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ALLOCATIVE EFFICIENCY OF GROUNDNUT (*Arachis hypogea l.*) PRODUCTION IN BAUCHI STATE, NIGERIA

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Abstract

The study examines allocative (cost) efficiency of sole groundnut production in Bauchi State. It focuses on identifying the determinants of groundnut output growth, by measuring how efficient farmers are with respect to the allocation of their inputs. Data from 251 farmers were elicited using structured questionnaires via: cluster, multi-stage, purposive and simple random sampling techniques were analyzed using: descriptive statistics, and Stochastic Frontier Cost Function (SFCF). The result revealed that 61.32 % were 31-50 years, 70.12% were male, 82.87% were married and 84.06% were literate. Cost of seed used (P_2), family labour (P_3) and agrochemicals (P_5) were highly significant at 1% level, while hired labour (P_4) and cost of fertilizer was also significant but at 5% and 10% respectively. (σ^2) was significant at 10% level, LR was 36.99, (γ) was 0.80. Mean AE was 58%. Farmers were advised to be more rational in resource allocation; loans should be accessible and affordable to farmers.

Key words**:** *allocative efficiency, Bauchi State, groundnut production*

INTRODUCTION

Groundnut (*Arachis hypogeal l.*) originated from South America, but is now widely cultivated throughout the tropical, sub-tropical and temperate countries, and in Africa, Asia, North and South America. Groundnut does well on sandy – loam soil, with pH range of 5-7 and soil should be rich in calcium and phosphorus which are essential for pod formation. It has the bunch, erect and creeping type. The popular varieties in Nigeria are kano local, kano 50, Castle cary, Samnut 21, 22, and 23 (rosette resistant varieties). Groundnut can be a sole crop or intercropped. It performs better as sole crop (Idoko and Elizabeth, 2014) [13].

Allocative (or price) efficiency refers to the ability of the firm to choose its inputs in a cost-minimizing manner (Murillo-Zamorano, 2004) [15]. Allocative efficiency reflects the ability of a farmer to use the inputs in optimal proportions given their respective prices (Asogwa *et al.*, 2011) [3]. The allocative efficiency (AE) of resource was determined by checking whether or not the ratio of the marginal value product to input price was equal to 1 (Kapopo and Assa, 2012) [14].

Amos (2013) [2] asserted that allocative efficiency of resource use is critical to enhancing productivity and incomes. The major goal of any production system is the attainment of an optimally high level of output with a given amount of effort or input. For allocative efficiency to hold, farmers must equalize their marginal returns with true factor market prices. Thus, technical inefficiency is related to deviations from the frontier isoquant, while allocative inefficiency reflects deviations from the minimum cost input ratios (Bravo-Ureta and Pinheiro, 1997) [6]. According to Farrell (1957) [8] a farm is allocatively efficient when production occurs at a point where the marginal value product is equal to the marginal factor cost.

In recent time, the world continues to witness increase in groundnut output. For instance the global groundnut output in 2006 was estimated at 33, 376, 717 metric tons; in 2009 the figure was put at 37, 166, 758 metric tons;

in 2011 rises to 40, 470, 923 metric tons and further witnessed an increase to 45, 654, 289 metric tons. While the world groundnut output continues to witness sharp increase, the story seem to be different in Nigeria as the output fell from 3, 825, 000 metric tons in 2006 to 2, 977,620 metric tons in 2009, and further declined to 2, 962, 627 metric tons in 2011 (FAOSTAT, 2013) [9]. It is against this backdrop that the paper seeks; to identify and describe their socioeconomic characteristics, determine their allocative efficiency (AE) and proffer recommendations.

MATERIALS AND METHODS

Data were collected by administering well-structured questionnaires to sole groundnut farmers via scheduled interview with the farmers. A total of two hundred and fiftyone (251) sole groundnut farmers were successfully interviewed.

Sample Size and Sampling Technique

Multi-stage, cluster, purposive and simple random sampling techniques were employed in the selection of the respondents in the following order; In the first stage, Bauchi State was clustered into three zones namely, Bauchi North, Bauchi West and Bauchi Central using the Bauchi State Agricultural Development Classification. In the second stage, Cluster sampling was used to cluster each zone into Local Government Areas. In the third stage, purposive sampling was used to select villages from each local government area. In the fourth stage, random sampling was used to select the registered sole groundnut farmers as follows. The sample size from each village was determined in form of proportion of the registered farmers.

