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Analysis of Technical Efficiency of Groundnut Production in Wukari Local Government Area of Taraba State, Nigeria

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Abstract

The study analyzed the technical efficiency of groundnut production in Wukari Local Government of Taraba State, Nigeria. A multistage sampling technique was employed in the study with the use of 120 structured questionnaires. The result showed that majority of the farmers were male with mean age of 39.18 years. Majority (53.35%) were married, the average mean of the household size was 7.14 and farm size was 3.61, which was acquired through inheritance (42.5%). Also, 30.8% of the respondents used family labor and 57.5% of the respondents having <100000 as their income level. Average gross margin for groundnut production in the study area was N147,513.92/ha. The return on investment was estimated to be N0.55, which implies that for every N1 expended, the farmer is expected to earn N0.55 in return. The result from the technical efficiency showed that farm size, fertilizer, seed and labour were all significant while the result from the technical inefficiency showed that educational level, farming experience, age and farm size were all significant. In conclusion, the study shows that groundnut production is a profitable business and was recommended that groundnut producers be encouraged to increase their scale of production to increase their yield, stakeholders in the sector should make provision for incentives such as in-service extension training to

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improve groundnut productivity also, implementation of policies that would encourage farm owners to form cooperative/organization or join the existing ones in the study area.

Keywords: Economic, Analysis, Groundnut, Production, Technical, Efficiency

INTRODUCTION

Groundnut (*Arachis hypogea L)* is ranked as 13th most significant food crop and 4th in oil seed crop of the world with their kernels containing 40-50% fat, 20-50% protein and 10-20% carbohydrates (FAO, 2006). Groundnut cultivation spans 26.4 million hectares worldwide, yielding a total of 36.1 million metric tons with an average productivity of 1.4 metric tons per hectare (Girei *et al.,* 2013). Nigeria's contributions to the world, Africa, and West Africa are approximately 10%, 39%, and 51% respectively, according to ICRISAT (2015) and Audu *et al.* (2017). The cultivation of the crop spans across a total area of 5.40 million hectares, resulting in a production of 5.43 million tonnes. The productivity of this crop is measured at 910kg per hectare. The main states in Nigeria that cultivate groundnut are Adamawa, Bauchi, Benue, Borno, Gombe, Jigawa, Kaduna, Kano, Kastina, Kebbi, Nasarawa, Niger, Plateau, Sokoto, Taraba, Yobe, and Zamfara. These states collectively cultivate approximately 2 million hectares of land in the country (Audu 2017). Pyramid-shaped structures constructed from sacks filled with groundnuts were prevalent in various locations in Nigeria until the 1970s. These locations included Kofarmazugal (Kano state), Bebeji (Kano state), Malam Madori (Jigawa state), and Dawakin Kudu (Kano state). The pyramid structures served as tourist attractions in Northern Nigeria and were regarded as a symbol of affluence in the nation. These structures gradually vanished as focus shifted from agriculture to crude oil after the 1970s. The occurrence of rosette virus outbreaks in 1975, 1983, 1985, and 1988 had a negative impact on groundnut production, which discouraged farmers from cultivating it (ICRISAT, 2019).

The cultivation of the crop is currently widespread across Nigeria, except in the riverine and swampy regions (Anonymous, 2004). An ideal climate for groundnut cultivation requires a well-distributed rainfall of at least 500mm during the crop growing season, along with abundant sunshine and relatively warm temperatures. The temperature range for optimal plant development is between 25℃ and 30℃, as stated by (Weiss, 2000).

Groundnut is an economically significant cash crop that plays a pivotal role in the Nigerian economy. The production, processing, and marketing of this commodity generate employment opportunities, income, and crucial foreign currency that the country utilizes to finance its capital development (Girei *et al.,* 2016). The groundnut sub-sector offers potential for the agro-industrial advancement of the nation (Audu *et al.,* 2017). It supplies the necessary ingredients for producing edible and industrial vegetable oils, as well as groundnut cake used in livestock feed. The food can be consumed in its raw form, boiled, roasted, transformed into a paste, and also utilized in the preparation of soups and stews (Taphee and Jongur, 2015). The shells serve as a source of fuel for certain local oil factories, or they are occasionally applied to fields as a means of improving the soil. Additionally, they can be utilized as a filler in livestock feed or in the production of chipboard for joinery purposes (Mukhtar, 2009).

