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EXPLORING PROFITABILITY PONTENTIALS IN GROUNDNUT (*ARACHIS HYPOGAEA*) PRODUCTION THROUGH AGROFORESTRY PRACTICES: A CASE STUDY IN NIGERIA

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ABSTRACT

This study was carried out to determine costs –returns profitability in groundnut –based alley cropping practices in three selected villages (Abouchiche, Gakem and Ibiaragidi) in Bekwarra Local Government Area, Cross River State, Nigeria. Three villages were purposively selected in Bekwarra Local Government Area, Cross River State, Nigeria, then forty respondents were randomly selected from each village(120 groundnut -based alley farmers were selected). Multiple regression analysis was the main tool of data analysis where different functions were used. The results indicated that Cobb-Douglas production function had the best fit in explaining the relationship between output of groundnut and inputs used, the co-efficient of multiple determinant(R^2= 0.60) indicated that sixty per cent of variability in output of groundnut is explained by the independent variables. The F-value of 16.61 indicates that the overall significance of the model at one per cent level, indicating that there is a significant linear relationship between the independent variables taken together and yield of groundnut produced in Bekwarra Local Government Area, Cross River State. The results also indicates that groundnut-base alley cropping system of production by small-scale farmer was profitable but respondents were inefficient in production of groundnut; they over-utilized or under- utilized resources (allocative in-efficiency). However, expectation of large profits had cause most of respondents in study area to shift from traditional bush fallow system of farming to improved groundnut alley-base cropping system that is more profitable. The study recommended that government should provide agro chemicals, improved farm implements, storage facilities and marketing facilities. Beside that, banks should provide loans at low interest rate to both small and large –scales farmers. The unemployed youth are encouraged to go into large scale groundnut based- alley farming business. Finally, government should make and implement policy that will enable farmers to reduce cost of production and maximize profit in short and long term production of groundnut through agro- forestry practices.

Key words: Alley cropping, Cobb-Douglas, Groundnut, Productivity, Profitability

INTRODUCTION

Until recently, the majority of people in what we call the developing countries lived a relatively unchanging life, producing food in the same way as their ancestors. This method of production, usually well adapted to the local environment, involved risks but ensured food for the family in all but exceptional years. By far, the most difficult problem is how to provide a good livelihood for the rural people through increased productivity (Kuye *et al*, 2004). They further maintain that a more intensive and productive use of land can help to solve the problem. The productive use of land that can help to solve this problem is called alley cropping**.** The farming system that is capable of maintaining their productivity without jeopardizing the need for conservation of natural resources and environmental soundness is alley cropping system. There is need to increase crop production using resources efficiently and alley cropping system of land management that allows sustainable levels of food production while maintaining soil fertility, providing reasonable supplies of firewood, fodder for animals, traditional medicine, and ornamentals and protecting the soil and water catchments area (Owa *et al*, 2006). United Nations Development Program (UNDP) (1999) revealed that the development of agriculture in Nigeria is not meeting the demand of its teeming-population, despite the country's endowment with abundant and diversified range of natural, human and capital resources and oil revenue, has remained one of the poorest countries in Africa.

Successive government had embarked on agricultural programmes aimed at boosting crop production in Nigeria. These programmes include River Basin Development Authority, Land Use Decree, World Bank Assisted Agricultural Development Programme, National Fadama Development Project, Root and Tuber Expansion Programme and the Special Programme on Food Security (Panwal *et al*, 2006). However, none of these programmes has been able to adequately solve the food problems. Since the desire objectives have not been achieved and productivity of food crops has remained

low. The low output realized by smallholder farmers is an indication that resources needed in the production of crops are not at optimal levels (Nweze, 2002; Panwal *et al*, 2006; Adinya *et al*, 2008).Therefore the need to use resources efficiently in the production of groundnut in Bekwarra Local Government Area of Cross River State, Nigeria.

