha)
X_5 = Quantity of other agrochemical used (in litres/ha)
X_6 = Quantity of fertilizer used (in kg/ha)
X_7 = Expenses on ploughing (tractor and animals traction) in Naira per hectare.

It is assumed that the technical inefficiency effects are independently distributed and U_i arises by function Cat Zero) of the normal distribution with, U_{ij}; and Variance δ_2 where U_{ii} is defined by:

$\mu_{ij} = \delta_0 + \delta_1 Z_{1ij} + \delta_2 Z_{2ij} + \delta_3 Z_{3ij} + \delta_4 Z_{4ij} + \delta_5 Z_{5ij} + \delta_6 Z_{6ij}$ - - - - - - - - (3.9)
μ_{ij} = Technical inefficiency of the ith farmer
Z_1 = Farming experience (in years)
Z_2 = Gender of the respondent
Z_3 = Household size (number of persons in farmer's household)

Z_4 = Extension contact (Number of meetings)
Z_5 = Literacy level (years in school)
Z_6 = Age of the respondents (in years)
Z_7 = Access to credit facilities (loan)
δ_1 - δ_7 = Are parameters to be estimated

The maximum likelihood estimate of P and 0 coefficients were estimated simultaneously using the computer programme FRONTIER 4.1 in which the variance parameters are expressed in terms of $\delta^2_s = \delta^2_v + \delta^2$ and $y = \delta/\delta^2$ (Coelli, 1994; Ajibefun, 1998).

3.3.2 The Empirical Stochastic Frontier Cost function Model

The dual cost frontier production function adopted in estimation of total cost of production as applied by Ogundari (2008) and Maurice (2012) is specified as follows:-

$LnC_i = \beta_0 + \beta_1 lnF_1 + \beta_2 lnF_2 + \beta_3 lnF_3 + \ldots \beta_8 lnF_8 + Y_i + V_i + U_i$ - - 3.10

Where:

C_i = Total cost of production of the i^{th} farmer (₦)
F_1 = Cost of acquired land (₦)
F_2 = Cost of fertilizer (₦)
F_3 = Cost of groundnut seed (₦)
F_4 = Cost of other agro-chemicals eN)
F_5 = Cost of family labour used (in-Man-days)
F_6 = Cost of hired labour used (in-Man-days)
F_7 = Cost of ploughing (Animal traction/tractor) (₦)
F_8 = Cost of transport (₦)
Y_i = Is the output of i^{th} farmer (kg)
V_i and U_i = are as previously defined

The inefficiency model is defined by:-

$U_j = \delta_0 + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3 + \delta_4 z_4 + \delta_5 z_5$ - - - - -(3.11)

Where:

U_i = Cost efficiency effect
Z_1 = Age of farmer (in years)
Z_2 = Farming experience (in years)
Z_3 = Literacy level (measured in years spent in school)
Z_4 = Family size (total number of persons in a household)
Z_5 = Frequency of extension contact/number of visits

Given the functional and distributional assumption of maximum likelihood estimate (MLE) for all parameters of the stochastic frontier production function defined by equation (3.1) the farm frontier production function, the corresponding cost function (3.2) and minimum cost of input (3.3) the technical efficiency (TE) is defined by equation (3.4) and (3.5), the variance parameter is defined by equation (3.6) and (3.7), the inefficiency model is defined by equations (3.8) and (3.9) and the stochastic cost function (3.10) and the inefficiency model of cost function (3.11) was estimated using the computer program, frontier 4.1 (Coelli, 1994; Ajibefun, 1998; Ogundari and Ojo, 2007).

3.3.3 Profit Function (Λ)

Profit Function relates maximizing profit (or minimizing cost) to the price of product(s) and input(s), (Sankhayan, 1988). The function was used to determine the influence of the production cost on the proceeds of the product (groundnut) realized. The generalized profit function is given as:

$(\Lambda) = Pyf(X_i \ldots\ldots X_n, Z) - \Sigma P_i X_i$ or $(\Lambda) = R - C$ - - 3.12

i = 1 – 6

Where

(Λ) = Profit (₦)
P_y = Unit price of output (₦)
$P_i X_i$ = Cost of variable input (₦)
P_i = Unit price of *i*th variable input (₦)
Z_i = fixed price (₦)
X_i = variable input (₦)

Thus, the revenue equation is expressed as

$TC = P_i X_i + P_2 X_2 + P_3 X_3 + P_4 X_4 + P_5 X_5 + P_6 X_6$ - - - 3.13

Where

$P_y Y$ = Total cost (₦)

P_1X_i = Cost of groundnut seeds (₦)
P_2X_2 = Cost of labour used (in mandays/hours)
P_3X_3 = Cost of fertilizer used (Kg/ha)
P_4X_4 = Cost of transportation (₦)
P_5X_5 = Cost of storage (₦)
P_6X_6 = fixed capital asset

