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# Analysis of Economic Efficiency of Sole Groundnut Farmers in Bauchi State, Nigeria

**[1]Biye, S. U., [2]Lawal, H. and [3]Jongur, A. A. U.**

[1]Department of Agricultural Economics & Extension, Faculty of Agriculture, Federal University, Kashere, P.M.B. 0182, Gombe State, Nigeria.
[2&3]Department of Agricultural Economics & Extension, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, P.M.B. 2076, Yola, Adamawa State, Nigeria.

## ABSTRACT

*The study was carried out to analyze the economic efficiency of sole groundnut (Arachis hypogea l.) farmers in Bauchi State, Nigeria. The underlying objectives were to analyse the technical and allocative efficiencies of the sole groundnut farmers so as to determine their economic efficiency. Data were collected from 251 farmers via structured interview schedule using cluster, purposive and simple random sampling. Descriptive statistics, Stochastic Frontier Production and Cost functions were used to analyse the data. The result revealed that most of farmers were male (70.12%), married (82.87%) and were literates (96.37%). About 61% of the respondents were within the age range of 31-50 years, with a mean age of 42 years and a standard deviation of 6.5. The elasticity estimates ($\beta_1$–$\beta_6$) of the explanatory variables were all positive and were significant except for labor. Sigma squared ($\sigma^2$) was statistically significant at 10% level, gamma, ($\gamma$) was 0.89 and is statistically significant at 10% level, implying that 89% of the variation in output was due to their differences in technical efficiencies. They had mean technical efficiencies (TE) of 0.75 (75%), their maximum and minimum TE was 97% and 37% respectively. Furthermore, their mean allocative efficiency (AE) was 58% while their maximum AE was 97% and the minimum was 35%. Their overall mean economic efficiency (EE) recorded was 0.54 (54%), with maximum of 75% and a minimum EE of 17% accordingly. Therefore it is evident that sole groundnut farmers in the study area were efficient in their production. It is recommended that more women should be encouraged into sole production in order to correct the gender in balance. Furthermore, there is room for improvement in their efficiency through rational resource allocation in light of relative price of inputs. There is dearth need for government and stakeholders in agriculture to make loan accessible and affordable to sole groundnut farmers for increased efficiency and productivity.*

***Keywords:*** *Analysis, Economic Efficiency, Sole Groundnut, farmers, Bauchi State.*

## INTRODUCTION

Groundnut (*Arachishypogaeal*.) is an important monoecious annual legume used for oilseed, food and animal feed all over the world (Pande *et al*., 2003; Upadhyaya *et al*., 2006). It is the main source of food in various forms and used as a component of crop rotation in many countries (Gbèhounou and Adengo, 2003). Groundnut is grown on 26.4 million ha worldwide with a total production of 38.2 million metric tons (FAOSTAT, 2010). Developing countries account for 97% of the world's groundnut area and 94% of the total production.

There is a large literature on the need to increase the quantity and quality of inputs in agriculture in developing countries as well as the need to increase access to resources to finance these inputs. However, it is also possible to increase output even given current levels and quality of inputs by

*Corresponding Author email: salihubnumarbiye@yahoo.com

increasing overall economic efficiency of farmers (Bravo *et al*., 1997). The concept of efficiency is critical in developing country's agriculture, given the level and quality of inputs available, how well farmers are able to utilize these inputs is an important determinant of the quantity of output they are able to produce.

Although the importance of efficient use of resources has long been recognized, the mainstream neoclassical paradigm in economics assumes that producers in an economy always operate efficiently. In reality, however, the producers are not always efficient. Two otherwise identical firms never produce the same output, and costs and profit are not the same. This difference in output, cost, and profit can be explained in terms of technical and allocative inefficiencies, and some unforeseen exogenous shocks. Given the resources (inputs), a producer is said to be technically inefficient if it fails to produce the maximum possible output. Similarly, a cost or profit maximizing producer is allocative inefficient if he fails to allocate the inputs optimally, given input and output prices. Both inefficiencies are costly in the sense that cost (profit) is increased (decreased) due to these inefficiencies. Costs of these inefficiencies are also reflected in lower productivity of inputs. Alternatively, productivity growth will be lower in the presence of any one, or both, of these inefficiencies (Kumbhaker and Lovell, 2000).