According to Akalusi and Chomini (2006) groundnut and other crops and livestock farming as currently practiced still give cause for concern. These practices have led to decline in soil productivity, deforestation, desertification, climate change, overgrazing, soil compaction, loss of biodiversity etc. Smaling (1993) shows that there has been a net nutrient loss in soils in the last 30 years mainly due to crops harvests this has led to leaching, de-nitrification, erosion and lack of soil nutrient replenishment. This is more pronounced in farms belonging to resource poor smallholder farmers. There is a need for shift away from these unsustainable practices and their resultant negative effects on the environment to more sustainable practices (Akalusi and Chomini, 2006). Sustainable agriculture involves farming systems that are capable of maintaining their productivity and commercial competitiveness without jeopardizing the need for conservation of natural resources and environmental soundness thereby maintaining its usefulness to society (Bisong, 2001). The farming system that is capable of maintaining their productivity without jeopardizing the need for conservation of natural resources and environmental soundness is alley cropping system. Alley cropping is a land use system that combines the growth of trees (*Leuceana leucocephala*) and groundnut in rows, sufficiently spaced to accommodate 4-6 rows of groundnut seeds, has gained prominence as a viable means of practicing sustainable groundnut production in era of economic melt down (Evans, 1992; Brasil, 1992; Akalusi and Chomini, 2006). Owa *et al (2006)* defined alley crop as the growing of leguminous trees in rows, while growing crops between the tree rows, high values, short duration crops can be grown in the alleys. *Leuceana leucocephala* (is exclusively leguminous nitrogen-fixing tree*)* that is periodically pruned to prevent shading of groundnut. Spencer (2002) revealed that resources –poor farmers must be assisted to rise beyond subsistence to increase their incomes through more efficient use of resources. They must be guided on what level of inputs combination that would ensure optimum production. However, higher level of production that leads to increased productivity and income from groundnut production among small and large scale farmers in Cross River State triggered their fast adoption of improved groundnut base-alley cropping system of farming with numerous advantages that out weighs traditional bush fallow system of farming. The Nigerian National Forestry Policy recognized the role of alley cropping practices in the consolidation of the nation's forest resources and its management for sustained yield (Anon, 1988; Akalusi and Chomini, 2006). Alley cropping was developed in Nigeria in the 1980's (Kang, 1993); since then it has been successfully introduced in other parts of Africa and Asian countries like the Philippines, Indonesia and Sri Lanka (Akalusi and Chomini, 2006). The contributions of alley cropping practices to crops production are as follows:

- Alley cropping is a stable alternative to shifting cultivation
- It is use for erosion control.
- It is use for soil fertility management.

The basis for soil fertility management is the ability of hedgerow trees (*Leuceana leucocephala*) to recycle nutrients, particularly from deeper soil layers which cannot be reached by the roots of groundnut. Sampet (1994) reported that *Leuceana leucocephala* as a good source of nitrogen for wheat and maize and other crops (groundnut, tomato and okro). He further stated that *Leuceana leucocephala* has been widely used in alley cropping system because it has high dry matter production, supplies the soil with high amounts of dry matter and nutrients especially nitrogen, phosphorous and calcium (Sampet,1994; Van Lauwe *et al*, 1998; Akalusi and Chomini, 2006). Mulongoy (1992) reported that yields of crop could be maintained for many years at reasonable levels with use of *Leuceana leucocephala* without application of inorganic fertilizers Van Lauwe *et al*, (1998) reported that *Leuceana leucocephala* has a good residue nitrogen recovery in the top soil (5 cm of the top soil); the residue quality has a major impact on the dynamics of applied residues nitrogen in alley cropping system. Attah-Krah (1990) reported that within six months *Leuceana leucocephala* fixed 250 kilogram of nitrogen per hectare. Also Kang and Mulongoy (1992) reported a range of 150-160 kilogram of nitrogen per hectare that was fixed by *Leuceana leucocephala* According to Kang *et al* (1990) and Attah-Krah and Okali (1986) they observed that soil soils under *Leuceana leucocephala* had a higher soil organic matter, total soil nitrogen, low soil temperature fluctuation, high soil moisture and soil moisture retention than soil without *Leuceana leucocephala*. Arowolo (2007) observed that erosion in plots with *Leuceana leucocephala* was reduced by 83 % when compared to the control treatment. Imogie *et al* (2008) reported that *Leuceana leucocephala* had a highly significant ($P \leq 0.1$) effect on soil physico-chemical properties than the control. They further stated that mean fresh fruit bunch yield, over a three year period, was significantly higher ($P \leq 0.05$), with fresh fruit bunch yield of 10.93 tons/ha in plots with *Leuceana leucocephala* as against 6.8 tons/ha in the control plots.