4.0 RESULTS AND DISCUSSION

4.1 Estimate of Stochastic Frontier Production Function of the Groundnut Farmers

The results of the maximum likelihood estimate of the stochastic frontier production function for the groundnut farmers (Table 1) showed that seed was the most important factor in groundnut production with an elasticity coefficient of 0.55 implying that a 10% increase in the quantity of seed would increase output by 5.5%. This result agrees with the findings of Tashikalma (2011) which found that agricultural productivity can be increased through increase in seed as input. Farm size was the second most significant factor in groundnut production with a positive elasticity coefficient of 0.25 which was statistically significant at 1 % level of probability. The implication is that, a 10% increase in hectare of land cultivated would increase output of groundnut by 2.5%. This is an indication that land as a factor of production is very vital in groundnut production in the study area. This result is in conformity with the findings of Awotide and Adejobi (2006), Ogundari and Ojo (2007), Mesike et al., (2009), and Shehu et al., (2007) which found out that farm size is one of the important factors in agricultural production. Other agricultural inputs eg herbicides were also significant inputs in groundnut production with an elasticity coefficient of 0.13 which was statistically significant at 1 % probability level. This implies that a 10% increase in the use of agrochemicals (herbicides) in groundnut production would increase output by 1.3%. Family labour was also significant.

In the inefficiency model the coefficient of gender was found to be negative and not statistically significant even at 10% probability level, implying that these farmers may be highly productive but not technically efficient. The connection between agricultural productivity and gender were well documented in the studies of Adekanye (1988), Babalola (1988) Odii (1992), Olawoye (1988). The possible explanation may be due to limited access to land by women who dominated groundnut farming in the study. The result however agrees with the findings of Adekanye (1988), Babalola (1988) and Olawoye (1988) which found that limited access to land affected women farmers technical efficiency.

Household size has a negative coefficient and statistically significant at 1% significance level. This implies that farmers with relatively large family size have the potential to increase farm output. This result is in consonance with the findings of Ya'ashe et al., (2010), Gwandi et al., (2010) and Jude (2011) which found that size has significant effect on technical efficiency.

Literacy level of the farmers was also found to be negative and statistically significant at 5% probability level. The possible explanation is that farmers with formal education are more likely to be technically efficient compared with the uneducated ones. This result conforms with the findings of Renato and Euan (2004) who reported that education was found to be one of the significant factors associated with technical efficiency of farmers.

Extension contact was negative but statistically significant at 5% probability level possibly mirrowing the impact of extension on adoption of technology. This result agrees with the findings of Ransom et al., (2003) that contact with extension significantly and positively affected adoption of improved varieties in hills of Nepal as well as those of Adewuyi (2002), Ajani (2000), Amaza (2002) and Awotide (2004) who reported that efficiency levels of farmers were significantly affected by extension service.

4.2 Frequency Distribution of Technical Efficiency of Groundnut Farmers

The range of technical efficiency of the farmers (Table 2) shows that the most efficient farmer had a technical efficiency of 0.98, while the least efficient farmer had a technical efficiency of 0.30, with a mean technical efficiency of 0.77.

The mean technical efficiency of 77% implies that on the average, the farmers were able to achieve about 77% of optimal output from the set of inputs and technology available to them. Thus, the output of the groundnut farmers in the study can be increased by 23% through improved resource allocation with no additional cost. This result is in agreement with the findings of Najafi and Zibadi (1995) who reported that, the mean technical efficiency of wheat farmers at Far province was 79.7%. Chaovanapoonphol et al., (2005) also found that the average technical efficiency of rice farmers was 79% in Thailand.

4.3 Estimation of Stochastic Cost Function for Groundnut Farmers

The maximum likelihood estimates for the parameters of stochastic cost function used in the determination of allocative efficiency indicate that four cost estimates (cost of fertilizer, seed, labour and ploughing) of the parameters were important determinants of total cost associated with groundnut production in the study (Table 3). This implies that an increase in these inputs will lead to increase in the total production cost.

Rent on land, cost of agro-chemicals, hired labour and cost of transportation were not statistically significant at any level of probability but carried appropriate signs indicating that they were associated with the total cost of production, but, were not major determinants of the total cost of production. Thus, an increase in these inputs may not lead to an increase in the total cost of production. In the inefficiency cost model, farming experience (Z_2), literacy level (education) (Z_3), household size (Z_4) were significant and positively related to cost efficiency of the farmers.

Farming experience carried negative sign and was statistically significant at 5%. This indicates that experienced farmers are likely to take cost decisions that will lead to allocative efficiency compared to farmers who have little or no experience. Also, family size was statistically significant at 5% probability level indicating that relatively larger household sizes are likely to use more of family labour to reduce the high cost of hired labour thereby enhancing cost efficiency.