The broad objective of the study was to carry out an economic analysis of sole groundnut production in Bauchi State. However, the specific objectives were to: describe the socioeconomic characteristics of sole ground production in the area and analyze the economic efficiency of the sole ground producers in the area.

## METHODOLOGY

The study was conducted in Bauchi state, itis located in the North Eastern part of Nigeria, it lies between latitudes 9° 3' and 12° 3' N of the equator; and Longitudes 8° 50' and 11° E of the Green which Meridian. It was created from the defunct north eastern Nigeria in 1976 and it consists of twenty (20) Local Government Areas namely: Alkaleri, Bauchi, Bogoro, Dambam, Darazo, Dass, Gamawa, Ganjuwa, Giade, Itas/Gadau, Jama'are, Katagum, Kirfi, Misau, Ningi, Shira, Tafawa-Balewa, Toro, Warji and Zaki (National Population Commission, 2006). Figure 1 is the map of Bauchi State showing the twenty Local Governments.

The state was divided into three zones namely; Bauchi North, Bauchi West and Bauchi Central. Bauchi North consists of nine local government areas; Bauchi West has seven while Bauchi central had four local government areas. In the first stage, four local government areas were selected from northern zone, three from the Western zone and two from the Central zone. In the second stage, a total of twenty seven villages were purposively selected. In the third stage, a total of two hundred and fifty one respondents was randomly selected and were interviewed.

A well-structured questionnaire was used to collect primary data from the sole groundnut farmers using a cluster purposive and simple random sampling techniques. Data collected include; age, gender, marital status, educational attainment and production activities. The data was analyzed using both descriptive and inferential statistics. The descriptive statistics used consist of simple percentage and frequency distribution to describe the socioeconomic characteristics of the sole groundnut farmers. Inferential statistics employed include Stochastic Frontier Production Function and Stochastic Frontier Cost Function to estimate their technical and allocative efficiencies respectively. The parameters of the Stochastic Frontier Model was obtained using the Maximum Likelihood Estimation Method (MLE) of the Stochastic, Frontier Model (version 4.1)

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. The Stochastic Frontier production is widely used for efficiency analysis due to its simplicity and flexibility coupled with the empirical support it has received from

data for various industries and countries Desai, 1976; Handerson, (2003); Kumbhaker and Lovell, (2000); Jondrow *et al*., (1982); Coelli *et al*., (1998); Hamidu *et al*., (2011). The Stochastic Frontier Production Function is expressed as:

$$LnY_{ij} = \beta_0 + \beta_1 LnX_{1ij} + \beta_2 LnX_{2ij} + \beta_3 LnX_{3ij} + \beta_4 LnX_{4ij} + \beta_5 LnX_{5ij} + V_{ij} - U_{ij} \ldots\ldots\ldots\ldots\ldots \quad (1)$$

The subscripts i and j refer to the $i^{th}$ farmers and $j^{th}$ observation respectively,

Where:
Ln =natural logarithm to base e.
$Y$ =output of groundnut(kg).
$\beta_0 - \beta_5$ = parameters associated with the explanatory variables in the production function.
$X_1$ = farm size (ha)
$X_2$ = quantity of seed (kg)
$X_3$ = family labour (man days)
$X_4$ = hired labour (man days)
$X_5$ = quantity of agrochemicals (litres)
$X_6$ = quantity of fertilizer (kg)

$V_{ij}$- random errors that are assumed to be independent of the $U_i$ and are normally distributed
$U_{ij}$ - 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 $\sigma_2$ and mean $U_i$ where the mean is defined by:

$$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where:
$\delta$ is a (7×1) vector of unknown parameters to be estimated.
$Z_1$ is age of farmers.
$Z_2$ is formal education (formal education=1, no formal education =2).
$Z_3$ is years of farming experience.
$Z_4$ is annual farm income of farmers in Naira (₦).
$Z_5$ is extension contact (number of time or if there is no contact)
$Z_6$ is household size (number of persons in a household).
$Z_7$ is variety of groundnut used (improved variety = 1, local variety = 0).

