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SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 4
September 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

PROFITABILITY AND ECONOMIC EFFICIENCY OF GROUNDNUT PRODUCTION IN BENUE STATE, NIGERIA

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PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
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ABSTRACT

There has been a remarkable reduction in the contribution of groundnut to Nigeria's foreign exchange earnings since the discovery of petroleum resources. There is need to re-position this valuable crop to assume its rightfull position in the nation's economy. Thus, this study assessed the profitability of groundnut production and level of technical and allocative efficiencies of the farmers using Benue State as a case study. Multi-stage sampling technique, which involves purposive selection of two Local Government Areas (Makurdi and Ogbadigbo) and subsequent random selection of groundnut farmers from the selected three communities was adopted in collecting cross-sectional data from 270 groundnut farmers using structured questionnaire and oral interview. Descriptive statistics, gross margin analysis and Stochastic Frontier Model were used to analyse the data. The study found that the mean gross margin per hectare of groundnut was ₦1,897.86 per month while the profitability test shows that it is profitable ($t= 6.87$; $P \leq 0.01$). However, the key variables that influence profitability are hired labour, cost of seed, agrochemical and cost of fertilizer. Meanwhile, the mean technical efficiency estimate of groundnut farmers in the study area was found to be as low as 4%. This could be attributed to high demand for labour, land and agrochemicals which are the critical factors that play a significant role in groundnut production. The socio-economic factors that affect groundnut production in the study area include farmers' age, household size and annual income. Similarly, an average farmer spent about 28% above the minimum frontier cost. Furthermore, the elasticity of cost of production with respect to cost of hired labour and cost of seed was found to be relatively high indicating their importance in groundnut production. More land should be put into groundnut production and farmers should be given essential agricultural inputs that will enhance the productivity of this cash crop. The study further recommends the development and dissemination of simple machines that can facilitate the stages involved in the production of groundnut.

Key words: Groundnut, Profitability, Frontier, Efficiency, Allocative

INTRODUCTION

Groundnut (*Arachis hypogea*), an annual plant herb (legume) comes from the pea family of Fabaceae. It is also known as peanut, earthnut, monkeynut and goobers in U.S. and British terms [1]. Groundnut seeds contain 40-50% fat, 20-50% protein and 10-20% carbohydrate [2]. Thus, nutritionally, it is a good source of vitamins and essential minerals. Groundnut seeds are consumed directly as raw, roasted or boiled (meal) and the oil extracted from the seeds is used as culinary oil. The oil is used in making margarine, crackers/cookies, candy, salted groundnut, salad oils nut chocolates, sandwiches and soaps. Furthermore, groundnut plants are used as animal feed (oil pressings from seeds, green material and straw) and industrial raw material (oil cakes and fertilizer). These multiple uses of the groundnut plant makes it a good cash crop for domestic markets as well as for foreign trade in several developing and developed countries.

Groundnut is one of the most popular and universal crops cultivated in more than 100 countries in six continents [3]. It is grown in 25.2 million hectares of land with a total production of 35.9 million metric tons [4]. It is the 13th most important crop and the 4th most important oilseed crop of the world [1]. Major groundnut producing countries are China (40.1%), India (16.4%), Nigeria (8.2%), USA (5.9%) and Indoesia (4.1%) [5]. Before the second world war, Nigeria’s groundnut figured prominently in world trade accounting for 29% of Africa’s export and 12% of the world’s export. Between 1950s and 1970s before the discovery of oil, Nigeria contributed 50% and 30% of the African and world exports, respectively. The decline in groundnut production in Nigeria has been attributed to the discovery of crude oil, groundnut rosette epidemic, drought and lack of organised inputs procurement and marketing [6].

According to Adama [7], over 330 products can be commercially produced from groundnut and jobs can be directly created from enhanced groundnut production with small improvement in the technology and the use of improved variety with corresponding increase of cultivated acreage. As a legume crop, groundnut adds nitrogen to the soil by increasing soil fertility. In recent times, there has been increased awareness in the cultivation of food legumes like groundnut, not only as food but as soil fertilizer. This reduces the farmers’ demand for inorganic fertilizer.