Analytical Techniques

Data collected from the sole groundnut farmers were subjected to analysis using both descriptive and inferential statistics. The descriptive statistics was used to describe the socioeconomic characteristics of the groundnut farmer. Stochastic Frontier Cost function was used in estimating the allocative efficiencies. The allocative (cost) efficiency function was derived analytically and defined as follows:

$$\mathrm{Ln}C_{ij} = \beta_0 + \beta_1 P_{ij} + \beta_2 LnP_{ij} + \beta_3 LnP_{ij} + \beta_4 LnP_{ij} + \beta_5 LnP_{ij} + V_{ij} - U_{ij} \quad (1)$$

Subscript ij refers to the j^{th} observation of the i^{th} farmer.

where: Ln = Logarithm to base e, C_{ij} = cost of production of groundnut (₦/ha), P_2 = cost of seed (₦/kg), P_3 = cost of labour (₦/ha), P_4 = cost of herbicide (litres/ha), P_5 = cost of pesticide (₦/kg), P_6 = cost of fertilizer (₦/kg), Allocative inefficiency frontier model is given as:

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

where:
U_i= non-negative random variables associated with technical inefficiency of production,
Z_1 = age of farmers, Z_2 = formal education (formal education=1, no formal education =2). Z_3 = years of farming experience, Z_4 = annual farm income of farmers (₦), Z_5 = extension contact (number of time or if there is no contact), Z_6 = household size (number of persons in a household), Z_7 = variety of groundnut used (improved variety = 1, local variety = 0).

RESULTS AND DISCUSSIONS

Socioeconomic Characteristics of the Respondents

Age. The age distribution of the respondent is presented in Table 1**.** 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 is 22 years while their mean age was 42.42 years. 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. This is in line with Battese and Coelli (1995) [4] and Otitoju and Arene, 2010) [18] who found a positive relationship between farmer's age and inefficiency.

Table 1. Age distribution of the respondents

Age	Frequency	Percentage
≤ 20	13	5.18
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**
Mean=42.42 Max. = 65	Min. = 22	

Source: field survey: 2015

Gender. The gender distribution of the respondents is presented in Table 2. 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) [18] also found that male significantly aid in security and wellbeing of the family; planning agriculture and many other aspects of rural life.

Table 2. Gender distribution of the respondents

Gender	Frequency	Percentage
Male	176	70.12
Female	75	29.88
Total	**251**	**100**

Source: field survey: 2015

Marital status of the respondents. Marital status of the respondents is presented in Table 3.

Table 3. Marital status distribution of the respondents

Status	Frequency	Percentage
Single	27	10.76
Married	207	82.87
Widower	14	5.58
Divorcee	2	0.79
Total	**251**	**100**

Source: field survey: 2015

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.

Educational levels of the respondents. Table 4 presents distribution of educational levels of the respondents. Analysis of the level of education of the respondents in the study area revealed that 37% of them had attended secondary schools, 31.08% had attained tertiary institutions and 15.05 % attended primary schools, while 12.35% had Quranic education. This implies that given a functional and effective extension service at their disposal, there exist a high tendency of assimilation of extension package among them, consequently leading to high rate of efficiency Sichoongwe *et al*. (2014) [21], Ghimire *et al*. (2014) [10]. According to Musa *et al.* (2016) [16], Ojo *et al.* (2013) [17], Wainaina *et al*. (2014) [22] educated farmers have the ability to understand profits associated with use of improved varieties Ghimire *et al*. (2015) [10].

Table 4. Educational level distribution of the respondents

Education	Frequency	Percentage
Uneducated	9	3.59
Quranic	31	12.35
Primary	40	15.94
Secondary	93	37.05
Tertiary	78	31.08
Total	**251**	**100**

Source: field survey: 2015

Table 5. Farming experience (years)

Farming experience	Frequency	Percentage
1-5	98	39.04
6-10	79	31.47
11-15	24	9.56
16-20	32	12.7
>20	18	7.17
Total	**251**	**100**

Source: field survey: 2015.

Farming experience of the respondents. The farming experience of the respondents is presented in Table 5. The result revealed that majority (39.04%) of them had farming experience of 1-5 years, 31.47% had between 6-10 years, 9.56% had 11-15 years, while 12.75% and 7.17% were within the ranges of 16-20 and >20 years respectively. This implies that sole groundnut farmers have wealth of farming experience capable of boosting their efficiency level and productivity as well. This conforms to the findings by; Otitoju and Arene (2010 [17], Adeyemo *et al.* (2010) [1], Idiong *et al.*

(2009) [12] and Ekunwe *et al*. (2008) [7], Rahji (2005) [18], who reported that age and years of farming experience improve efficiency as a result of "practice makes perfect".

