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Land Use Pattern and Profitabilty among Crop Farmers in Nasarawa State, Nigeria.

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Abstract

The study examined land use pattern and profitability among crop farmers in Nasarawa State, Nigeria. Specifically, it described the existing land use pattern and evaluated the optimal farm profit. Multi stage sampling technique was used to select 240 respondents for the study. Data for the study were obtained from primary source with the aid of well structured questionnaires and analysed using descriptive and inferential statistics. It was found that sole cropping (53.7%) was the major enterprise practiced by the farmers while 46.3% of the farmers practiced mixed cropping. The total profit made at the profit maximizing output level was estimated to be ₦284941.44 and the mean output level (3056.5063) is significantly lower than the profit maximizing output level (Y= 6510.00). It was concluded that proper farm plan is a vital tool for profit making, educating farmers on the need for mixed cropping will help to address the issue of land shortage since land is a vital input for agricultural productivity, the mixture of maize and cowpea was found to be the best optimal farm enterprise. Crop farmers in the study area should be educated on the need to practice mixed cropping, farmers should be encouraged to cultivate a mixture of crops that will enable them optimized profit. Government and financial institutions should make credits available to farmers to acquire more inputs at subsidized rate to enable get more profit.
Key word: *Land use pattern, Profitability, Crop farmers and Regression*

INTRODUCTION

Land is often the only available resource on which rural families can rely on to build their lives. Inappropriate and uncontrolled use of natural resources can downgrade their quality and destroy them. Sustainable development and optimized use of natural resources involves effective utilization of the existing resources without damaging the assets and resources of next generations (Clark, 1996).

Proper utilization of land is essential to sustainable agricultural production and improvement in environmental quality. Throughout much of North central Nigeria, crop production is in serious competition, sometimes to the point of open conflict with nomadic cattle rearers. This is aggravated by urbanisation and growth of hitherto villages into towns, industrialization and construction of roads, which have resulted in cultivable land being withdrawn from its traditional agricultural uses, reduction in land-man ratio and average size of farmland. Population pressure has also contributed to shifts in land use (Lockwood, 1991). Farmers have responded to these pressures by expanding the use of land and intensifying production per unit land (Saka, *et al.*, 2011).

The land use pattern in agriculture is a dynamic concept as it changes over space and time (Nmadu *et al.,* 2004). According to Oladeebo (2006), Agricultural land use is the result of the

direct application of effort applied in relation to decision made by farmers regarding the actual use and pattern to be use in production. The importance of agriculture in Nigeria cannot be overemphasized. Agriculture contributes more than 40% of the total annual GDP employs about 68% of the labour force accounts for over 70% of the non-oil exports and provides over 80% of the food of the country. Over time, agriculture land use patterns undergo changes usually facilitating greater intensification of land use as a form of adapting to changing contents within an agro-ecosystem (Oviasogie, 2005). Land use pattern of a region is an outcome of natural and socio- economic factors and their demographic pressure as explained by Emokaro (2008). Olumese *et al*. (1999) claimed that 80% of farmers are engaged into food crop production.

Analytical models used to determine optimal farm profit includes Gross Margin, Net Farm Income and Profit function model. For the purpose of this research profit condition maximization approach was used because profit maximization approach put into consideration factors that influence profits. This involves determining the total cost (TC) and total revenue (TR) function. Each of the TR and TC is expressed as a function of quantity of output. The total revenue and total cost functions are as specified in equations (3) and (4), respectively, such that total revenue and total cost are individually increasing function of output (Y).

$TR = f(Y)$ ---------- (1)

$TC = c(Y)$ ---------- (2)

In order to determine the profit maximizing level of output, the marginal cost $\frac{\partial TC}{\partial Y}$ of output must be compared with marginal revenue $\frac{\partial TR}{\partial Y}$. The first order condition of determining the profit maximizing level of output states that marginal cost should be equal to marginal revenue, implying that the difference between the first derivatives of total revenue and total cost functions should be equal to zero as indicated in equation (1)

$$\frac{\partial TR}{\partial Y^2} - \frac{\partial TC}{\partial Y} < o \quad \text{---------- (3)}$$

In ascertaining that the level of output obtained in equation (3) is the one that maximizes profit, the second order condition must be met as indicated in equation (4)

$$\frac{\partial^2 TR}{\partial Y^2} - \frac{\partial^2 TC}{\partial Y^2} \quad \text{----------(4)}$$

Profit function maximization approach: This necessitates the derivation of total profit function such that profit is a function of output as stated in equation (5)

$\prod = f(Y)$ ……(5)

The first order condition requires that the first derivative of the profit function be equal to zero as in equation (6)

$\frac{\partial \Pi}{}$

$\partial Y = 0$ ……………………………………………………………(6)

The level of output obtained in equation (8) is the profit maximizing level if the second order condition stated in equation (7) is satisfied.

$$\frac{\partial^2 II}{\partial Y^2} = 0 \quad \text{……………………………………………………………………………(7)}$$

Maximization of average profit approach: This is a variant profit maximization objective where the enterprise is interested in deriving maximum profit per unit of output. The average profit function is obtained and the level of output at which both the first and second order conditions are met (equations (8) and (9), respectively) represents the average profit maximizing level of output.

