GROUNDNUT PRODUCTIVITY AND RETURN TO SCALE AMONG SMALLHOLDER FARMERS.

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ABSTRACT
Groundnut production in Nigeria is characterized by low yields, averaging about 500 kg per ha, despite potential yields of 3000 kg per ha; production is mostly at subsistent level, hence it becomes pertinent to mitigate this output deficits. Therefore, this study analyzed groundnut productivity and return to scale among smallholder farmers in Kanke, Plateau state, Nigeria. Primary data collected via multi-stage sampling from 150 respondents were analyzed using descriptive statistics, Farm budget model, Total Factor Productivity (TFP) index and Double-log Production function. The results of the study revealed that the socioeconomic factors of the respondents significantly affected groundnut production in the study area. The estimated net farm income was ₦56,050ha^{-1} and benefit cost ratio is 0.59. Furthermore, 63.3% of the smallholders were sub-optimally productive as their TFP indices were below the optimal scale; attributable to sub-efficient input mix and cost of production inputs. The coefficient of multiple determinations (R^2) was 0.736 implying that about 74% of the variation in the output of groundnut was accounted for by the variables in the regression model. The estimated value of returns to scale was 0.876($\sum \rho<1$); indicating a decreasing returns to scale. All the constraints identified were economically important and critically affected groundnut production in the study area. This study recommends improved access to agricultural credit and capital; adoption of improved practices and technologies; input subsidy and supply; improved extension services; policy modification and initiation of interventions and programs to boost sustainable groundnut production.

Keywords: Constraints, determinants, total factor productivity, profitability, production elasticity, yield.

1.0 INTRODUCTION

Groundnut (*Arachis hypogaea*) is a member of the genus *Arachis* in the family *leguminosae*. As a leguminous crop, it has high nutritional potentials; it contains high quality edible oil (50%) protein (25%) and carbohydrate (20%). China, India, Nigeria, USA, Indonesia and Sudan are major producers of groundnut (National Peanut Council, 2006; Mukhtar, 2009). It is the 6th most important oil seed crop in the world (FAO, 2006; Weiss, 2000). It is a cash crop providing income and livelihoods to farming households in most developing and developed countries (Alabi *et al*., 2013). The groundnut sub-sector provided the key opportunity for the agro industrial development of Nigeria and contributed to the country's foreign exchange earnings. Groundnut export accounted for about 70% of total export earnings in Nigeria, making it the country's most valuable single export crop ahead of other cash crops like cotton, oil palm, cocoa and rubber, it has contributed significantly to the development of the nation's GDP (NBS, 2007).In some cases, groundnut plant is being referred to as "multipurpose crop". Groundnut kernels are consumed directly as raw, roasted or boiled. Oil extracted from the kernels is used as culinary oil. The cake obtained after pressing out the oil is used in feeding livestock. Groundnut kernel also provides nutritious fodder (haulms) in livestock rations. Also the leaves and straws are used in feeding livestock in their green and dry forms or in making chipboard for use in joinery (Mukhtar, 2009; Hamidu *et al*., 2006; Taru *et al*., 2010). It is also processed into or included as an ingredient in a wide range of other products and local diets which includes; groundnut paste, groundnut cake (*kulikuli)*, groundnut porridge made with millet (*kunungyada)*, groundnut candy *(kantungyada)* and groundnut soup (*miyargyada)*. The shells are used for fuel by some local oil factories or they are sometimes spread on the field as a soil amendment. The uses of groundnut plant make it an excellent cash crop for domestic markets as well as foreign trade in several developing and developed countries (FAO. 2006). Groundnuts are also important in the confectionary trade and the stable oil is preferred by the deep-frying industries. The oil is also used to make margarine and mayonnaise. Confectionary products such as snack nuts, sauce, flour, peanut butter and cookies are made from high quality nuts of the crop. The crop, despite its names and appearances, it is not considered as a nut but rather a legume with high oil and protein content Mukhtar, 2009). The crop is essentially cultivated in both tropical and sub-tropical countries. Groundnut believed to be the most popular and widely cultivated legume in Nigeria because of its adaptation to varied climatic conditions (Girei *et al*., 2013). In Nigeria, groundnut is either cultivated sole or in mixtures with other crops like maize, sorghum, millet or cassava; the leading producing states include Niger, Kano, Jigawa, Zamfara, Kebbi, Sokoto, Katsina, Kaduna, Adamawa, Yobe, Borno, Taraba, Plateau, Nasarawa, Bauchi, and Gombe States (NAERLS, 2011; Garba *et al*., 2002). FAO (2011) reported that developing countries constitute 94% of the global production of groundnut. It further reported that the production of the crop is concentrated in Asia and Africa, where the crop is mostly grown by small-scale farmers under rain-fed conditions with limited inputs.