Sources of Capital of the respondents. The distribution of the sources of capital of the respondents is presented in Table 6. The analysis on the respondents' sources of capital for sole groundnut farming activities revealed that bulk (71.31%) of their capital came from their personal savings, 13.55% through borrowing from friends and relatives, and 10.76% from Bank of Agriculture, while only 3.58% obtained loan from commercial banks. The implication is that farmers in the area had poor access to formal farm credit. This is in agreement with findings of Idachaba (2006) [11], who asserted that poor access to formal farm credit constitute a major constraint militating against the rural farmers' agricultural productivity.

Table 6. Sources of capital of the farmers

Source	Freq.	Percentage
Personal savings	179	71.31
Borrowing	34	13.55
Comm. Bank Loan	9	3.58
Bank of Agric.	27	10.76
Money lenders	2	0.79
Total	**251**	**100**

Source: field survey: 2015

Allocative Efficiency Estimation. The maximum likelihood estimate of the stochastic frontier cost function is presented in Table 7. The maximum likelihood estimates of the stochastic frontier cost function shows that the entire coefficient were positive and thus conform to the apriori expectations. All the coefficients were significant except for farm size (P_1) which was not significant. Costs of seed used (P_2), family (P_3) and agrochemicals (P_5) were highly significant at 1% level, while hired (P_4) and chemical fertilizers (P_6) were also significant but at 5% and 10% respectively.

Cost of seed (P_2) was significant at 1% implying that it is an important variable in the estimation of the total cost of groundnut in the study area. The coefficient of seed was 0.1487 means that unit increase in the cost of seed would result into 1.487% increases in the total cost of production in the area and vice versa.

Cost of family labour (P_3) was also highly significant at 1% and the cost coefficient of family labour was 1.8895. This implies that a unit increase in the estimated cost of family labour would result in the total cost of groundnut production increasing by 1.89% in the area. Cost of hired labour (P_4) was also significant but at 5% level. The coefficient of hired labour was 2.7412, signifying that a unit increase hired labour would account for 2.74% increase in the estimated total cost of production of sole groundnut in the area.

Cost of agrochemicals (P_5) was also significant at 1% with a coefficient of 3.4630, means that a unit increase in the cost of agrochemicals would account for 3.46% increase in extra total cost of production. Cost of fertilizer (P_6) was significant but at 10%, with a coefficient of 1.2435, implying that 1.24% increasing in total cost of production was accounted by a unit increase in the cost of fertilizer in the production of groundnut.

Similarly, the inefficiency effects revealed that all the coefficients were negative and thus carry the expected sign except for extension contacts (z_5) and variety of seed (z_7) which were found to be positive. A negative coefficient implies positive effect on cost efficiency and vice-versa. This signifies that with the exception of the contact with extension agent (z_5) and variety of seed (z_7), all other variables had influence on the sole groundnut farmers' efficiency in cost allocation. Age of the farmers and their farm income seem to have a very high influence on their cost efficiencies, as they were statistically significant at 1%. This means that any change in the two mentioned variables would affect their efficiencies accordingly. This is also in agreement with findings of Biye (2016) [5] and Idachaba (2006) [11], who affirmed a positive relationship between farm income and efficiency.

The estimated coefficient of age of the farmers was negative and statistically significant at 1% indicating that increase in ages of the farmers tend to decrease cost inefficiency in sole groundnut production. Farming

experience (z_3) and variety of groundnut seeds (z_7) used were also found to be insignificant. This implies that farming experiences and the variety of seed used does not influence their allocative efficiencies. However, years of formal education (z_2) and extension contact were statistically significant at 10%, while household size was statistically significant at 5%. Extension contact and formal education can positively influence their ability on rational resource allocation.

This is in line with; Adeyemo *et al.* (2010) [1], and Shehu *et al.* (2010) [20], who asserted that educated farmers, are more likely to adopt progressive farming practices and new technologies and thus increase their overall efficiency.

Sigma squared (σ^2) was also significant at 10% level, implying the presence of good fit and the correctness of the distributional form assumed for the composite error term in the model. Gamma (γ) was found to be 0.80 and is statistically significant at 10%. This means that 80% variation in output was accounted by variation in their efficiency in cost allocations.