Efficiency of production is a very important factor for productivity growth especially in areas where resources are meager as in Nigeria. Efficiency of production is achieved through optimal resource

allocation such that more output is achieved with same resource level or the same level of output is achieved using fewer resources. Technical and allocative efficiencies are often investigated using production function models (Kipkoech *et al*, 2005). Technical efficiency is the measure of the farms success in producing maximum output from a given set of resources (inputs) i.e. ability to operate on the production frontier (Farrel, 1957). Allocative efficiency is expressed as the ratio of technically maximum possible output at the farmers' level of resources. Allocative efficiency is the ability of the farmer to use the inputs in optimal proportions given their respective prices and the production technology. Economic efficiency is the product of the technical efficiency and allocative efficiency. Micro-economic theory holds that for profit maximization, firms should produce at the point where the marginal value product of a resource equals its price (Udo and Akintola, 2001a; Udo and Akintola, 2001b; Awoke, 2001; which states that a production input is efficiently utilized if the ratio of the VMP/ input price equates to unity, a ratio less than unity indicates over-utilization of production inputs while a ratio greater than unity shows that resources are under- utilized.

Groundnut farmers in Bekwarra Local Government Area of Cross River State fail to exploit fully the potential of resources and make production errors which results to decline in production and low profit.

Groundnut (*Arachis hypogaea*) belongs to the family *leguminosea.* It originated from Latin America and the Portuguese were responsible for its introduction into West Africa from Brazil in the 16th century (Abalu and Etuk, 1986; Hamidu *et al*, 2006). Nigeria produces 41% of the total groundnut production in West Africa (Abalu and Etuk, 1986; Hamidu *et al*, 2006). Groundnut contain 25% protein and more than 40% oil (Echekwu and Emeka, 2005).Groundnut flour is used as an ingredient in soup, confectionaries and pudding. Groundnut cake is often deep fried or dried to make a snack called *Kuli-Kuli* (Hamidu *et al*, 2006)**.** Little is known about the profitability of ground production through agro-forestry practices in the study area. It is against this background that this study attempt to explore, answers to this question: do rural farmers engaged in ground production through agro-forestry practices in the study area make profit? This study seeks to examine the profitability of groundnut based- alley farms in three selected villages in Bekwarra Local Government Area, Cross River State, therefore this paper tried to provide some useful information in policies towards increasing profit. Hence, this study had the following objectives:

(i) To determine profitability of ground production through agro-forestry practices in the study area.

(ii) To analyze the costs and returns of ground production through agro-forestry practices in the study area.

MATERIALS AND METHODS

Study area: The research study was conducted in Bekwarra Local Government Area of Cross River State, Nigeria. The Local Government Area occupies an area of about 304.30 Square Kilometers and about 57,965 people inhabit the area (Population Census, 1991 In: Quarterly News Letter of the Ministry of Local Government Affairs, C.R.S 2006). It is located on latitude 6^{o} 40'N and longitude 8 45'E. Bekwarra Local Government Area is bounded on the North by Benue State, South by Ogoja Local Government Area, East by Yala Local Government Area, while in the West by Obudu Local Government Area (Menakaya and Floyd, 1978). There are two distinct climate seasons in the area, rainy season from March to October and dry season from November to February. The annual rainfall varies from 2,942mm to 3,424mm (CRADP, 1992). The average temperature is about 28^{o}c (CRADP, 1992). Fishing and subsistence agriculture are the main occupations of the people. Crops grown in the locality include groundnut, rice, maize, yam, cassava, pineapple, plantain and banana. Population depends largely on natural water sources for all their water-related activities, as pipe-borne water supply is not available. Health services in the area require a lot of improvement. Level of hygiene in the communities is generally poor (Arene *et al*, 1999).

