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Economic Efficiency of Resource Use in Groundnut Production in Adamawa State of Nigeria

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Abstract: Groundnut is the 13th most important food crop of the world. It is the world's 4th most important source of edible oil and 3rd most important source of vegetable protein. The study examines the economic efficiency of resource use in groundnut production in Michika local government area of Adamawa State. It focuses on the relationship between groundnut out and the various inputs used by groundnut farmers, elasticity and economic efficiency of resource used in production of groundnut. Primary data were basically used with the aid of structured questionnaires administered on 143 farmers using a simple random technique. The regression analysis indicated that the cobb- Douglas function gave the best fit. The R^2 was highly significant at 1% level with the value of 0.784%. This implies that 78.84% of the total variations in groundnut yield is explained by combine influence of all the explanatory variables (farm inputs) in the regression equation. Three out of the eight independent variables were significant at 1% level, these were farm size (X_3), seed (x_5) and labour input (X_8) more so they positively affect the groundnut indicating that the more the farm size, quantity of seed and labour used, the more output. Economic efficiency of resource used showed the seed and labour were underutilized, while fertilizer and agrochemicals were over utilized.

Key words: Groundnut · Economic · Efficiency · Resource use · Production

INTRODUCTION

Groundnut *Arachis hypogea* originated from Latin America and was introduced into west Africa by Portuguese traders in the 16th centaury [1-4]. The origin of this crop dates back to 350 BC [5]. Who also reported that, the first probable domestication of groundnut took place in the valley of the panama and Paraguay River systems in the grain Chaco area of South America and then moves to the North America through slave trade.

Misari *et al*. [6] reported that agro ecological zone of groundnut production are the Sahel (12° to 13°N, Sudan (10° to 13°N), Northern half of the guinea savanna (6° to 8°N). major groundnut zones are the Sudan and northern Guinea Savanna where the soil and agro climatogical conditions are favorable. Groundnut requires 500 to 1600mm of rainfall, which may last for 70 to 200 days of rainy season in the Sudan savanna. It also requires well-drained light colored loosed friable sandy loam soil, optimum moisture in pod zone and mean daily temperature of about 30°.

The rainfall should be well distributed during the flowering and pegging of the crop. The total amount required for pre-sowing operations in 100mm, for sowing is 150mm and for flowering and pod development an evenly distributed rainfall of 400-500 is required. Groundnut cannot withstand frost, long as severe drought or water stagnation. However, the crop does best in sandy loam and loamy soils and in the black soils with good drainage. Heavy and sticky clays are not suitable for groundnut cultivation because the pod development is hampered in these soils [7].

Groundnut, is one of the most popular commercial crop in Nigeria which accounted for 70% of the total Nigeria export earning between 1956 and 1967 but declined between 1955 and mid 1980s due to combine effect of drought and disease [6]. During this period, groundnut area in Nigeria declined to almost half of the existing level of 1.7 million hectares. Groundnut production in Nigeria in 2002 was 23390000mt [7].

NPC. [9] stated that groundnut is used for making margarine, candy, salted groundnut, crakers/cookies,

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salad oils and soaps. It was however reported that almost every part of groundnut, plant is used in some way.

According to [10] over 330 products can be commercially produced from groundnut and jobs can be directly created from massive groundnut production with small improvement in the technology and the use of impaired variety with corresponding increase of cultivated hectares.

Agricultural sector has the mainstay of Nigeria's economy employing 70% of the active labour force and contribution significantly to the country's GDP and foreign earnings. In 1960, 1970 and 1980, it contributed 55.20, 440.70 and 18% to GDP respectively. Despite the factors that continuous to constrain agricultural activities such as poor rural infrastructure, poor fertilizer distribution and high cost of farm inputs, the sector, still remain important in the economy. Its contribution to GDP in 1996, 1997 and 1999 stood at 39%, 339.4% and 40.40%, respectively [11], Groundnut had relied primarily on export of agricultural commodities as source of both internal and foreign exchange before the oil boom era. Before the world war 11, Nigeria's groundnut figured prominently in world trade accounting for 29% of Africa export and 12% of the world export. In the 1950s, Nigeria contributed 50% of the African export and 30% of the world export. Nigeria produces 41% of the total groundnut production in West Africa [12].

Misari, [13] attributed the decline in groundnut production to the discovery of petroleum in the southern part of Nigeria, groundnut rosette epidemic, drought and lack of organized inputs and marketing.

The persistent decline in groundnut production over the decline caused Nigeria Government great concern and has devised various means of revitalizing the production through research for impaired yields.

Despite this numerous crop improvement practices and vast resources of land and labor as reported by [9], there seems to be inadequate supply of groundnut to meet the demand of the teeming population in Adamawa State. Population is mainly undertaken by small holders for subsistence, using traditional methods and employing low yielding variety with low yield per hectare per head. As a result, there is need to reverse the foregoing scenario with a view to improving the productivity and efficiency of resource use among groundnut farmers through the investigation of the nature of productivity and efficiency in their production. The purpose of this study is therefore to estimate the production function for groundnut production and analyze resource use efficiency in groundnut production in the study area.