Table 7. Maximum Likelihood Estimates of the Stochastic Frontier Cost Function

Variable	Parameter	Coefficient	Stand. error	t-ratio
Cost factors				
Constant	β_0	3.4305	0.2910	11.7878***
farm size (P_1)	β_1	0.0552	0.1059	0.5208
seed (P_2)	β_2	0.1487	0.0420	3.5407***
family labour (P_3)	β_3	0.0189	0.0039	4.8878***
hired labour (P_4)	β_4	0.0274	0.1119	2.4497**
agrochemicals (P_5)	β_5	0.0346	0.0062	5.5770***
fertilizers (P_6)	β_6	0.0124	0.0042	2.9512*
Inefficiency Effects				
Age (z_1)	δ_1	-0.1143	0.0199	-5.7325***
Formal education (z_2)	δ_2	-0.0319	0.0177	-1.8111*
Farming experience (z_3)	δ_3	-0.0230	0.0425	-0.4788
Farm income (z_4)	δ_4	-0.1435	0.0342	-4.2031***
Extension contact (z_5)	δ_5	0.0153	0.0104	1.4797*
Household size (z_6)	δ_6	-0.2491	0.1124	-2.2173**
Variety of seed (z_7)	δ_7	0.0724	0.1351	0.5362
Diagnostic statistics				
Sigma squared	σ^2	0.2822	0.0187	15.1041*
Gamma	(γ)	0.7953	0.2664	2.9853*
Log Likelihood Ratio	L LR	36.99		

Source: Computer output from Frontier 4.1
***Significant at 1% level; **Significant at 5% level; *Significant at 10% level

Allocative Efficiency of the Sole Groundnut Farmers

Table 8. Allocative Efficiency of the Sole Groundnut Farmers

Range of Allocative Eff.	Freq.	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**

The allocative efficiencies of the sole groundnut farmers deduced from the stochastic frontier cost function are presented in Table 8.

The result revealed that a wide variation in allocative efficiency exist among them, as the minimum allocative efficiency recorded was between 0.30 and 0.39, whereas the maximum was between 0.90 – 0.99. The mean AE 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%). This shows that there exists a very wide variation in allocative efficiency among the sampled population.

CONCLUSIONS

Majority (61.32%) of the sole groundnut farmers were adult male (70.12%) and were married (82.87%). Also most of them are literates as only (3.59%) of them can neither read nor write. They had a mean farming experience of 19 years. They have poor access to farm credit as only 10.76% and 3.58% of them were privileged to get loan from Bank of Agriculture and Commercial banks respectively.

Although the sole groundnut farmers were slightly efficient in resource allocation, there exists a wide variation in AE, with a mean AE of 0.58 (58%). However, there is still room for improvement by 42% through more rational allocation of inputs, diversifying their sources of quality inputs at affordable price. Farm size was insignificant. A unit increase in costs of; agrochemicals and hired labour will result to increase in the total cost of sole groundnut in the area by 3.46% and 2.74% respectively. 80% variation in output can be explained by their efficiency in cost allocations

From the foregoing analysis, it is recommend that:

(i)Farmers should improve their cost efficiency through rational resources allocation in such a way that inputs such as hybrid seeds, fertilizers and herbicides are procured at the least cost possible without compromising quality and also from certified sources.

(ii)Government and stakeholders in agriculture, notably groundnut production should increase farmers' access to farm loans so as to boost productivity in the area.

(iii)Farmers are advised to expand production by putting more land under cultivation and also form cooperative in order to drastically cut cost of hired.

REFERENCES

[1] Adeyemo, R., Oke, J. T. O., Akinola, J. T. O., 2010, Economic Efficiency of Small Scale Farmers in Ogun State, Nigeria. Tropicultura 28 (2).

[2] Amos, A. P., 2013, Allocative Efficiency of Resource Use by Cassava Farmers in Wamba Local Government Area, Nasarawa State, Nigeria. International Journal of Economic Development Research and Investment, Volume 4, Number 3, December 2013.

[3] Asogwa, B. C., Ihemeje, J. C., Ezihe, J. A. C., 2011, Technical and Allocative Efficiency Analysis of Nigerian Rural Farmers: Implication for Poverty Reduction. Agricultural Journal Vol. 6 (5) pp. 243-251.