Purposive and random sampling techniques were used to select the respondents. There are 18 Local Government Areas in Cross River State. There are five local government areas in Northern Zone of Cross River State (Bekwarra, Yala, Ogoja, Obudu and Obanliku Local Government Areas), six local government areas in Central Zone of Cross River State (Boki, Etung, Ikom, Obubra, Yakurr and Abi Local Government Areas) and seven local government areas in Southern Zone of Cross River State (Calabar South, Calabar Municipal, Bakassi, Akpabuyo, Odukpani, Akampka and Baise Local Government Areas). The three agricultural zones in the state consist of 17 blocks, 8 circles and 136 cells with 5200 contact farmers. However, contact and non- contact farmers were use for this study. At the first stage one (1) local government area was purposively selected from 18 local government areas, then three farming communities were purposively selected from ten farming communities. For better coverage in the study area, one village was purposively selected from each of the selected farming communities (3 villages were taken from 3 farming communities). Forty respondents (20) contact farmers and (20) non-contact farmers) were randomly chosen from each of the selected villages. In all, 120 respondents were selected.

Data Analysis: Data obtained for this study was subjected to different types of analyses. In this study, the following tools were employed, namely: descriptive statistics, costs and returns analysis, multiple regression analysis. Multiple regression technique was used to determine the relationship between groundnut output and the selected variables. The linear, Cobb-Douglass and semi-log production functions forms were used to determine which of the forms would best fit the relationship between groundnut output and the explanatory variables.

The implicit form of regression for this analysis was given as:

$Y = f(X_1, X_2, X_3, X_4, X_5\ e_1)$ and explicitly form of the regression model for this analysis is given by:

$Y = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + e$

Where: Y=total output of groundnut (kilogram)

X_1=educational level of respondents (measured on a 4 point scale of First School Leaving Certificate=1, Senior Secondary School Certificate=2, Tertiary Institution=3, No education=4)

X_2=adoption of groundnut base alley cropping system technology (spacing distance) (measured on a 3 point scale of

10 cm between hedge and groundnut seed row=1, 30 cm between hedge and groundnut seed row =2, 60 cm between hedge and groundnut seed row=3)

X_3= labour (man-days)

X_4= farm size (hectare)

X_5 = fertilizer (kilogram)

$b_o - b_5$ = Regression coefficients to be estimated.

e = error term (error or disturbance term is included to capture the effects of exogenous and endogenous variables not included in the model)

Three linear function forms were tried; these are Linear Production Function, Cobb-Douglas Production Function and Semi-Log Production Function forms. Whichever model that has the highest R^2 and shows many statistical significant variables will be adopted following (Kmenta, 1971, Koutsoyiannis, 1977 and Awoke, 2001).The functional forms fitted are specified below:

(a) Linear Production Function:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + e$ ....equation (1)

Where Y, X_1- X_5= a re defined in the implicit form

$b_o - b_5$ = Regression coefficients of variable inputs X_1- X_5

a = constant term

e = error term

(b) Cobb-Douglas Production Function (by apply logarithm on both sides of Cobb-Douglas Production Function):

$\text{Log } Y = \text{Log } a + b_1 \text{ Log } X_1 + b_2 \text{ Log } X_2 + b_3 \text{ Log } X_3 + b_4 \text{ Log } X_4 + b_5 \text{ Log } X_5 + e$ ....equation (2).

(c) Semi-Log Production Function:

$Y = \text{Log } a + b_1 \text{ Log } X_1 + b_2 \text{ Log } X_2 + b_3 \text{ Log } X_3 + b_4 \text{ Log } X_4 + b_5 \text{ Log } X_5 + e$ ....equation (3)

Where Y,

X_1- X_5= a re expressed in the implicit form

$b_o - b_5$ = Regression coefficients of variable inputs X_1- X_5

a = constant term

e = error term

Each resources was measured using the formula: the average physical product (APP) was derived by dividing total output by total inputs

$$APP = \frac{Y}{X}$$

The marginal physical product (MPP) was derived by dividing total output by total inputs

$$MPP = \frac{DY}{DX}$$

MPP x price of product= marginal value product (MVP)