Despite numerous efforts by the Nigerian Government to rivatilize the production of this crop through research, crop improvement practices and vast resources of land, there seems to be inadequate supply of groundnuts to meet both the local and international market demand. Consequently, with the huge potential of this cash crop, there is need to investigate the level of productivity and efficiency of its production in Nigeria. No systematic study has investigated the profitability, technical and allocative efficiency of groundnut in Benue State. Thus, the two major objectives of this study were to assess the profitability of the groundnut crop in Benue State and to determine the level of technical and allocative efficiencies of production of the crop in the study area.

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METHODOLOGY

The study was carried out in Benue State, in the middle belt zone of Nigeria, located between latitude 8^0-10^0N and between longitudes 6^0-8^0E. It has a total landmass of about 33,955 km^2 with 23 Local Government Areas. The State is politically and agriculturally divided into three zones: A,B, and C with a population of 4,219,244 people, and 413,159 farm families [8, 9]. Benue State shares boundary with Nasarawa State to the North, Taraba State to the East, Cross-River to the South, Kogi State at the West and Cameroon Republic to the South-East.

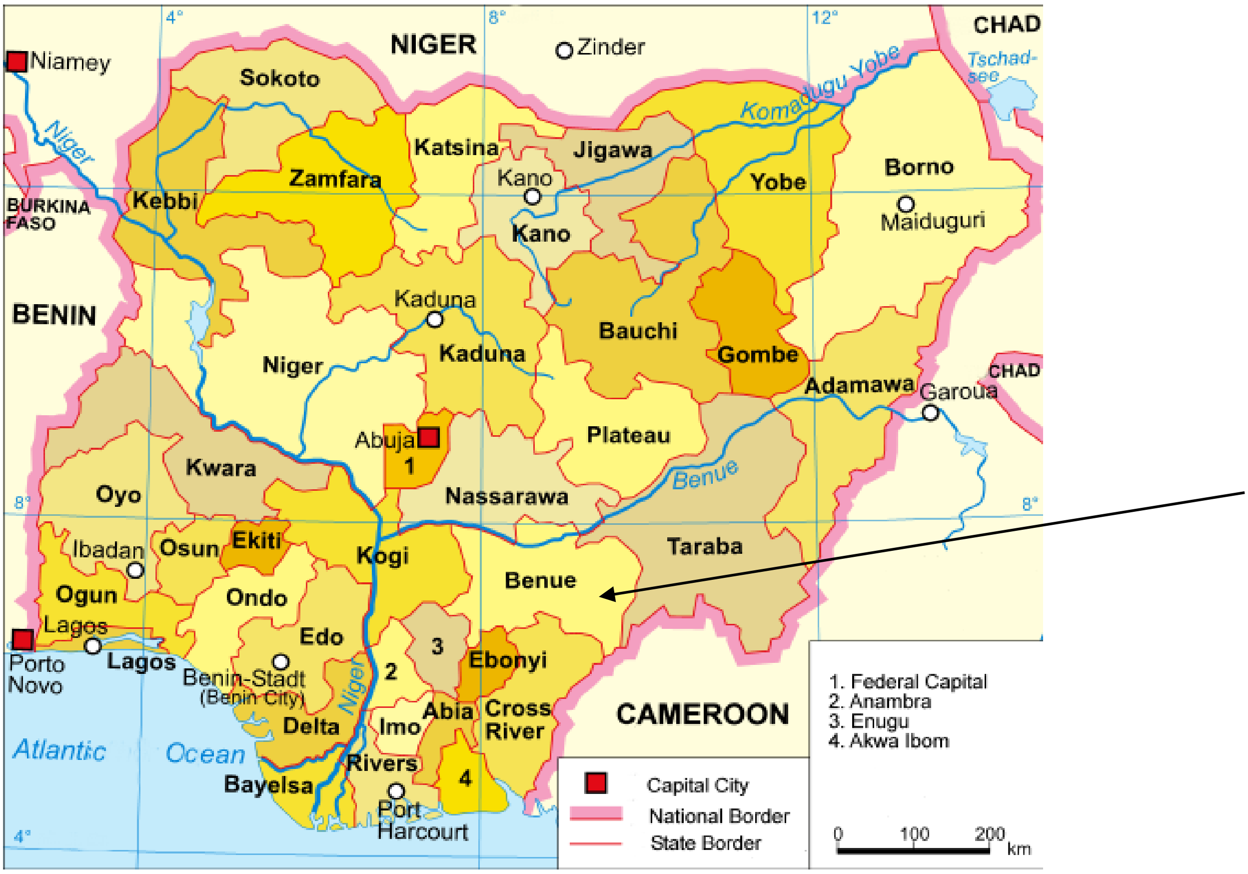

Figure 1: Map of Nigeria showing the study area (Benue State)