4.4 Frequency Distribution of Allocative Efficiency

The distribution of farmers' allocative efficiency indices (Table 4) indicates that the minimum and maximum farmers' allocative efficiency scores ranged between 0.506 and 0.883 showing that there was high variation between the least allcoatively efficient groundnut farmer and the best allocatively efficient farmer. The least allocatively efficient farmer would require about 49%, to achieve allocatively efficient gain. Although the farmers were somehow allocatively efficient there are still considerable potentials for improvement in the allocation of resources so as to minimize resource wastage associated with production process and consequently reducing production cost.

4.5 Frequency Distribution of Economic Efficiency of Groundnut Farmers

The economic efficiency of the groundnut farmers ranged between 0.220 and 0.861 with a mean of 0.54 (Table 5). Majority of the farmers (55.55%), had economic efficiency of 50 – 69%, while 33.33% had economic efficiency of less than 50%. The mean score of 0.54 implies that groundnut farmers in the study were not economically efficient in the use of productive resources. There is a high magnitude of variation between the least economically efficient farmer and the best economically efficient farmer which may perhaps be due to misallocation and/or under utilization of productive resources. The resultant effect is high cost per unit of output and hence the inability to maximize profit.

4.6 Profit (Λ) and Cost Relationship in Groundnut Production

Profit (Λ) function was used to analyze the influence of cost of production on the profit realized. Of the six independent variables used in the analysis, four were significant at 1% level of probability implying that increases in the use of these variables would affect groundnut profit. Costs of seeds and transport were positively related to groundnut profit, while labour cost and storage cost were inversely related to groundnut profit (Table 6). An increase in the quantity of seed used in groundnut production is expected to bring about increase in the cost of seed. Theoretically, all things being equal, there is an inverse relationship between profit and cost, but in the study area, seed was underutilized vis-à-viz, the area of land put under cultivation. Increasing seed quantity (by implication increasing seed cost) would result in increasing groundnut density per unit area which ultimately would increase groundnut yield per hectare and in turn increase profit.

In a related development, the positive coefficient of transportation cost implies that an increase in cost of transportation would bring about increase in profit. This is true because the transportation cost burden is systematically transferred to the final consumers in the prices paid by them per unit of the commodity bought. A one percent increase in transportation cost will bring about a 0.7% increase in profit.

However, labour cost and storage cost were inversely related to groundnut profit implying that increasing cost of these variables would bring about decrease in profit and vice versa. Labour cost was measured as the sum of both cost of hired labour and imputed cost of family labour used in production. In the study area, most of the respondents resorted to the use of family labour probably due to the high cost of hired labour. In the maximum likelihood estimate (MLE) (Table 1) family labour measured in mandays was underutilized, while hired labour also measured in mandays was not significant.

5.0 Conclusion

Farm size, seed, family labour and other agrochemicals had significant relationship with groundnut production at various probability levels. The mean technical efficiency was 0.769 with minimum and maximum efficiencies of 0.303 and 0.979. The inefficiency model showed that farming experience, household size, extension contact and education were the variables that increased the technical efficiency of the respondents. Cost function indicated that costs of fertilizer, seed, family labour and ploughing significantly affected the cost of groundnut production. The mean allocative efficiency was 0.70 with minimum and maximum scores of 0.51 and 0.88 respectively. Farming experience, literacy level, family size were the significant factors that influenced the allocative efficiency of groundnut farmers. Costs of seed, labour, transport and storage positively influenced the level of profit of the groundnut farmers. The economic efficiency of the farmers ranged from 0.22-0.86 with a mean of 0.54 implying that the groundnut farmers in the study area were economically inefficient in the use of productive resources. It can be said that the groundnut farmers in the study were generally not efficient. Remedial actions targeted at improving the farmers overall efficiency levels need to be put in place.

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Table 1: Maximum Likelihood Estimate (MLE) of Stochastic Frontier Production Function for Small-Scale Groundnut Farmers (n = 270)

Variable	Parameters	Coefficient	Std error	T-value
Constant	β_0	2.10***	0.048	4.41
Farm size	β_1	0.253***	0.0084	3.02
Seed	β_2	0.546**	0.0302	1.80
Family labour	β_3	0.109*	0.0053	2.03
Hired labour	β_4	0.0013	0.0016	0.080
Fertilizer	β_5	0.0021	0.0028	0.074
Other agrochemical	β_6	0.133***	0.0040	3.29
Expenses on ploughing	β_7	0.0097	0.0015	0.067
Inefficiency Effects				
Farming experience	δ_1	-0.29***	0.0086	3.29
Gender	δ_2	-0.17	0.0497	0.033
Household size	δ_3	-0.26***	0.0094	2.76
Extension contact	δ_4	-0.18**	0.0086	2.13
Literacy level	δ_5	-0.16**	0.0077	2.05
Age	δ_6	-0.0044	0.0055	0.081
Access to credit	δ_7	-0.417	0.024	1.68
Variance Parameters				
Sigma – Squared	δ^2	0.431***	0.0018	7.32
Gamma	γ	0.721***	0.0093	7.75