The allocative efficiency (AEL) of resource was determined by ascertaining whether or not the ratio of the marginal value product to the inputs price was equal to one

$$AEL = \frac{MVP}{P} = 1$$

Where MVP = marginal value product

P= unit price of input

The marginal products (MP) were derived by multiplying the average production (AP) by the elasticity of production (EP), given that

$$MP = AP \times EP$$

$$EP = \frac{MP}{AP}$$

Profit analysis used for this study is expressed as:

GM =TR-TVC

Profit= GM-TFC

Where: GM = Gross Margin

TR = Total Revenue from production of groundnut (naira)

TVC = Total Variable Cost of production of groundnut (naira)

RESULTS AND DISCUSSION

Analysis of Table 1 revealed that 23.33% of the respondents had Senior Secondary School Certificates (SSSC). However, 3.33% of the respondents revealed that they attended Tertiary Institutions (TI). While 39.17% of the respondents disclosed that they had First School Leaving Certificates (FSLC).Only 34.17% of the respondents had no education. The groundnut based-alley farmers that had no education (39.17%) revealed that lack of educational training affected their yield and production efficiency because they were unable to read the instruction on fertilizer bags. In addition to that, lack

of extension agents to guide them on recommended rate of fertilizer application therefore as a

Table 1: Distribution of respondents according to socio-economic characteristics of groundnut–based alley cropping practices in Bekwarra Local Government Area Cross River State, Nigeria.

Education Attainment	Abuochiche	Gakem	Ibiaragidi	Total frequency	Percentage (%)
First School Leaving Certificate	21	13	13	47	39.17
Senior Secondary School Certificate	4	10	14	28	23.33
Tertiary Institution	-	3	1	4	3.33
No education	15	14	12	41	34.17
Total	40	40	40	120	100
Adoption of Improved Alley Cropping system (Spacing distance)					
10cm between *Leuceana leucocephala* and pineapple sucker rows	1	5	13	19	15.83
30cm between *Leuceana leucocephala* and pineapple sucker rows	29	16	17	62	51.67
60cm between *Leuceana leucocephala* and pineapple sucker rows	10	19	10	39	32.50
Total	40	40	40	120	100
Labour (man-days)					
1	8	12	9	29	24.17
2	12	10	10	32	26.67
3	9	5	4	18	15.00
4	4	9	7	20	16.67
5	5	1	6	12	10.0
6 man-days and Above	2	3	4	9	7.50
Total	40	40	40	120	100
Farm size(hectare)					
0.1- 2	34	37	27	98	81.67
3-4	6	3	13	22	18.37
Total	40	40	40	120	100
200 kilogram of fertilizer per hectare (NPK)	15	14	12	41	34.17
250 kilogram of fertilizer per hectare (NPK)	-	3	1	4	3.33
300 kilogram of fertilizer per hectare (NPK)	4	10	14	28	23.33
350 kilogram of fertilizer per hectare (NPK) and above	21	13	13	47	39.17
Total	40	40	40	120	100

Source: Field survey, 2009

Table 2: Average production costs and returns, profit per hectare of groundnut–based alley cropping practices in Bekwarra Local Government Area Cross River State, Nigeria.

Variables	Unit price (₦/Kg	Abuochiche	Gakem	Ibiaragidi	Total quantity	Total Cost(₦)	Total Revenue (TR) (₦)
groundnut output(PO	40,000	5040	8750	6120	19910	-	796,400,000
Seed of groundnut used as planting material	40	1200	1840	1600	4640	185600	
Leuceana leucocephala	40	240	680	520	1440	1440	
Family labour	62.5	8.00	9.40	1.02	18.42	1,151.25	
Hired labour	62.5	4.20	4.90	5.30	14.40	900.00	
Farm size	1000	89.20	98.80	89.60	277.60	277,600.00	
Fertilizer	100.1	3.01	3.05	3.03	9.09	6,817.50	
Total fixed cost(TFC)	250	250	250	250	-	750.00	
Total variable cost (TVC)							473,508.75
Profit							795925741.30