A multi-stage sampling technique was adopted in selecting the respondents. First, a purposive selection of two Local Government Areas (LGAs) (Makurdi and Ogbadigbo) was made following the choice of these LGAs as sites for 'legume technology' by First Bank of Nigeria (Plc) Professorial chair in Agronomy. From the two LGAs selected, Odoba, Pila and Shaminja communities were purposively selected based on the presence of demonstration sites in the communities. Subsequently, simple random sampling technique was used in the selection of farmers at the community level. With the sampling frame drawn, a sampling proportion of 39.2% of farmers in each community was taken which gave a total of 270 respondents.

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Data for this study were collected by the use of a well-structured questionnaire administered to the 270 selected groundnut farmers in the study area. Both descriptive and inferential statistics were used to analyze the data for the study. Gross margin and Stochastic Frontier production function were used in estimating the profitability; and technical and allocative efficiencies of the farmers, respectively. The parameters of the stochastic frontier model were obtained by the maximum likelihood estimation method using the computer programme, FRONTIER version 4.1 [10].

Model Specification

Technical efficiency

Technical efficiency model is embedded in equations linking groundnut outputs to resources inputs on one hand and groundnut output to inefficiency model on the other hand. Inefficiency effects is linked to the age of farmers, educational level, farming experience, annual income, household size, extension contact and variety of crop planted. Cobb-Douglas Stochastic Frontier production function was assumed to be the appropriate model for the analysis of the farm data. The estimated Cobb-Douglas model was expressed as:

$$LnY_i = \beta_0 + \beta_1 LnX_{1i} + \beta_2 LnX_{2i} + \beta_3 LnX_{3i} + \beta_4 LnX_{4i} + \beta_5 LnX_{5i} + V_i - U_i \dots\dots\dots\dots (1)$$

Where

Ln –denotes natural logarithm to base e.

Y_i– represents output of the ith farmer (in kg).

β_i – represents the unknown parameters associated with the explanatory variables in the production function (1=0, 1,2)

X_{1i} = farm size – total amount of land under groundnut cultivation (ha).

X_{2i} = quantity of seed (kg/ha).

X_{3i} = quantity of inorganic fertilizer (in kg/ha).

X_{4i} = quantity of agro-chemicals (litres/ha).

X_{5i} = amount of hired labour in mandays.

V_i- random errors that are assumed to be independently and identically distributed of the U_i.

U_i– non-negative random variables associated with technical inefficiency of production which are assumed to be independently distributed, such that U_i is obtained by truncation (at zero) of the normal distribution with variance σ^2 and mean U_i where the mean is defined by:

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$$U_i = \sigma_0 + \sigma_1 Z_{1i} + \sigma_2 Z_{2i} + \sigma_3 Z_{3i} + \sigma_4 Z_{4i} + \sigma_5 Z_{5i} + \sigma_6 Z_{6i} + \sigma_7 Z_{7i} \ldots\ldots (2)$$

Where
σ is a (7× 1) vector of unknown parameters to be estimated.
Z_1 is age of farmers.
Z_2 is years of formal education.
Z_3 is farming experience.
Z_4 is annual farm income of farmers in Nigeria Naira (₦).
Z_5 is extension contact.
Z_6 is household size (Headcount / number of persons in a household).
Z_7 is variety of groundnut (Improved variety = 1, local variety = 0).