Statement of the Problem

Groundnut is so popular in the northern Nigeria where there were pyramids of groundnut in the 1950's and 1960's but because of the discovery of petroleum, groundnut along with some other economic crops like cocoa and palm oil trees were neglected to mere crops (Abdulahhi *et al.,* 2014). Nigeria was once the leading exporter of groundnuts in Africa during the 1970s. However, a combination of drought, rosette, and other diseases decimated groundnut production in the country (Ajeigbe *et al.,* 2015). Despite the ample availability of land and human resources in Nigeria, the yield per hectare from groundnut production has been consistently decreasing over the years. Despite extensive initiatives by the Nigerian government to rejuvenate groundnut production through research, crop improvement practices, and ample land resources, there is still an insufficient supply of groundnuts to meet the demand in both the local and international markets (Ani *et al.,* 2013). "The question now is what is the economic analysis of groundnut production in Wukari Local Government Area, Taraba State, Nigeria?" The questions are further stated below:

Research Questions

This study was guided by the following research questions;

i. What were the socio-economic characteristics of the farmers?
ii. What was the income level of the respondents?
iii. What was the gross margin of groundnut farmers in the study area?

iv. What were the determinants of technical efficiency and inefficiency of groundnut production in the study area?

Objectives of the study

The aim of this research is to analyse technical efficiency of groundnut production in Wukari local government area of Taraba State, Nigeria..

The specific objectives were to:

i. describe the socioeconomic characteristics of the respondents;
ii. examine the income level of the respondents in the study area;
iii. examine the gross margin of groundnut farmers in the study area and
iv. identify determinants of technical efficiency and inefficiency of groundnut production in the study area.

METHODS

The Study Area and Sampling Technique

The study area for this research was Wukari Local Government Area of Taraba state, Taraba state which is located in North eastern part of Nigeria and Wukari, located in the southern part of Taraba state, having a latitude of 7°51'N to 7°85'N and longitude 9°46'E to 9°78'E of the Greenwich meridian. The local government area occupies a total area of 4308km^2(1663sqmi). The local government areas share common boundaries with karim lamido, Bali and Takum LGA to the Northeast, Plateau state to the North and Benue state to the southwest. The climate of the area is marked by dry season between (November-March) and rainy season between (April-October). It has an average annual rainfall ranging between 1000mm to 1500mm and temperature range between 20°c to 40°c (Oyatayo *et al.,* 2015).

This research made use of primary method of data collection. Structured questionnaires were the major source of primary data collection. The questionnaire was designed in line with the objective of the study. A multi-stage sampling technique was employed in this study with the use of structured questionnaire. Firstly, five (5) wards were purposively selected which are: Hospital ward, Bantaje ward, Kentu ward, Puje ward and Rafin-Kada ward. In the second stage, four (4) villages were selected out of the five (5) wards. Finally, simple random sampling technique was used to select farmers from each village proportionate to size, which gives a total of one hundred and twenty (120) respondents.

Data Analysis Techniques

The data for this study was analyzed using the following; descriptive statistics was used to analyze objective (i) and (ii), gross margin analysis was used to achieve objective (iii), regression analysis using the stochastic production function to analyze objective (iv).

Model Specification

Gross Margin Analysis

Gross margin is the difference between the gross farm income (GI) and the total variable cost (TVC), and was used to achieve objective ii.

GM = GFI-TVC……...(i)

Where:

GM = Gross margin (Naira/hectare)

GFI = Gross farm income (Naira/hectare)

TVC = Total variable cost (Naira/hectare)

Stochastic Production Function

A stochastic production function was used to achieve objective (iv) and is defined by

$Y_i = f(X_i;B) \exp (V_i-U_i)$, i=1,2…..n …….. (ii)

Let Yi represent the output of the i-th farm, Xi represent the vector of input quantities used by the i-th farm, B represent a vector of unknown parameters to be estimated, and f(.) represent an appropriate function such as Cobb-Douglas or translog. The term Vi refers to a symmetric error that captures the impact of random variables on the output, such as weather, disease outbreaks, and measurement errors, which are beyond the control of the farmer. On the other hand, the term Ui represents a non-negative random variable that represents inefficiency in production compared to the stochastic frontier. The random error Vi is assumed to follow a normal distribution, with each error being independent and identically distributed.

These errors are assumed to be independent of the Uis, which are non-negative truncations of a normal distribution (specifically, a half-normal distribution) or have no exponential distribution.

The stochastic frontier model was proposed separately by Aigner, *et al.* (1976) and Meeusen and van den Broeck (1977). The technical efficiency of an individual farmer is determined

by comparing the actual output to the maximum possible output, based on the existing technology.

Technical efficiency (TE)= Y_i/Y_i*

=(f(X_i;B) exp (Vi-Ui)/ f(Xi,B) exp (Vi)=Exp (-Ui)…….(v)

Where Yi is the observed output and Yi* is the frontier output.

The parameters of the stochastic frontier production function are estimated using the maximum likelihood method.