[4] Battese, G. E., Coelli, T. J., 1995, A Model for Technical Inefficiency Effects in Stochastic Frontier Production Function for Panel Data. Empirical Economics 20: 325 - 332.

[5] Biye, S. U., 2016, Analysis of Production Efficiency and Profitability among Groundnut (*Arachis hypogea l.*) Farmers in Bauchi state, Nigeria. Unpublished PhD Thesis, Department of Agricultural Economics & Extension, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria

[6] Bravo-Ureta, B., Pinheiro, E., 1997, Technical, Economic, and Allocative Efficiency In Peasant Farming: Evidence From The Dominican Republic. The Developing Economies.

[7] Ekunwe, P. A., Orewa, S. I., Emokaro, C.A., 2008, Resource Use Efficiency in Yam Production in Delta and Kogi States of Nigeria. Asian Journal of Agricultural Research 2(2): 187-201.

[8] Farrell, M. J., 1957, The Measurement of Productivity Efficiency. Journal of the Royal Statistical Society, Series A, Vol. 120, Part 3, pp.253- 90.

[9] FAOSTAT (2013). Factfish Peanuts, production Quantity for World. www.factfish.com/statistic country/world/peanuts, production.

[10] Ghimire, R. G., Wen-Chi, H. U., Hrestha, R. B. S., 2015, Factors Affecting Adoption of Improved Rice Varieties among Rural Farm Households in Central Nepal. Rice Science 22(1):35-43.

[11] Idachaba, F. S., 2006, Rural Development in Nigeria: Foundations of Sustainable Economic Development. Ife Journal of Agriculture, 8: 111 – 118.

[12] Idiong, I. C., Agom, D. I., Effiong, E. O., Ohen, S. B., 2009, Analysis of Technical and Economic Efficiencies in Rice Production Systems in the Niger Delta Region of Nigeria. In Sustaining Agricultural Growth to Meet National Economic Development Goal. Proceedings of the 23rd Annual Conference of Farm Management Association of Nigeria (FAMAN).

[13] Idoko, M. D., Elizabeth, S., 2014, Challenges in Groundnut Production and Adoption of Groundnut Production Technology Information Packages among Women Farmers. Agriculture and Biology Journal of North America, http://Www.Scihub.Org/Abjna. Vol. 5 (6) pp.252-258

[14] Murillo-Zamorano, L., 2004, Economic Efficiency and Frontier Techniques.Journal of Economic Surveys 18(1): 33–77.
[15] Musa H. A., Mesfin, H. M., Abady, S., W. Mesfin, Kebede, A., 2016, Adoption of Improved Groundnut Seed and its Impact on Rural Households' Welfare in Eastern Ethiopia. Cogent Economics & Finance, Vol.4(1): 1-13.
[16] Ojo, C. O., Ghide, A., Phanuel, A., 2013, Gender Resource Accessibility and Profitability among Groundnut Producers in Hong Local Government Area of Adamawa State, Nigeria. Asian Journal of Agriculture and Rural Development 3(9):650-656.
[17] Otitoju, M., Arene, C. J, 2010, Constraints and Determinants of Technical Efficiency in Medium-Scale Soybean Production in Benue State, Nigeria. *Africa* Journal of Agricultural Research 5(17): 2276–2280.
[18] Rahji, M. A. Y., 2005, Determinants of Efficiency Differentials in Lowland Rice Production Systems in Niger State, Nigeria. Ibadan Journal of Agricultural Research 1(1): 7-17.
[19] Shehu, J. F., Iyortyer, J. T., Mshelia, S. I., Jongur, A. A. U., 2010, Determinants of Yam Productivity and Technical Efficiency among Yam Farmers in Benue State, Nigeria. Journal of Social Science (2) pp 24.
[20] Sichoongwe, K., Mapemba, L., Tembo, G., 2014, The Determinants and Extent of Crop Diversification among Smallholder Farmers: A Case Study of Southern Province, Zambia. International Food Policy Research Institute Working Paper 5:1-14.
[21] Vincent, K., Assa, M., 2012, Economic Analysis of Groundnut Production in Kasungu District, Malawi: A Production Economics Approach. University of Malawi. Online at http://mpra.ub.uni-muenchen.de/41593/ MPRAP
[22] Wainaina, P., Songporne, T., Matin, Q., 2014, Improved Seeds, Fertilizer or Natural Resource Management? Evidence from Kenya's Smallholder Maize Farmers. Paper Prepared for Presentation at the EAAE 2014 Congress Ljubljana, Slovenia.