Allocative (cost) Efficiency
The allocative (cost) efficiency function is derived analytically and defined as follows:

$$\mathrm{Ln}C_1 = \beta_0(Y^*) + \beta_1(P_{1i}) + \beta_2 Ln(P_{2i}) + \beta_3 Ln(P_{3i}) + \beta_4 Ln(P_{4i}) + \beta_5 Ln(P_{5i}) \ldots\ldots (3)$$

where
C_1 = the cost of production of groundnut in Naira (₦).
Y^*= the total output measured in Naira.
i= refers to individual production farm.
P_{1i}= total output in kg/ha.
P_{2i} = cost of seed (₦/ha).
P_{3i}= cost of inorganic fertilizer (₦/ha).
P_{4i}= cost of agrochemical (₦/ha).
P_{5i} = cost of labour (₦/ha).
Cost/Allocative inefficiency frontier model is given as:
$U_i = \sigma_0 + \sigma_1 Z_{1i} + \sigma_2 Z_{2i} + \sigma_3 Z_{3i} + \sigma_4 Z_{4i} + \sigma_5 Z_{5i} + \sigma_6 Z_{6i} + \sigma_7 Z_{7i}$ where
where Z_1 to Z_7 are the same as stated above.

RESULTS

The result of gross margin analysis of groundnut production in the study area is presented in table 1. The result indicates that an average farmer spends about 49.50% of the total variable costs on hired labour. Similarly, about 31.40% of the mean total variable cost is used in procuring seed. However, the costs of inorganic fertilizer and agrochemical represent as low as 11.46% and 7.64% of the total variable costs, respectively. The total variable cost per hectare was one-third the total revenue per hectare. The gross margin per hectare as ₦22,774.37. Moreover, the result of profitability test (table 1) shows that the total revenue is significantly higher (t= 6.87; $P \leq 0.01$) than the total variable cost, indicating that their difference is not by chance.

The result of Cobb-Douglas stochastic estimation is presented in table 2. The statistical significance of sigma squared indicates the appropriateness of the model.The gamma value of 0.99 means that about 99% of the variations in groundnut output is attributed to variations in technical efficiencies of farmers.The result shows that the elasticity of production with respect to farm size, quantity of agrochemicals and labour are 0.29, 0.094 and 0.25, respectively, and are, therefore, the major determinants in groundnut production in the study area.

The analysis of technical efficiency in groundnut production presented in table 3 revealed a technical efficiency range of 0.004 to 0.83 with a mean of 0.0387. The result also shows that majority of the farmers (98.5%) have technical efficiency that ranged from 0.004 to 0.199; 0.4% have technical efficiency estimates of 0.2 to 0.399. More so, the result of inefficiency model (table 2) reveals that age (-0.822), annual income (-0.32), and household size (0.48) are the major determinants of technical efficiency in groundnut production in the study area.

Furthermore, the result of stochastic cost frontier model estimates in groundnut production presented in table 4, shows that output (-0.019), labour cost (0.59), cost of seed (0.41), cost of inorganic fertilizer (0.011) and cost of agrochemicals (0.0148) have significant influence on the cost of groundnut production. Moreover, the elasticity of cost of production in terms of hired labour and seed was found to be relatively high, indicating their relative importance in groundnut production. The elasticity of cost of production in terms of quantity of inorganic fertilizer and agrochemical were found to be low.

The result in table 5 shows that the allocative efficiencies among farmers differed substantially, ranging from 1.0001 to 3.233 with a mean of 1.275. The result further shows that majority (82.6%) of the farmers have allocative efficiency estimates between 1.00 and 1.499, while only 0.7% have between 3.0 and 3.50. The result of inefficiency model presented in the lower section of table 4 shows that age (0.096), education (0.49), annual income (0.396), variety (0.146), extension contact (-0.17) and, household size (-2.35) are the major determinants of allocative efficiency in groundnut production.

DISCUSSION

Profitability Analysis of groundnut production

Among the variable costs involved in the production of groundnut, the cost of labour rated highest. It accounted for nearly half of the total variable costs. This shows that the crop is labour-intensive. Similarly, another important variable in groundnut production in the study area is the cost of seed. About two-thirds (31.40%) of the total variable cost is used for procuring seeds. However, the costs of inorganic fertilizer and agrochemical were minimal (11.46% & 7.64% of total variable cost, respectively) suggesting the low use of the variables in the study area. The total variable cost per hectare was found to be one-third the total revenue per hectare. The gross margin per hectare was ₦1,897.86 per month.