RESULTS AND DISCUSSION

Socio Economic Characteristics of Groundnut Farmers

The socio-economic characteristics of respondents significantly influence their farming patterns (Madaki *et al.,* 2016). In this study, 61.7% of groundnut farmers were male and 38.3% female, highlighting a gender imbalance. Age-wise, 9.2% were under 20, 40% were between 21-41, and 50.8% were 41-60 years old. Most respondents (53.35%) were married, with household sizes primarily between 6-10 members (58.3%). Educationally, 53.3% had tertiary education, 27.5% had WAEC/SSCE, 15% had no formal education, and 1.7% had the first school leaving certificate. Regarding association membership, 31.7% were members, and 68.3% were not, possibly due to unawareness of the benefits. Only 26% had contact with extension agents in the last planting season, aligning with Adewuyi and Okunmadewa (2001), who noted that extension services significantly impact economic efficiency.

Financially, 75% of respondents used personal savings, 4.2% used agricultural/commercial banks, 16.7% used cooperative societies, and 4.2% borrowed from friends and relatives (Taphee *et al.,* 2015). Occupation-wise, 67.5% were farmers, 14.2% civil servants, 14.2% traders, and 4.2% artisans. Experience-wise, 51.7% had 1-10 years, 35% had 11-20 years, 10% had 21-30 years, 3.3% had 31-40 years, and 2.6% had 41-50 years of farming experience, indicating significant expertise.Most respondents (80.8%) farmed on 1-5 hectares of land, 17.5% on 6-10 hectares, and 1.7% on 11-15 hectares, indicating small-scale farming (Girei et al., 2013). Regarding land acquisition, 42.5% inherited, 15.8% leased, 13.3% received gifts, 15% purchased, and 13.3% rented land. Labor-wise, 30.8% used family labor, 22.5% hired labor, and 46.7% used both.

Table 1: Socio Economic Characteristics of Groundnut Farmers

Socio-economic Characteristics	Frequency	Percentage	Mean(Standard deviation)
Sex			
Male	74	61.7	
Female	46	38.3	
Age			
<20	11	9.2	
21-40	48	40.0	
41-60	61	50.8	39.18(±11.39)
Marital Status			
Married	64	53.3	
Single	37	30.8	
Divorced	0	0.0	
Separated	11	9.2	
Widow/widower	8	6.7	
Household size			
1-5	41	34.2	
6-10	70	58.3	
11-15	6	5.0	
16-20	3	2.5	7.1417(±3.08778)
Educational Background			
Non Formal Education	18	15.0	
Primary School	2	1.7	
Secondary School	33	27.5	
Tertiary Education	64	53.3	
Other forms of Education	3	2.5	
Members of Association			
Yes	38	31.7	
No	82	68.3	
Extension Agent Contact			
Yes	26	21.7	
No	94	78.3	
Source of Capital			
Personal Saving	90	75.5	
Agricultural /Commercial banks	5	4.2	
Cooperative /thrift society	20	16.7	
Friends and Relatives	5	4.2	
Major Occupation			
Farming	81	67.5	
Civil Service	17	14.2	
Trading	17	14.2	
Artisan	5	4.2	

Farming Experience			
1-10	62	51.7	
11-20	42	35.0	
21-30	12	10.0	
31-40	4	3.3	
Farm Size			
1-5	97	80.8	
6-10	21	17.5	
11-15	2	1.7	3.6083(±3.05770)
Land Acquisition			
Inheritance	51	42.5	
Lease	19	15.8	
Gift	16	13.3	
Purchased	18	15.0	
Rent /Hired	16	13.3	
Source of Labor			
Family Labor	37	30.8	
Hired Labor	27	22.5	
Both	56	46.7	
Total	120	100.0	

Source: Authors' compilation

Income level of the respondents

The income level of the respondents was divided into four groups <100000 which was the highest accounted for 57.5%, the second and third group, 100001-200000 and 200001-300000 respectively both accounted for 10.8% and the fourth group which is >300000 accounted for 20.8% as shown in table 2.

Table 2: Distribution of the income level of the respondents

Income	Frequency	Percentage	Mean (standard deviation)
<100000	69	57.5	**3.8076E0(±8.591E6)**
100001-200000	13	10.8	
200001-300000	13	10.8	
>300000	25	20.8	
Total	**120**	**100.0**	