Hypothesis:

Ho_1: There is no relationship between the output and input used in groundnut production.

Ho_2: There is no relationship between socio economic variables and groundnut output.

Data collection: Purposive, multistage and simple random techniques were adopted for the study. These involved the choice of Michika local government Area in the southern zone of Adamawa State, this followed by selection of 4 districts from the eight districts, 2 wards each from the selected districts, three villages each from the selected wards and 143 groundnut farmers from the villages. Data were collected on production inputs, outputs, inputs and output prices and socioeconomic characteristics of the farmers for the year 2005 cropping season.

Data analysis: Multiple regression was used to develop production function for groundnut production and was used to measure the efficiency of resources use. The implicit form of the model is as follows;

$$Y= f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, U_i)$$

Where, Y = groundnut output (in 100kg of shelled groundnut)

X_1 = Age of farmers (in Years)

X_2= Family size

X_3 = Farm size (Ha)

X_4 = Farming experience in years

X_5 = Quantity of seed used (kg)

X_6 = Quantity of fertilizer (kg)

X_7 = Quantity of agrochemical used (in kg)

X_8 = Labour input (in man days)

b_0 = Constant term

b_1- b_8 Regression coefficient to be estimated

U_i = Error term.

Different functions, linear, semi-log, double-log and exponential were tried and the double log (Cobb-Douglas) was chosen for the analysis based on goodness of fit (economic, econometric and statistical criteria). The model was explicitly expressed as follows.

$$LnY = lnb_o + b_1lnX_1 + b_2lnX_2 + b_3lnX_3 + b_4lnX_4 + b_5lnX_5 + b_6lnX_6 + b_7lnX_7 + b_8lnX_8 + U_I$$

The *apriori* expectation was that the coefficient of X1-X8 would be positive.

Elasticity of production: Elasticity of production is the measure of response of output to changes in the variable input (Olukosi & Ogunbile, 1989). Based on the function of best fit, the elasticity of various inputs was determined by this formula.

$$dy/dxi * X_i/Y_1$$

where Y is the groundnut output
x's are the various input used in production
X, Y are the mean average of input and output respectively.

Since the Cobb-Douglas production function gave the best fit, the regression coefficient are still the elasticities.

Resource efficiency: The estimated coefficients were used to compute the MVP and its ratio (r) with MFC used to determine the economic efficiency of resource used. The model was estimated as follows

$$r = MVP/MFC$$

Where, r = efficiency ratio
MVP = marginal value product of variable inputs
MFC = marginal factor cost (price per unit inputs)

Based on economic theory, a firm maximizes profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one. The value are interpreted thus,

- If r is <1; resource is excessively used or over utilized hence decreasing the quantity use of that resource increases profits.
- If r > 1; resource is under used or being underutilized hence increasing its rate of use will increase profit level.
- If r = 1; it shows the resource is efficiently used, that is optimum utilization of resource hence the point of profit maximization (Olukosi & Ogunbile, 1989)

RESULTS AND DISCUSSION

Four functional forms were fitted into the model. These were linear, semi-log, double-log and exponential. The result is summarized in Table 3. the four functional forms of production function were employed in the analysis of input-output data to measure the contribution of each input to production, when the inputs interacted together to produce output. The selection of lead equation was based on the comparison of coefficient of multiple determination (R^2), the apriori expectation, the magnitude of standard error of the estimated parameter and statistical significance of the estimated regression coefficient.

The double-log had the best and was selected as the lead equation for the analysis of input- output relationship in the groundnut production. The lead equation is thus presented as;

All the coefficients except the coefficient associated with family size (X_2) and farming experience (X_1) bore apriori signs. The level of groundnut output is expected to vary positively with farm size, quantity of fertilizer applied, quantity of seed planted, quantity of agrochemical applied, labour input, farming experience, family size and age of farmers. About 78.40% of the variations in yield of groundnut output was explained by thee specified factor inputs as indicated by the R^2.

The coefficient of farm size (X_3) was positive and significant at 1%. The positive coefficient of the farm size suggests that a unit increase in the variable in groundnut production when other explanatory variables are held constant is consistent with increased output level. This in consonance with the *apriori* expectation. Ceteris paribus, increase in farm size means that more inputs would be utilized and consequently more output expected. The significance of farm size highlights the importance of this factor in peasant agriculture where the commonest mode of production is extensive, as opposed to intensive pattern.

The coefficient of seed input (X_5) was found to be positive and significance at 1%, thereby disposing the hypothesis of no relationship between the input and output in production.