**Stochastic Frontier Cost Function**

The allocative (cost) efficiency function was derived analytically and defined as follows:

$$\text{Ln}C = \beta_0(Y*) + \beta_1 Ln(P_{1i}) + \beta_2 Ln(P_{2i}) + \beta_3 Ln(P_{3i}) + \beta_4 Ln(P_{4i}) + {}_5 Ln(P_{5i}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:
C = cost of production of groundnut in Naira (₦).
$i$ = individual groundnut farm.
$P_{1i}$= total output in kg/ha
$P_{2i}$ = cost of seed (₦/kg)
$P_{3i}$= cost of labour (₦/ha)
$P_{4i}$= cost of herbicide (litres/ha)
$P_{5i}$= cost of pesticide (₦/kg)
$P_{6i}$ = cost of fertilizer used (₦/kg)
Cost/Allocative inefficiency frontier model is given as:
$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i}$ where
$U_i$- non-negative random variables associated with technical inefficiency of production,

Where: $Z_1$ to $Z_7$ are the same as stated above.

## RESULT AND DISCUSSION

### Socioeconomic Characteristics of the Respondents

The result shows that most of the respondents (61.32 %) were within the age ranges of 31-50 years, while only 5.18% of them were 20 years and below. The maximum age was 65 years and the minimum age was 22 years while their mean age was 42.42 years with a standard deviation of 6.5, an indication of significant variation in age of the respondents who are relatively young and physically active. This has a direct effect on the ability of the respondents to seek and comprehend improved production practices relative to older respondents, consequently influencing their tendency of recording higher efficiency among farmers which is in line with (Battese and Coelli, 1995; Otitoju and Arene, 2010) who found a positive relationship between farmer's age and inefficiency, thus express concern that aging population have negative impact on the farmers' efficiency as well as profitability.

Male farmers constitute the majority (70.12%) while only few (29.88%) of them were female, which implies that there are more male farmers than female farmers engaged in groundnut farming in the area. Otitoju and Arene (2010) also found that male significantly aid in security and wellbeing of the family; planning agriculture and many other aspects of rural life. Most (82.87%) of the groundnut farmers in the study area were married, while 10.76% and 5.58% of the respondents were single and widowed/widowers respectively. However, less than 1% of the respondents were divorced/divorcee. 37% of them had attended secondary school, 31.08% tertiary education and 15.05 % primary education, while 12.35% had Quranic education. However, only 3.59% had not attained any form of education.

Majority of the sole groundnut farmers (71.31%) fund their farming through personal savings, 3.58 from commercial banks, 10.76% from Bank of Agriculture, while only 0.79% source their capital from money lenders. This implies that farmers in the area had poor access to formal farm credit. Given the fact that majority of farmers in Nigeria are poor, the implication of this is that there is little chance for acquiring quality inputs as well as expansion of the farm holdings, consequently reducing their efficiency. This is in agreement with findings of Idachaba (2006); Deaton (1997); Zeller (1994); and Udry (1990) who asserted that poor access to formal farm credit constitute a major constraint militating against the rural farmers' agricultural productivity. Similarly, Petrick (2005); Sial and Carter (1996) and Feder *et al*. (1990) found that lack of access to credit facility poses significant adverse effects on farm output.