Groundnut is grown on 26.4 million hectares worldwide, with a total estimated output of 37.1 million metric tons. Nigeria is the third highest producer of groundnut in the world after China and India with a production of 16.1million metric tons, 6.9million metric tons and 2.9million metric tons respectively in 2011. Groundnuts are cultivated on more than 2 million hectares of farmland annually; with pod yields ranging from 1000-3500 kg/ha (FAO, 2011).It is estimated that over 80% of the farm holdings in Nigeria are in subsistent scale. In developed countries, groundnut yield is improved through the development, dissemination and efficient use of resources coupled with improved varieties whose yield range from 2.8 to 6.1 tons per hectare. According to National Agricultural Extension Research and Liaisons Services (NAERLS, 2011) groundnut yield in Nigeria has generally been poor due to a combination of several factors despite the availability of productive land potentials. Studies have shown that, there is a shortfall of over 80% of groundnut requirement for both domestic consumption and by agro industries involved in processing and marketing of the commodity (Ani *et al*., 2013). This large gap between actual and potential yields is also attributable to factors such as; poor access to improved varieties for particular ecologies, inappropriate crop management practices, pests and diseases, climate variability, poor access to production technology and inputs, crop improvement practices, increased non-supportive farm policies and inadequate market linkages have negatively impacted on groundnut production (Audu *et al*., 2017). Groundnut production in Nigeria is mostly at subsistent level, using traditional methods and employing low yielding varieties with low yields per hectare (Girei *et al*., 2013; Taru *et al*., 2010). Therefore there is a critical need to reverse this negative trend, with a view to improving groundnut production. This is in-spite of efforts by various research institutes such as The Institutes for Agricultural Research, (IAR) Samaru, Zaria. National Agricultural Extension Research and Liaisons Services (NAERLS) and International Crop Research Institutes for Semi-Arid Tropics (ICRISAT) in developing improved species and management practices that will ensure sustainable production of the crop. It is important to find out the extent these factors influence firm efficiency and returns to scale of the farmers so that specific policies may be designed to step up their output level. Groundnut pod yields from farmer's field are low, averaging about 500 kg per ha; less than the potential yield of 3000 kg per ha. This yield deficit is of concern and it against this backdrop that we seek to analyze the following specific objectives;

i. describe the socioeconomic profile of the respondents;
ii. estimate the costs and return of groundnut production;
iii. evaluate the level of groundnut productivity;
iv. determine the input and output relationship in groundnut production;
v. estimate the returns to scale in groundnut production; and
vi. identify the constraints of groundnut production.

2.0 METHODOLOGY

2.1 Study Area

The study was carried out in Kanke Local Government Area (LGA) of Plateau state, Nigeria; with coordinates between latitude $9^0 21'18''$N and longitude $9^0 42'4''$E. The Local Government Council headquarters is located in Kwal. Kanke LGA consists of four districts; Kabwir, Amper, Ampang, and Garram. It covers an estimated land area of 926km^2 and a population of 121,424 (NBS, 2013). Average rainfall per annum is 1,280mm, with an average temperature of 27^0C. The major food crops cultivated in the study area include; groundnut, sorghum, millet, upland rice, maize, yam and cocoyam (FAOSTAT, 2010). They are also involved in domestic rearing of various livestock such as; cattle, goat, poultry, piggery and dogs.