The positive value of seed coefficient is in line with the expected sign in groundnut production. Other things being equal,, higher seed rate in kg/ha implies greater number of crops stands peer hectare and consequently higher yield, except where there is over- crowding leading to competition for nutrients and low yields.

The coefficient of labour (X_8) was positive and significant at 1% and disproves the hypothesis of no relationship between inputs and outputs. The positive coefficient is in agreement with hypothesized expected sign and implies that as the amount of labour increases, the output also increases,. This type of relationship is however expected where the available labour is efficiently managed along with other resources to avoid redundancy and diminishing return to labour.

Table 1: Cobb-douglas regression estimates for groundnut production

Variables	Coefficients	T - value
Age	0.291	90.43
Family size	0.0453	-0.81
Farm size	0.185	2.82
Farming experience	0.084	-1.21
Seed	0.203	2.88
Fertilizer	0.018	0.76
Agrochemicals	0.025	0.52
Labour	0.529	6.39
R2	0.784	
Standard error	0.358	
Constant	3.421	

Source: Field survey, 2006

*** = Significance @ 1% level

Figure in parenthesis are t-ratios

Table 2: Estimated resource-use efficiency in groundnut production

Farm input	Production elasticities	MPP	MVP	MFC (N)
Age	0.291	33.651	-	
Family size	-0.043	-28.382	-	
Farm size	0.185	283.639	-	
Farming exp.	-0.084	-46.859	-	
Qty of seed	0.203	7.080	-5022.68	71
Qty of ferti.	0.018	0.357	25.35	66
Labour (man days)	0.529	11.755	834.61	400
Estimated to RTS	1.124			

Source: field survey, 2006

Table 3: Ratio of MVP to MFC

Inputs	MFC	MVP/MFC (Px)
Seeds	71	7.08
Fertilizer	66	0.38
Agrochemical	800	0.83
Labour	400	2.09

Source: Field survey 2006

The coefficient of fertilizer (X_6) was positive and in accordance with the expected sign meaning that that quantity of fertilizer applied was directly related to the output while the statistical insignificance of the coefficient implies that fertilizer was not a determinant of output in groundnut production.

The coefficient of agrochemicals used (X_7) had insignificant coefficient at any of the specified levels indicating lack of relationship between output and agrochemical applied. A likely reason for the significance of the coefficient of agrochemical could be either insufficient supply of agrochemical or its inefficient use since groundnut production is tedious and more labour demanding. While the positive value of the coefficient of agrochemical is in consonance with *apriori* expectation. The positive sign of the coefficient is in agreement with the hypothesized expected sign and implies that as their ages increases to certain level, their output also increases, this is however, possible up to certain level. The insignificance of their ages further lends credence to the fact age is not an important determinant of output in agricultural production.

The regression mode is significant at 1% level as shown by F statistic. This implies that the whole equation is at best fit. The R^2 of 0.7840 indicated that 78.40% of the variability in the output of groudnut is accounted for by the various independent variables used.

The regression coefficients in the double-log function are Elasticities of the independent variables with which the coefficient are associated (Table 1). The output of groundnut is inelastic with respect to groundnut farm size, age of farmers, family size, farming experience, quantity of seed planted, quantity of fertilizer applied, quantity of agrochemical used and labour inputs. This implies that a change in the level of use of any of these variables will result in less than proportionate change in output of groundnut.

The Return to Scale (RTS), summing up of the production elasticities of the inputs amount to 1.124 which is more than unity and thus characterized by increasing return to scale. This implies that production was in the irrational zone of production (stage 1) and that the percentage change in the variable input. That is factor input were not efficiently allocated and utilized while output was optimally produced.

Resource use efficiency: Economic efficiency of resources use in groundnut production was determined using the ratios of their Marginal Value Product (MVPs) to the Marginal Factor Cost (MFC). The MVP for each inputs was calculated by multiplying the marginal physical product (MPP) of each input by the arithmetic mean price of the crop output. The MVPs and their ratios of MFCs of thee variable resources in groundnut production are presented in Table 2. According to MPP to MVP figures, on the average and with all other factors held constant, an increase in man-days of labour would increase output by 11.766kg and revenue by N834.61 per hectare. While an increase in quantity of seed planted would increase output by 7.08kg and revenue by N502..68.

The Marginal Value Product (MVP) of seeds, fertilizer, agrochemicals and labour were computed and compared to their unit prices. The marginal value products of these resources were compared to determine the degree of efficiency in their use..

Comparison of the ratio of the MVP to MFC shows that two resulting ratio were greater than unity; labour and seed, indicating that the inputs were under used or being under utilized on the farms during the cropping season hence increasing their rate of use will increase output and profit level. Similarly, two resulting ratios were less than unity; fertilizer and agrochemical indicating that the inputs were excessively used or over utilized hence decreasing quantity of the inputs use will increase output and profit level. This confirms the hypothesis that resources are not efficiently utilized.

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