Source: Field survey, 2009

result of this illiteracy problem some of them under applied fertilizers per hectare (34.17% of them applied127 200 kilogram of fertilizer per hectare (NPK) while others over applied fertilizers in their farms (39.17% of them applied 350 kilogram of fertilizer per hectare (NPK) and above) and. This implies that lack of educational training acquired by groundnut farmers affected their yield and production efficiency and income. Of course, this goes to confirm the earlier deduction by (Adinya, 2001) that technical and commercial education broaden farmers' intelligence and it also enable farmers to perform the farming activities intelligently, accurately and efficiently this leads to increase yield, productivity and farm income.

Footnote: Profit analysis used for this study is expressed as:

GM =TR-TVC

Profit= GM-TFC

Where:

TR = Total Revenue from production of groundnut (naira)= ₦796,400,000

TVC = Total Variable cost of production of groundnut (naira)= ₦ 473,508.75

GM = Gross Margin= ₦ 796,400,000- ₦473,508.75 = ₦ 795926491.30

Profit= GM-TFC= ₦795926491.30- ₦ 750.00= ₦ 795,925,741.30

Table 2 revealed that the total yield of groundnut produced in the study area was 19910kg and the value of groundnut produced was ₦796,400,000. A total of 2051.25 man-days were used in groundnut production. The profit obtained was ₦ 795,925,741.30. Further analysis of Table 2 revealed that the benefit of groundnut based alley cropping technique of farming is attractive to the point at which the cost incurred in it adoption was fully offset by huge revenue that accrued from groundnut based alley farming business. The unemployed youth are encouraged to go into large scale groundnut based- alley farming business.

Table 3: Multiple regression equations for groundnut–based alley cropping practices in Bekwarra Local Government Area Cross River State, Nigeria.

Production function forms	constant	X_1	X_2	X_3	X_4	X_5	R^2	Adjusted R^2	F-Value
Linear Production	-3.347	0.129	0.328	0.140	1.335	1.596	0.46	0.48	13.31
Function	(1.348)	(0.213)	(0.474)	(0.115)	(0.168)	(0.050)			
Semi-log Production	-5.756	0.574	0.981	1.153	7.240	4.019	0.48	0.50	14.40
Function	(5.058)	(1.005)	(1.316)	(0.902)	(1.102)	(1.601)			
Cobb-Douglas	-1.315	9.688	0.166	0.258	0.949	0.557	0.60	0.62	16.61
Production Function	(0.710)	(0.145)	(0.185)	(0.130)	(0.168)	(0.238)			

Source: Field survey, 2009 Footnote: values are significant at 1%
Figures in parenthesis are standard errors

Table 3 revealed that Cobb-Douglas production function is the lead equation because it has the highest R^2 value of 0.60 and met other econometric criteria; therefore Cobb-Douglas production function equation is a good equation compared to linear and semi-log production function equations.

The regression analysis revealed that education has positive influence on output of groundnut produced in Bekwarra Local Government Area, Cross River State and is significant at 1 per cent level of significance. Further analysis of Table 3 revealed that labour, farm size, fertilizer and adoption of improved alley cropping system has positive influence on output of groundnut production and it is significant at 1 per cent level of significance. The F-value of 16.61 indicates that the overall significance of the model at 1per cent level, indicating that there is a significant linear relationship between the independent variables taken together and yield of groundnut produced in Bekwarra Local Government Area, Cross River State. Kalirajan (1981) and Fujimoto (1988) reported similar results for labour in the aggregate while Akalusi and Chomini, 2006) reported similar result for alley cropping system of spacing distance of 60cm between *Leuceana leucocephala* and groundnut rows. They further stated that alley cropping system can improve productivity in a sustainable manner by having outputs that satisfy most of the farmers' income need, at the same time nutrient recycling is enhanced, soil erosion is prevented and soil moisture is conserved. Kang and Mulongoy (1992) reported that yields of crop could be maintained for many years at reasonable levels with use of *Leuceana leucocephala* without application of inorganic fertilizers Van Lauwe *et al*, (1998) reported that *Leuceana leucocephala* has a good residue nitrogen recovery in the top soil (5 cm of the top soil); the residue quality has a major impact on the dynamics of applied residues nitrogen in alley cropping system. Attah-Krah (1990) reported that within six months *Leuceana leucocephala* fixed 250 kilogram of nitrogen per hectare. Also Kang and Mulongoy (1992) reported a range of 150-160 kilogram of nitrogen per hectare that was fixed by *Leuceana leucocephala* According to Kang *et al* (1990)