2.2 Sampling Procedure

Multistage sampling technique was used to select respondents for the study. The first stage involved the purposive selection of Kanke out of the 17 LGAs in the State; due to the prevalence of smallholder groundnut farmers in the area. The second stage involved the selection of two (2) districts (Amper and Ampang) in the LGA; also, two (2) communities from each of the selected districts [Amper (Gwamlar and Pibwir) and Ampang (Goktok and Shaktu)] where purposively selected; due to the prevalence of sole based groundnut production systems. The last stage involved the systematic random selection of smallholder groundnut farmers, using the compiled list by the local enumerators in the selected districts and communities, at constant proportionality of 0.1 (10%); which is the constant ratio or fraction of variable quantity to another to which it is proportional, one hundred and fifty (150) respondents were selected for the study from a sample frame of 1,513 smallholders; and validated using raosoft sample size calculator at 99% confidence level and 10% margin error. The distribution is presented in Table 1.

Table 1: Sample Frame and Size Distribution

S/No	District	Communities	Sample frame	Sample size (10%)
1	Amper	Gwamlar	460	46
		Pibwir	391	39
2	Ampang	Goktok	288	28
		Shaktu	374	37
	Total		1,513	150

Source: Field Survey (2020)

2.2 Method of Data Collection
Data was collected using a well-structured questionnaire designed in line with the objectives of the study.

2.3 Analytical Techniques
Descriptive and inferential statistics were adopted in this study. Primary data collected was analyzed using descriptive statistics (frequency counts and percentages), Farm budget model (costs and returns analysis), Total Factor Productivity (TFP) index, Regression analysis (Double-log Production function model). The return to scale in groundnut production was estimated using the elasticity of production factors (production elasticity).

2.3.1 Farm Budget Model (Costs and Returns Analysis)
The costs and returns analysis was used to determine the net farm income per hectare, as adapted by (Girei *et al*., 2013); explicitly the farm budgeting model is presented in equation (1) as:

N.F.I=TR-TC….. (1)

Where; Net Farm Income (NFI) [Nigerian Naira (₦)]; Total Revenue (TR) (₦); Total Cost (TC) (₦)

The equations for computing the components for the estimation of NFI are presented in equations (2), (3) and (4) as:

$TR = P_Y.Y$…... (2)

Where: P_Y = unit price of output produced (₦); Y = quantity of output (kg)

TC=TVC+TFC ….. (3)

Where: TVC=total variable cost (₦); TFC=total fixed cost (₦)

$TVC = P_X.\ X_I$….. (4)

Where: P_X = unit price of variable input (kg or liter); X_I = quantity of i_{th} input (kg/liter)

TFC = farm improvements +depreciation cost of farm implements, assets etc. (₦).

The depreciation values were computed using the straight line method of depreciation and is presented in equation (5) as:

Depreciation (₦) = cost – salvage value/number of years ……….. (5)

2.3.2 Profitability Ratios
To determine the financial performance and sustainability of groundnut production in the study area, the benefit-cost ratio was estimated using equation (6):

Benefit-cost ratio = NFI ÷ Total cost ………. (6)

Where: NFI = Net farm income; TC=total cost

2.3.3 Total Factor Productivity
Total factor productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs (Fakayode *et al*., 2008). This can be computed following Key and McBridge (2005) as the ratio of the output to the total variable cost (TVC) and presented in equation 7 as;

$$\frac{\text{TFP}}{\text{TVC}}=\frac{Y}{TVC}=\frac{Y}{\sum PiXi} \text{ ………. (7)}$$

Where: Y = quantity of output; TFP = Total Factor Productivity; TVC = total variable cost; Pi = unit price of the ith; variable input; and Xi = quantity of ith variable input. This methodology ignores the role of total fixed cost (TFC) as it does not affect either the profit maximization or the resource-use efficiency conditions (Fakayode *et al*., 2008). Therefore, equation 7can be rewritten and presented in equation 8 as;

$$\text{TFP}=\frac{Y}{AVC} \text{ ………. (8)}$$

Decision Rule: TFP index can be interpreted as follows; (< 0.1) = Sub-optimal; (1.0 – 1.09) = Optimal; and (≥1.10) Super-optimal