**Table 1: Socioeconomic Characteristics Distribution of the Respondents**

| Variable | Percentage | Mean | Standard dev. | Min. | Max. |
|---|---|---|---|---|---|
| **Age (years)** | | | | | |
| ≤ 20 | 13 | 5.18 | 42.42 | 22 | 65 |
| 21 – 30 | 37 | 14.74 | | | |
| 31-40 | 72 | 28.69 | | | |
| 41-50 | 82 | 32.67 | | | |
| 51 – 60 | 41 | 16.33 | | | |
| ≥ 61 | 6 | 2.39 | | | |
| **Total** | **251** | **100** | | | |
| **Gender** | | | | | |
| Male | 176 | 70.12 | | | |
| Female | 75 | 29.88 | | | |
| **Total** | **251** | **100** | | | |
| **Marital status** | | | | | |
| Single | 27 | 10.76 | | | |
| Married | 207 | 82.87 | | | |
| Widower | 14 | 5.58 | | | |
| Divorcee | 2 | 0.79 | | | |
| **Total** | **251** | **100** | | | |
| **Educational level** | | | | | |
| Uneducated | 9 | 3.59 | | | |
| Quranic education | 31 | 12.35 | | | |
| Primary education | 40 | 15.94 | | | |
| Secondary education | 93 | 37.05 | | | |
| Tertiary education | 78 | 31.08 | | | |
| **Total** | **251** | **100** | | | |
| **Sources of capital** | | | | | |
| Personal savings | 179 | 71.31 | | | |
| Friends/relatives | 34 | 13.55 | | | |
| Commercial Banks | 9 | 3.58 | | | |
| Bank of Agriculture | 27 | 10.76 | | | |
| Money lenders | 2 | 0.79 | | | |
| **Total** | **251** | **100** | | | |

Source: *Field Survey, 2015*

**Technical Efficiency of the Sole Groundnut Farmers**

The distribution of farmers' technical efficiency (TE) indices extracted from the stochastic production function analysis is presented in Table 4.18 below. Generally, the technical efficiency of the sampled farmers is less than 1.0, indicating that sole groundnut farmers in the study area are producing below the maximum efficiency frontier. There exists a very large difference in technical efficiency among the sole groundnut farmers. This therefore implies that the best farmers (12.75%) were within a technical efficiency range of 0.90 - 0.99, while only few farmers (0.79%) were regarded as the worst, with technically efficiency range of 0.30 – 0.39. The mean technical efficiency is 0.75 (75%) which means that, on the average, the respondents were able to obtain a little over 75 percent of optimal output from a given mix of production inputs. Thus, their mean technical efficiency can be increased in the short run by 25% to attain the technical efficiency frontier.

The maximum technical efficiency recorded among them is 0.97 (97%) on the other hand; the minimum technical efficiency recorded is 0.37 (37%). The farmer with maximum technical efficiency is close to the efficiency frontier (1.0), while the farmer with the least TE is very far away from the efficiency frontier. Hence, it is an indication that there exists a very wide variation in their technical efficiencies. Thus, for the farmer with the least technical efficiency 0.37 to attain the highest farmers specific technical efficiency in the population, the farmer require an efficiency gain of 0.6 (60%) i.e. (0.97 - 0.37).

**Table 2: Technical Efficiency Distribution of the Sole Groundnut Farmers**

| Range of TE | Frequency | Percentage |
|---|---|---|
| 0.30 – 0.39 | 2 | 0.79 |
| 0.40 – 0.49 | 3 | 1.19 |
| 0.50 – 0.59 | 36 | 14.34 |
| 0.60 – 0.69 | 51 | 20.32 |
| 0.70 – 0.79 | 57 | 22.71 |
| 0.80 – 0.89 | 70 | 27.90 |
| 0.90 – 0.99 | 32 | 12.75 |
| **Total** | **251** | **100** |
| Mean =0.752 | | |
| Max. = 0.97 | | |
| Min. = 0.37 | | |

Source: *Field Survey, 2015*

**Allocative Efficiency of the Sole Groundnut Farmers**

The allocative efficiency of the sole groundnut farmers deduced from the stochastic frontier cost function is presented in table 4.19. The result revealed that a wide variation in allocative efficiency exist among them, as the minimum allocative efficiency recorded was as low as 0.30 – 0.39, whereas the maximum was between 0.90 – 0.99. The mean TE was 0.58 (58%) which is almost halfway to the attainment of the optimal level (efficiency frontier). The highest allocative efficiency recorded was 0.97 (97%), while the lowest was 0.35 (35%). It also showed that the vast majority of the farmers' allocative efficiency falls within the range of 0.40 to 0.69, which collectively accounted for 85.3%. This shows that there exists a very wide variation in allocative efficiency among the sampled population.