Source: Authors' compilation

Gross margin of groundnut production

The result of the gross margin of groundnut production in the study area is represented in table 3. The total revenue was estimated at ₦417424.58 per hectare. The total cost of labor was ₦192,484.00/ha, this cost accounted for the highest percentage that is, 54.32% of the variable cost. The labor costs include the cost of land preparation, planting, weeding, herbicides, fertilizer application, harvesting, peeling and packaging. The wage rate varies depending on the operation that was carried out. The total cost of fertilizer per hectare was ₦35258.00/ha, this accounted for 9.95% of the total variable cost. The total cost of groundnut seed for all farmers was ₦9382.66/ha and it is accounted for 26.48% of the total variable cost. Groundnut seeds are obtained from different sources like the seed companies, stores and open market. Cost of herbicides per hectare in the study area amounted to ₦18917.00 and thereby having 5.33% of the total variable cost. Groundnut is a crop that need to be weeded twice and the adopted culture in the study area include of herbicides (agro chemical) to control weed before planting and the use of manual weeding when groundnut is in developing stage. The total cost of insecticide in the study area amounted to ₦13869.00/ha having the percentage of 3.91% of the total variable cost. The total variable cost however was ₦269910.66/ha. The total variable costs of production include cost of labor, fertilizer, seed, herbicides, and insecticide which was subtracted from the total revenue to give a gross margin of ₦147,513.92.

Table 3: Average gross margin of groundnut production

Item	Amount(₦)/ha	Percentage
Revenue	**417424.58**	
Variable cost		
Labor cost	192484.00	71.31
Seed cost	9382.66	3.48
Fertilizer cost	35258.00	13.06
Herbicide cost	18917.00	7.00
Insecticide cost	13869.00	5.15
Total variable cost (TVC)	**269910.66**	**100.0**
Gross margin (TR-TVC)	**147513.92**	

Source: Authors' compilation

Determinants of technical efficiency of groundnut production

The maximum likelihood (ML) estimates of the stochastic frontier production function parameters for groundnut are represented in table 4. The coefficients of the estimated parameters have desired signs and are statistically significant to the technical efficiency. The farm size is estimated at 0.193 and is statistically significant at 1%, fertilizer is estimated at -0.180 and is negatively significant at 5%, seed is estimated at 0.757 and is statistically significant at 1% and labor is estimated at 0.097 and is statistically significant at 5%. The ratio of the standard error of U to that of Vi called lambda is estimated at 0.029. Gamma is equal to 0.00084, this implies that 0.084% of the total variation in groundnut output is due to technical efficiency.

Table 4: **Technical efficiency of groundnut production**

Variables	**Parameters**	**Estimates**	**t-ratio**
Constant term	b_o	5.539	1.95*
Farm size (X_1)	b_1	0.193	2.89***
Fertilizer (X_2)	b_2	-0.180	-2.20**
Seed (X_3)	b_3	0.757	19.78***
Labor (X_4)	b_4	0.097	2.02**
Herbicide (X_5)	b_5	0.016	0.86
Log. Likelihood function		-235.545	
Sigma v		1.722	
Sigma u		0.051	
Lambda		0.029	

Figures in parentheses are t-ratios *=sig at 10% **=sig at 5% *=sig at 1%**

Technical inefficiency of groundnut farmers

The result on the determinants of technical inefficiency of groundnut farmers in the study area indicated that the educational level significantly influenced technical efficiency by 1%, farming experience significantly influenced the technical efficiency by 1%, the age of the

farmer is negatively significant to the technical efficiency by 10% and the area of land cultivated (farm size) significantly influenced technical efficiency of groundnut farmers by 1%. This is in agreement with the findings of Hung-Hao and Fang (2011) who pointed out that farm size have positive effect on efficiency.

Table 5: Technical inefficiency of groundnut farmers

Variables	Parameters	Coefficient	Standard error	t-ratio
Constant term	Z_0	8.036	1.569	5.12***
Educational level	Z_1	0.902	0.181	4.97***
Marital status	Z_2	-0.131	0.083	-1.57
Gender	Z_3	-0.294	0.290	-1.01
Farming experience	Z_4	0.243	0.063	3.86***
Age	Z_5	-0.068	0.038	-1.82*
Farm size	Z_6	0.695	0.037	18.70***
F value				223.80***
R-squared		0.922		
Adj R-squared		0.918		

Figures in parentheses are t-ratios *=sig at 10% **=sig at 5% *=sig at 1%**

CONCLUSION

Based on the findings from the study, it can be concluded that farm size, fertilizer, seed and labor had significant effect on groundnut production as evident from the analysis. The largest proportion of groundnut producers in the area operated on medium scale and groundnut production has proved to be a profitable business in the study area. In line with the findings of the study, the following recommendations are put forward.

i. It is recommended that groundnut producers be encouraged to increase their scale of production for increased productivity. This could be achieved if small scale farmers can come together and pool their resources together in cooperative
ii. It is also recommended that stakeholders in the sector should make provision for incentives such as in-services extension training to improve groundnut productivity.
iii. Implementing of policies that would encourage farm owners to form cooperative/organization or join the existing ones will be a big step in the right

direction. This could also reduce the cost of inputs through bulk purchase as against individual procurement of inputs thereby reducing the cost of production.

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