2.3.4 Regression Analysis
Inputs and output relationship in groundnut production was analyzed using the regression model. The double-log function gave the best fit and was chosen as the lead equation on the basis of the number of significant variables, magnitude of the coefficients, statistical and econometric criteria. The model in its explicit form is presented in equation (9) as:

$$\text{LogY} = b_0+b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5+ b_6\log X_6 + b_7\log X_7 + e_i \text{…... (9)}$$

Where: Y = groundnut output (kg/ha); b_0 = Constant term; $b_1 – b_7$ = Regression coefficient to be estimated; X_1= gender (male=1, female=0); X_2 = Farm experience (years); X_3= farm size (ha); X_4= Labour input (man-days); X_5= seed (kg); X_6= Fertilizer (kg); X_7= Herbicides (litre); and e_i = Error term

2.3.5 Return to Scale (RTS)
It refers to the change in output as a result of a given proportionate change in all the factors of production simultaneously. It is a long run concept as all the variables are varied in quantity. Returns to scale are increasing or constant or decreasing depending on whether proportionate simultaneous increase of input factor's results in an increase in output by a greater or

same or small proportion. Elasticity of production is used to estimate returns to scale and presented in equation (10):

Elasticity of production ($\sum\rho$) = %change in output (%$\Delta\Upsilon$) / %change in input (%$\Delta\chi$) …… (10)

It can also be estimated in terms of the relationship between Marginal Physical Product (MPP) and Average Physical Product (APP) and presented in equation (11):

$\sum\rho = \frac{\Delta\Upsilon}{\Upsilon} \div \frac{\Delta\chi}{\chi}$…... (11)

Also, presented in equation 12 as;

$\sum\rho = \frac{\Delta\Upsilon}{\Delta\chi} \div \frac{\chi}{\Upsilon}$ …... (12)

Given that;

$\frac{\Delta\Upsilon}{\Delta\chi} = MPP$; and $\frac{\chi}{\Upsilon} = 1/APP$ …... (13)

Therefore;

$\sum\rho = MPP\ /\ APP$ …... (14)

However, in production function the return to scale is obtained by the summation of elasticity coefficients of the independent variables as adapted from Reddy *et al*., 2004 and presented in equation (15) as:

$\sum\rho^k = RTS^k$…….. (15)

Where:$\sum$=Summation sign; $\sum\rho^k$= Elasticity coefficient of k variable; and RTS= Returns to scale

Decision Rule:

If $\sum\rho^k > 1$, it denotes increasing returns to scale;

If $\sum\rho^k = 1$, it denotes constant returns to scale; and

If $\sum\rho^k < 1$, it denotes decreasing returns to scale.