Stochastic Frontier Production Function for groundnut

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
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PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

The result of Cobb-Douglas stochastic production frontier model of groundnut shows that the perfomance of the model in terms of sigma squared and gamma are large and significantly different from zero at 1%. This indicates goodness of fit and correctness of the distributional assumptions of the error term. This implies that the conventional production function is not an adequate representation of the data.The value of gamma of 0.99 means that about 99% of the variations in groundnut output is attributed to variations in technical efficiencies of farmers.

The result shows that farm size, quantity of agrochemicals and labour significantly influenced groundnut output in the study area as observed by Amaza, Onu & Okunmadewa [11]. The output elasticity of farm size, agrochemical and labour were all less than unity. The sum of the coefficients (output elasticity) of the variables of the Cobb-Douglas stochastic frontier production model is 0.6586. This indicates decreasing return to scale, suggesting that a proportionate increase in all inputs used in groundnut production would lead to a more than proportionate decrease in groundnut production in Benue State. Analysis of technical efficiency in groundnut production revealed that an average groundnut farmer operates at a low level. This implies that technical efficiency of farmers could be increased by less use of inputs in groundnut production.

Furthermore, age, annual income, and household size are the major determinants of groundnut production in the study area. This result suggests that technical inefficiency effects in groundnut production in Benue State declined with increase in age and annual farm income while it increases with household size. In other words, old farmers with high annual income with relatively less household size achieved higher levels of technical efficiency in groundnut production in Benue State.

Stochastic Frontier Cost Function for Groundnut

The result of stochastic cost frontier model estimates in groundnut production reveals that the performance of the model in terms of λ and δ are large and signifcant at 1%. The magnitude of gamma (γ) found at 0.99 implies that 99% of the variations in the cost of production of groundnut in Benue State are accounted for by differences in allocative efficiency of farmers. Output, labour cost, cost of seed, cost of inorganic fertilizer and cost of agrochemicals have significant influence on the cost of production of groundnut in the study area. This implies that these variables are the major determinants in allocative efficiency of groundnut production in the study area. Moreover, the elasticity of cost of production with respect to cost of hired labour and cost of seed was found to be relatively high, indicating their relative importance in groundnut production. The elasticity of cost of production in terms of quantity of inorganic fertilizer and agrochemical were found to be low. This may be attributed to the low use of these inputs by farmers.

The mean allocative efficiency among groundnut farmers was 1.275. This implies that an average groundnut farmer spends about 28% above the minimum cost of production.This also implies that allocative efficiency could be increased by 28% through cost allocation of resources, given the current state of technology. The result of inefficiency model revealed also that age, education, annual income, variety, extension contact and household size are the major determinants of allocative efficiency in groundnut production. This implies that increase in age, education and annual income and the use of improved variety of groundnut decreases the allocative efficiency of farmers. However, increase in household size and extension contact increases the allocative efficiency of groundnut production in the study area.

CONCLUSION AND RECOMMENDATIONS

The study assessed the profitability and economic efficiencies of groundnut production in Benue state. Groundnut production was found to be moderately profitable with a gross margin of ₦22,774.37. Groundnut farmers in the study area were found to be technically inefficient since the average farmer operated at 4%. Also, an average groundnut farmer spent about 28% above the minimum cost of production. Age, annual income and household size are the major determinants of technical and allocative efficiencies of groundnut farmers in the study area.

It was recommended that farm mechanization be promoted and encouraged among groundnut farmers by developing and disseminating simple machines to forestall labour shortage. This will not only ensure greater productivity and efficiency but will attract youth into the agricultural sector. More farm lands should be put into groundnut production in the study area. Again, policies designed to enhance the use of less production inputs by the groundnut farmers in Benue State would lead to increase in groundnut output and increased profitability of the crop in the State.