**Table 3: Distribution of Allocative Efficiency of the Sole Groundnut Farmers**

| Range of Allocative Efficiencies | Frequency | Percentage |
|---|---|---|
| 0.30 – 0.39 | 7 | 2.79 |
| 0.40 – 0.49 | 56 | 22.31 |
| 0.50 – 0.59 | 88 | 35.06 |
| 0.60 – 0.69 | 70 | 27.89 |
| 0.70 – 0.79 | 25 | 9.96 |
| 0.80 – 0.89 | 4 | 1.59 |
| 0.90 – 0.99 | 1 | 0.40 |
| **Total** | **251** | **100** |
| Mean =0.58 | | |
| Max. = 0.974 | | |
| Min. = 0.3453 | | |

**Source:** Computer output from Frontier 4.1

**Economic Efficiency of the Sole Groundnut Farmers**

The overall efficiency otherwise termed as the economic efficiency is the product of both technical and allocative efficiencies which must optimally add up to 1.0, is presented in Table 4.20. Thus, farmers have to be optimally technical efficient (technical efficiency of 1.0) and also allocate efficiently (allocative efficiency of 1.0) to be able to attain the economic efficiency frontier (1.0). The mean economic efficiency obtained is 0.54 (54%), implying that the farmers' technical efficiencies and allocative efficiencies must be raised by 46% on the average so as to raise their economic efficiency to 1(economic frontier). The highest economic efficiency recorded was 0.75 (75%) while the least was 0.17 (17%). Majority (82.9%) of the farmers collectively fall within the range of 0.30 to 0.59 of the entire farmers in the study area. The result further shows that the farmer with the least economic efficiency of requires an economic efficiency gain of 58% (i.e. 0.75 - 0.17) through improved input as well as resource allocation, for the farmer to maximize profit similar to the most efficient farmer in the sample population.

**Table 4: Economic Efficiency Distribution of Sole Groundnut Farmers**

| Range of Economic Efficiencies | Frequency | Percentage |
|---|---|---|
| 0.10 – 0.19 | 1 | 0.40 |
| 0.20 – 0.29 | 25 | 9.96 |
| 0.30 – 0.39 | 77 | 30.68 |
| 0.40 – 0.49 | 80 | 31.87 |
| 0.50 – 0.59 | 51 | 20.32 |
| 0.60 – 0.69 | 51 | 6.37 |
| 0.70 – 0.79 | 16 | 0.40 |
| **Total** | **251** | **100** |
| Mean = 0.54 | | |
| Max. = 0.75 | | |
| Min. = 0.17 | | |

**Source:** Computer output from Frontier 4.1

## CONCLUSION

Sole groundnut farming in Bauchi State is dominated by male small scale farmers cultivating an average of 31-50 years (61.36%), married (82.87%) and was mostly literate to some extent. Majority (71.31%) of the sole groundnut farmers source their capital from personal savings. Only 14.34% obtained loan from banks. The farmers were themselves efficient evident from their mean technical and allocative efficiency of 0.75 and 0.58 respectively. Their overall efficiency was 0.54.

## RECOMMENDATIONS

From the result of the study, the following recommendations were made, that;

i. There is need to encourage more women into sole groundnut production to address gender in balance in the area.
ii. There is the need to increase their efficiency through rational resource allocation in light of relative prices of inputs so that their productivity will increase and consequently boosting their income or profit.
iii. Government and stakeholders in agriculture should make credit accessible to them at single digit or zero interest rate so that they can boost their efficiency and productivity.

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