3.0 RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics

Table 2 shows the socioeconomic profile of groundnut farmers in the study area. The results revealed that the mean age of the respondents is 36 years; implying that most groundnut farmers in the study area were in their economically active age and thus will be able to undertake rigorous activities of groundnut cultivation. Similarly they will accept and adopt new innovation and technologies faster. This is in conformity with the position of Musa, *et.al*. (2010) who also reported a similar result in their study on crop production. Average household size was 8 people. This has a relationship with family labor supply typified of the agrarian community. Similarly, it implies labor availability for farming activities; this is in conformity with the position of Onuwa *et.al*. (2020) who reported that, the higher the household size the more the supply of family labor and less cost on hired labor required for production activities. The mean farming experience is 12years; implying that the respondents had adequate experience necessary for increased production. The good use of experience comes in the form of management, planning and decision making in the farm operations and activities. It is also very important in terms of coordinating farm activities. This shows that the managerial ability of farmers can be inferred to be reasonably good. The more experienced a farmer is the more efficient his decision making processes and more he will be willing to take risks associated with adoption of innovation to increase his production. Farming experience is the act of gaining knowledge through constant practicing of skill, which brings about specialization. Experience enhances more efficient use of scarce resources by smallholders. This result corroborates with Girei *et al*., 2013; Alabi *et al.,* 2013 who also reported similar results in their respective studies on groundnut production. The average farm size of the respondents was 1.3ha; implying that most of the respondents had smallholdings and as such subsistent production was prevalent in the study area. The smallholding was attributable to the land tenure systems, resulting to land fragmentation. This corroborates with (Madaki *et al*., 2016) who reported that agricultural production is still highly dominated by the small scale farmers. An average of 117 man-days of labour per hectare was employed by the respondents on their groundnut farms; implying that groundnut production is relatively labour intensive. This result corroborates with (Girei *et al*., 2013; Alabi *et al*., 2013) who also reported similar results in their respective studies on groundnut production. The average quantity of seed used per hectare was 70kg.The germination percentage is usually low so more seeds per hectare are usually required to ensure germination. This increases the cost of seeds and reduces profitability. This result corroborates with the findings of Onuwa *et al*. (2018); Mailumo *et al*. (2017); and Girei *et al*. (2013) who also reported similar results in their respective studies on groundnut production. The mean quantity of fertilizer applied per hectare was 350kg; implying that fertilizer application improved yield potentials; however, application was grossly inadequate. Organic (poultry) manure was more available and affordable in the study area and was applied usually without scientific recommendation (Ibrahim *et al*., 2012).The average quantity of herbicides used was 6 litres; which is grossly inadequate. This is an indication that weed management is an important practice in crop production. Weed infests farm fields after sowing; they compete for soil nutrients and eventually mitigate crop yield. The farmers rarely used pesticides on their farms. According to (Ibrahim *et al*., 2012) manual weeding was labour intensive; hence, application of herbicides improved firm efficiency. The average yield recorded by the farmers was 605kg ha-1, which is very low as compared to global average yields estimated at 2000Kg ha-1 and potential yields of 3000 kg ha-1 is also attainable under improved management systems (FAO, 2011).

Table 2: Summary Statistics of Respondents Socioeconomic Profile

Factors	Mean
Age	36
Household size (population)	8
Farming experience (years)	12
Farm size (ha)	1.3
Labour (man-days)	117
Seed quantity (kg/ha)	70
Fertilizer (kg/ha)	350
Herbicide (liters/ha)	6
Yield (kg/ha)	605

Source: Field Survey (2020)

3.2 Profitability (Costs and Return) Analysis

Table 3 revealed that the gross output per hectare was 605kg.The costs and return analysis reveals that total cost of groundnut production per hectare was estimated as ₦95,200, while the estimated total revenue was ₦151,250 ha^{-1}. The estimate of net farm income was ₦56,050 ha^{-1}, suggesting that groundnut production in the study area was a relatively profitable venture. From the analysis, the estimates of total variable and fixed costs were ₦77,700 ha^{-1} and ₦17,500 ha^{-1} respectively. The major cost components in groundnut production were fertilizer (54.1%), farm improvement (15.2%) and seed (11%).The estimated benefit-cost ratio was ₦0.59. This indicates that for every ₦1 naira invested in groundnut production the farmer should earn ₦0.59; implying that groundnut production in the study area was relatively profitable. This result is in conformity with the works of Girei *et al*., 2013; RMRDC, 2004 and Ani *et al*., 2013 who also reported similar results in their respective studies on groundnut production.

Table 3: Costs and Return Analysis for Groundnut Production (₦ ha^{-1})

Variables	Amount (₦/ha)	%
(A) Returns:		
Gross output 605 ha^{-1}		
Price/kg ₦250		
Total Revenue (TR)	151,250	
(B) Variable cost (VC):		
(i) Labour	8,500	8.9
(ii) Seed	10,500	11.0
(iii) Herbicides	7,200	7.6
(iv) Fertilizer	51,500	54.1
Total Variable cost (TVC)	77,700	
(C) Fixed cost (FC):		
(vi) farm asset depreciation	3,000	3.2
(vii) Farm improvement	14,500	15.2
Total fixed cost(TFC)	17,500	
Total cost (TC)	95,200	100
(D) Net farm income (NFI)	56,050	
(E) Profitability ratio:		
Benefit-cost ratio (NFI/TC)	0.59	