Table 1: Descriptive Statistics of Cost and Returns in Groundnut Production in the Study Area

Crop	Statistics	Revenue (₦/Ha)	Total Variable Cost(₦/Ha)	Cost of Seed (₦/Ha)	Cost of Labour (₦/Ha)	Cost of Ferilizer (₦/Ha)	Cost of Agrochemical(₦/Ha)	Gross Margin (₦/Ha)	Profitability test
GROUND NUT	N	270	270	270	270	270	270	270	
	Mean	36037.3	13262.96	4164.94	6564.87	1520.01	1013.14	22774.37	
	Mode	25000	20000	3000	5000	0	0	15000	
	Std. Deviation	52638.8	14035.10	2897.58	11391.12	2709.52	2068.20	52822.44	
	Minimum	3250	1000	417	500	0	0	-112600	
	Maximum	800000	176600	16000	150000	21000	10875	783500	
	t-value								6.869**

Source: Analysis of field data, 2009

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AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
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September 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 2: Cobb-Douglas Stochastic Frontier Estimates for Groundnut Production in Benue State

Variables	Parameter	Coefficient	t-ratio
Stochastic production frontier			
Constant	β_0	8.28**	9.43
Ln Farm size	β_1	0.29**	3.608
Ln Seed rate	β_2	0.017	0.24
Ln Quantity of fertilizer	β_3	-0.0024	-0.22
Ln Quantity of Agro-chemical	β_4	0.094**	4.74
Ln Hired labour	β_5	0.25**	3.92
Inefficiency model			
Constant	δ_0	9.93**	7.72
Age	δ_1	-0.822**	-4.115
Educational level	δ_2	-0.039	-0.40
Farming Experience	δ_3	1.14	1.94
Annual income	δ_4	-0.32**	-5.20
Extension contact	δ_5	0.04	0.717
Household size	δ_6	0.48**	3.610
Variety	δ_7	0.165	1.65
Variance Parameter			
Sigma Square	δ^2	0.297**	11.46
Gamma	Γ	0.99**	11.67
Log likelihood function		-218.95	

**significant at 1% level;*significant at 5% level

Source: Analysis of Field data, 2009

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ISSN 1684 5374

Table 3: Distribution of Respondents by Technical Efficiency Estimates of Groundnut Enterprise

EFFICIENCY RANGE	FREQUENCY	PERCENTAGE
0.0040 < 0.2	266	98.5
0.2 < 0.4	1	0.4
0.4 < 0.6	1	0.4
0.6 < 0.8	1	0.4
0.8 < 1.00	1	0.4
Total	270	100

Mean efficiency = 0.0387

Minimum efficiency = 0.0040

Maximum efficiency = 0.83

Source : Analysis of Field data, 2009

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ISSN 1684 5374

Table 4: Stochastic Cost Frontier Estimates for Groundnut Farmers in Benue State

Variables	Parameter	Coefficient	T-ratio
Stochastic Cost frontier			
Constant	β_0	0.87**	29.53
Ln Output	β_1	-0.019**	-14.69
Ln Labour cost	β_2	0.59**	105.29
Ln Cost of seed	β_3	0.41**	66.76
Ln Cost of fertilizer	β_4	0.011**	29.46
Ln Cost of agrochemical	β_5	0.0148**	65.53
Inefficiency model			
Constant	δ_0	-9.49**	-16.63
Age	δ_1	0.96**	12.92
Educational level	δ_2	0.49**	6.21
Farming Experience	δ_3	0.061	1.22
Annual income	δ_4	0.396**	12.75
Extension contact	δ_5	-0.17**	-4.20
Household size	δ_6	-2.35**	-13.06
Variety	δ_7	0.146*	1.98
Variance Parameter			
Sigma Square	δ^2	0.29**	9.73
Gamma	Γ	0.99**	51998896
Log likelihood function		181.902	
LR test		181.89	

**significant at 1% level,*significant at 5% level

Source: Analysis of field data, 2009

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Table 5: Distribution of Respondents by Allocative Efficiency Estimates of Groundnut Enterprise

EFFICIENCY RANGE	FREQUENCY	PERCENTAGE
1.00 < 1.50	223	82.6
1.50 < 2.00	31	11.5
2.00 < 2.50	7	2.6
2.50 < 3.00	7	2.6
3.00 < 3.50	2	0.7
Total	270	100.0

Mean efficiency = 1.275

Minimum efficiency = 1.0001

Maximum efficiency = 3.2326

Source : Analysis of Field data, 2009

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