Source: Computed from Field Data
*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Table 2: Technical Efficiency Distribution of Groundnut Farmers

Efficiency Level	Frequency	Percentage
0.30 – 0.39	4	1.48
0.40 – 0.49	8	2.96
0.50 – 0.59	28	10.37
0.60 – 0.69	41	15.19
0.70 – 0.79	77	28.52
0.80 – 0.89	73	27.04
0.90 – 1.00	39	14.44
Total	**270**	**100**
Minimum	0.303	
Maximum	0.979	
Mean	0.769	

Source: Computed from Field Data

Table 3: Maximum Likelihood Estimate (MLE) of Stochastic Cost Function for the Groundnut Farmers (n = 270)

Variable	Parameters	Coefficient	Std error	T-value
Constant	β_0	3.47***	0.440	7.90
Rent on land	β_1	0.0028	0.0034	0.83
Cost of fertilizer	β_2	0.405**	0.0174	2.33
Cost of groundnut seed	β_3	0.208**	0.0083	2.52
Cost agrochemical	β_4	0.000021	0.0056	0.0039
Cost of family labour	β_5	0.0085***	0.0027	3.15
Cost of hired labour	β_6	0.0063	0.364	0.17
Cost of ploughing	β_7	0.149***	0.0041	3.67
Cost of transportation	β_8	0.153	0.0108	1.42
Inefficiency effects				
Age	δ_1	-0.0075	0.0085	-0.895
Farming experience	δ_2	-0.237**	0.106	-2.241
Literacy level	δ_3	-0.316***	0.0081	-3.874
Household size	δ_4	-0.162**	0.0070	-2.313
Extension contact	δ_5	-0.0043	0.0057	-0.754
Variance parameters				
Sigma – Squared	δ^2	0.212***	0.00019	11.429
Gamma	γ	0.771***	0.189	4.075
Likelihood function		137.16		

Source: Computed from Field Data
*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Table 4: Allocative Efficiency Distribution of Groundnut Farmers

Efficiency Level	Frequency	Percentage
0.50 – 0.59	38	14.07
0.60 – 0.69	80	29.63
0.70 – 0.79	103	38.15
0.80 – 0.89	49	18.15
0.90 – 1.00	00	00.00
Total	**270**	**100**
Minimum	0.506	
Maximum	0.883	
Mean	0.695	

Source: Computed from Field Data

Table 5: Economic Efficiency Distribution of Groundnut Farmers

Efficiency Level	Frequency	Percentage
0.20 – 0.29	06	2.22
0.30 – 0.39	26	9.63
0.40 – 0.49	58	21.48
0.50 – 0.59	88	32.59
0.60 – 0.69	62	22.96
0.70 – 0.79	28	10.37
0.80 – 0.89	02	0.75
0.90 – 1.00	00	0.00
Total	**270**	**100**
Minimum	0.220	
Maximum	0.861	
Mean	0.541	

Source: Computed from Field Data

Table 6: Regression Analysis of the Effect of Cost on Profit of the Groundnut Farmers (n = 270)

		Explanatory Variables								
Functional Forms	**Constant**	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**R^2**	**R^{-2}**	**F**
Linear	-9933.799 (-0.946)	19.539 (17.372)***	-1.189 (-10.715)***	5.948 (5.169)***	10.330 (4.238)***	-0.661 (-1.426)	0.977 (0.349)	0.747	0.741	129.58
Exponential	4.199 (96.336)***	0.000 (23.208)***	-4.260 (-9.240)***	5.320 (1.114)	1.090 (1.080)	-4.077 (0.035)**	1.830 (0.875)	0.779	0.774	154.76
Semi-logarithm	-460609.0 (-4.094)***	81346.518 (2.252)**	-146321 (-8.006)***	549.886 (0.576)	801408.26 (10.632)***	-4134.968 (-1.581)	3945.173 (0.536)	0.694	0.687	99.59
+ Double-logarithm	0.123 (0.294)	1.369 (10.153)***	-0.617 (-9.120)***	-0.002 (-0.667)	0.752 (7.165)***	-0.030 (-3.099)***	0.042 (1.558)	0.788	0.783***	162.62***

Source: Computed from field data
*** = Significant at 1%
** = Significant at 5%
* = Significant at 10%
Figures in parenthesis are corresponding t – statistics
+ = Lead equation