Source: Field Survey (2020)

3.3 Groundnut Productivity

The summary statistics of the TFP result in Table 4 revealed that most (63.3%) of groundnut farmers were sub-optimally productive as their TFP indices were below the optimal scale, which indicates sub-optimal input mix and allocation in the production process; 36.3% were found to be optimally productive as indicated by their TFP indices and 13.7% were super-optimally productive as their TFP indices were above the optimal scale. The low productivity could be attributed to the sub-efficient practices adopted by the groundnut farmers and utilized in their input mix, which yielded low groundnut output in their respective farms in the study area. This corroborates with the findings of Fakayode *et al*., 2008 who also reported a similar result in their study on Agricultural Productivity Profiles in Nigeria.

Table 4: Distribution Based on Total Factor Productivity

Productivity index	Frequency	%
Sub-optima (<1.00)	95	63.3
Optima (1.00-1.09)	40	26.7
Super-optima (>1.10)	15	1.0

Source: Field survey (2020)

3.4 Determinants of Groundnut Production

Table 5 presented the regression (double log function) analysis that determined the input and output relationship in groundnut production. The F-ratio (4.613) is significant at 5% (P<0.05) level, implying that the regression model significantly predicts the outcome variable. The variables significantly explained the variations in the gross (groundnut) output. Therefore the regression model is of good fit for the data, suggesting a linear relationship among the variables. The coefficient of multiple determinations (R^2) was 0.736 implying that 74% of the variation in the output of groundnut was accounted for by the variable inputs in the model. The remaining 26% not explained may be due to omitted variables and the stochastic error term. The coefficient of farming experience (0.572) was positive but statistically significant at 5% level (p≤0.05). This implies that farmers with more years of farming experience tend to be more efficient in groundnut production; farmers with more years of experience tend to become more efficient through 'learning-by-doing'. This corroborates the findings of Madaki *et al*., (2016) who also reported a similar result in their study on groundnut production. The coefficient of farm size (0.537) was positive and statistically significant at 5% level (p≤0.05), implying that an increase in farm size increases the likelihood of improved farm output and *vice versa*. This is in line with the study of Mailumo *et al*. (2017) who also reported similar outcomes. The coefficient of labour (0.216) is significant at 5% level (p≤0.05) and it is positively related to groundnut output. This implies that, an increase in man-day of labour would increase groundnut output. In that regard labour is needed in carrying out essential farm operations such as weeding, fertilizer application and harvesting. This is in line with Alabi *et al*. (2013) who reported a similar result in their study in groundnut production. The coefficient of seed quantity (-0.523) was negative but statistically significant at 1% level (p≤0.01), implying that an increase in the quantity of seed planted relative to small farm holdings might result to overcrowded fields which constrains optimum yield; hence, the need to adopt effective agronomic practices. This corroborates with Mailumo *et al*. (2017) who also reported a similar result in their study on smallholder groundnut production. The coefficient of fertilizer application (0.372) was positive and statistically significant at 5% level (p≤0.05), implying that fertilizer application improved yield potentials. This corroborates with Girei *et al*. (2013) who also reported a similar result in their study on groundnut production. The coefficient of herbicides (0.239) is statistically significant at 1% level (p≤0.01). This means that an increase in its use would increase the likelihood of improved output. The use of herbicides reduces fatigue and drudgery associated with weeding and also enables farmers to operate large hectares of farm land. This corroborates with Awoke *et al*. (2003) who also reported a similar result in their study on groundnut production.