and Attah-Krah and Okali (1986) they observed that soil soils under *Leuceana leucocephala* had a higher soil organic matter, total soil nitrogen, low soil temperature fluctuation, high soil moisture and soil moisture retention than soil without *Leuceana leucocephala.* Arowolo (2007) observed that erosion in plots with *Leuceana leucocephala* was reduced by 83 % when compared to the control treatment. Imogie *et al* (2008) reported that *Leuceana leucocephala* had a highly significant ($P \leq 0.1$) effect on soil physico-chemical properties than the control. They further stated that mean fresh fruit bunch yield , over a three year period, was significantly higher ($P \leq 0.05$), with fresh fruit bunch yield of 10.93 tons/ha in plots with *Leuceana leucocephala* as against 6.8 tons/ha in the control plots.

Table 4: Estimated elasticities of production function (EP), Average production (AP), Marginal production (AP), Marginal value product (MVP) and Allocative efficiency (AEL) of groundnut-based alley cropping in Bekwarra Local Government Area, Cross River State, Nigeria.

Variables	EP	AP	MVP	MPP	P	AEL	Inference
Adoption of alley cropping of *Leuceana leucocephala* and groundnut seed rows	1	0.010	0.48	0.010	40.0	0.010	Over utilized
Labour	1.01	0.27	17.09	0.273	62.50	0.27	Over utilized
Farm size	1	2.30	2313.33	2.30	1000	2.30	Under utilized
Fertilizer	1	0.040	1.19	0.040	25	0.040	Over utilized

Source: Field survey, 2009

Decision rule:
EP= 1 is unitary elasticity production
EP > 1elastic production
EP < 1 in-elastic production

Table 4 revealed that marginal value product of alley cropping system of spacing(spacing between *Leuceana leucocephala* and groundnut seed rows), labour, farm size and fertilizers were ₦ 0.48, ₦ 17.09, ₦ 2,313.33 and ₦ 1.19 respectively, while allocative in-efficiency for alley cropping system of spacing(spacing between *Leuceana leucocephala* and ground seed rows), labour, and fertilizers were 0.010 over utilized, 0.27 over utilized ,0.040 over utilized while farm size was 2.30 under utilized, there existed production in-efficiency, there is potential for groundnut based-alley farmers to improve on production technique.

Conclusion: The result of this study showed that the total yield of groundnut produced in the study area was 19910kg and the value of groundnut produced was ₦796,400,000. A total of 2051.25 man-days were used in groundnut production through agro-forestry practices in Bekwarra Local Government Area of Cross River State. Also this study showed that groundnut-base alley cropping system of production by small-scale farmers was profitable (profit obtained was ₦ 795,925,741.30) but respondents were inefficient in production of groundnut; they over-utilized or under- utilized resources (allocative in-efficiency). However, expectation of large profits had cause most of respondents in study area to shift from traditional bush fallow system of farming to improved groundnut alley-base cropping system that is more profitable.

Finally, estimating a production function calls for accurately measured data on output and inputs. The five explanatory variables in the model were statistically significant. The cost of farm land was a powerful explanatory variable with unitary elasticity of production.

Some key recommendations have been derived. They are address to governments, industry, farmers, research and development organizations and development agencies. The recommendations are as follows:

* Urge relevant government agencies to provide agro chemicals, improved farm inputs, storage facilities and marketing facilities.
* The provision of loans with low interest rate to both small and large –scales farmers.
* The unemployed youth are encouraged to go into large scale groundnut based- alley farming business.
* Government should make and implement policy that will enable farmers to reduce cost of production and maximize profit in short and long term production of groundnut through agro- forestry practices.

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