Table 5: Analysis of Factors Affecting Groundnut production

Variable	Coefficient	Standard Error	T-Ratio
Constant	4.323**	1.669	2.59
Gender(X_1)	0.124$^{n.s}$	0.231	0.537
Experience(X_2)	0.572**	0.209	2.736
Farm size(X_3)	0.537**	0.21	2.557
Labour(X_4)	0.216**	0.08	2.7
Seed(X_5)	-0.523***	0.165	-3.17
Fertilizer(X_6)	0.372**	0.144	2.583
Herbicides(X_7)	0.239***	0.072	3.319
R^2	0.736		
F Ratio	4.613**		

Source: Field Survey (2020);*** = 1% (*P*<0.1) level; **= 5% (*P*<0.05) level; $^{n.s}$ = Not Significant

3.5 Elasticity of Production

Table 6 revealed that the value of elasticity of production($\sum \rho^k$). The estimated value of returns to scale is 0.876, thus,$\sum \rho < 1$ which indicates a decreasing return to scale. Decreasing returns to scale is due to a decline in the technical efficiency of variable and fixed resources. Variable resources are abundant relative to fixed resource. The additional productivity of variable resource becomes negative hence increase in the use of variable factors yields less additional output. Thus, addition of successive units of variable factors to fixed factors in the process of groundnut production adds less to the gross output of groundnut produced. This value represents stage III of the production function; which is regarded as an irrational (supra-optimal) stage of production. This stage offers the opportunity of reorganization of fixed and variable resources; it also correlates with the Law of Negative marginal returns. This result corroborates with Audu *et al*. (2017): who posited similar results in their study on groundnut productivity.

Table 6: Elasticity of Factors of Production and Returns to Scale

Factors of Production	Elasticity of production ($\sum \rho^k$)
Farm size	0.572
Labour	0.216
Seed	-0.523
Fertilizer	0.372
Herbicides	0.239
RTS	0.876

Source: Field Survey (2020)

3.6 Constraints of Production

Table 7 revealed the constraints of groundnut production among smallholders in the study area. The constraints identified include inadequate farm capital (85.3%), cost of inputs (70.7%), poor management practices(63.3%), poor access to production technology(54.0%), inadequate storage facilities (48.7%), pest and diseases (41.3%). poor extension services (32.7%) and land fragmentation (20%).All the constraints identified critically affected groundnut production in the study area; hence the need to mitigate this trend. This corroborates with Awoke *et al*. (2003) who also reported a similar result in their study on groundnut production.

Table 7: Constraints of Groundnut Production

Constraints	Frequency*	%
Inadequate farm capital	128	85.3
Cost of inputs	106	70.7
Poor management practices	95	63.3
Poor access to production technology	81	54.0
Inadequate storage facilities	73	48.7
Pest and diseases	62	41.3
Poor extension services	49	32.7
Land fragmentation	30	20.0

Source: Field Survey (2020); * = Multiple response

4.0 CONCLUSION AND RECOMMENDATIONS

This study analyzed groundnut productivity and return to scale among smallholders in Kanke, Plateau State, Nigeria. The results of the study revealed that the socioeconomic factors of the respondents significantly affected groundnut production in the study area. Groundnut production in the study area was a relatively profitable venture. Groundnut farmers were sub-optimally productive as revealed by the index of TFP; which indicates sub-optimal input mix and allocation in the production process. The variables in the regression model including farming experience, farm size, labour, seed, fertilizer application and herbicides; significantly explained the variations in groundnut output among smallholders. The estimated value of returns to scale indicates a decreasing return to scale; due to a decline in the technical efficiency of variable and fixed resources. The constraints identified include inadequate farm capital, cost of inputs, poor management practices, poor access to production technology, inadequate storage facilities, pest and diseases, poor extension services and land fragmentation. Therefore, effort should be channeled towards ameliorating these constraints. Based on the foregoing, these recommendations are proposed: Adoption of policies that provides improved access to agricultural credit and farm capital; policy formulation that ensures improved access to and adequate supply of subsidized inputs and production technology; adoption of modern production practices and storage technologies; adequate supply of agrochemical requirements; improved access to research and development that proffers solutions for effective pest and disease control and serve as source of certified seeds for cultivation; improved extension delivery services; tenure policy modification that ensures adequate land allocation for agricultural purposes and mitigates land fragmentation. Also, robust investments, interventions and programs should be initiated, to boost sustainable groundnut production in the study area.

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