$$\frac{\partial \frac{II}{Y}}{\partial Y} = 0 \quad \text{…………………………………………………………………..(8)}$$

$$\frac{\partial \left(\frac{II}{Y}\right)}{\partial Y^2} < 0 \quad \text{……………………………………………………………………….(9)}$$

Maximization of sales revenue: This involves obtaining the value of output that maximizes sales (R). The sales revenue function is stated in equation (10) and the conditions for determining the level of output that maximizes sales revenue are given in equations (11) and (12).

$$II\ r\ (Y) \quad \text{…………………………………………………………………..(10)}$$

$$\frac{\partial R}{\partial Y} = 0 \quad \text{………………………………………………………………………………….(11)}$$

$$\frac{\partial}{\partial Y} = < 0 \quad \text{…………………………………………………………………………………..(12)}$$

METHODOLOGY

This study was conducted in Nasarawa State, North Central Nigeria. The state is made up of thirteen Local Government Areas and they are grouped into three Agricultural zones of Northern, Southern and Western zone. The state lies between latitude $8^o30'$ and $8^o\ 40'$ N and longitude $7^o\ 34'$ and $7^o\ 45'$ E (Nasarawa State Ministry of Information, 2005). Nasarawa State covers an area of 27,117km^2 with estimated population of 1,863,275 people (NPC, 2006). It has a mean temperature range from 25^{o}C in October to about 36^{o}C in March with annual mean rainfall of 1311.75cm (Nigerian Meteorological Agency, Lafia 2012). Alluvial soils are found along the Benue trough and their flood plains. The forest soils which are rich in humus are found in most part of the State. There are also sandy soils in some parts of the State. Solid minerals notable are salt and bauxite. The state is an agrarian state with large percentage of the populace engaged in farming and agro-allied activities. The soil texture is sandy loan and very fertile for crops like sorghum, cowpea, cassava, rice among others that was cultivated in the study area.

Multi-stage sampling procedure was used in the selection of respondents. Firstly, purposive sampling was used to select two Local Government Areas each from the three agricultural zones of Nasarawa State. Northern zone, Akwanga and Wamba Local Government Areas, Southern zone; Lafia and Obi Local Government Areas and Western Zone, Keffi and Nasarawa Local Government Areas. Secondly, from each Local Government Areas two communities were randomly selected. Thirdly, 20 farmers were randomly selected from each of the community, giving a sample size of 240 farmers.

Data for this study were collected from primary source. Primary data were collected using structured questionnaire. The data collected consisted of information on Land uses, land use intensity, crop production practices, and cropping systems. Data collection for the study was between the months of April and July, 2014.

The data for this study were analysed using both descriptive and inferential statistics such as percentage, frequency and gross margin and profit regression model.

The profit model estimated is as specified in equation (7) in section 2.6.2 and this addressed objective v. Profit is conceptualized as the amount by which revenue exceeds costs. Revenue in optimal farm is the product price per unit (kg) of crops. Both explicit and implicit costs of production were taken into consideration in the computation of cost, that is, economic cost concept will be applied. Thus profit ($\prod$) was used in this study as revenue less economic cost.

$\prod$ is the dependent variable measured in Naira (₦) which is regressed on the independent variable (Y).

Y is the quantity (weight) of crops produced by the farmers measured in a unit of 100kg bag.

Both $\prod$ and Y were computed for each farmers and regression analysis were carried out on the functional forms stated in equations (13) to (16) using statistical package for social sciences (SPSS) software programme.

Linear: $\prod = \beta_0 + \beta_1 Y + e$ ……13

Quadratic: $\prod = \beta_0 + \beta_1 Y - \beta_2 Y^2 + e$ …… ……14

Cubic: $\prod = \beta_0 + \beta_1 Y - \beta_2 Y^2 + \beta_3 Y^3 + e$ … ……15

Double log: $\log\prod = \log\beta_0 + \beta_1 \log Y + e$ ……16

The significance of the regression coefficients and adjusted coefficient of multiple determination and F – test was used in selecting the lead equation. From the lead equation selected, the profit maximizing output level of the farmers were determined as the output level at which both the first and second order conditions were satisfied. In order to identify the average profit maximizing output level, the average profit function was derived from the profit function (lead equation) and the first derivative was equated to zero to satisfy the first order condition. Second order condition will be used to confirm that the output level obtained is the global maximum. Mathematical Software Package was used to determine the value of output at which the first derivative of each of the profit maximizing and output level is individually equal to zero.

RESULTS AND DISCUSSION

Land Use Pattern of Crop Farmers

The results on land use pattern are shown in Table 1. The study showed that the farmers adopted different agricultural diversification strategies to fully utilize the land and cope with risks and uncertainties in other to optimally use the land. The result in Table 1 shows that 53.7% of the respondents practiced sole cropping which implies that sole cropping is the highest form of land use pattern adopted by farmers in the study area while 46.3 % of the respondents practiced mixed cropping. The finding is not in agreement with that of Amaza (2000) who reported mixed cropping as the dominant land use pattern of farmers in Gombe State of Nigeria.

Table 1: Land Use Pattern Adopted By Farmers in the Study Area.

Cropping System	Frequency	Percentage
Sole Cropping	128	53.7
Mixed Cropping	112	46.3
Total	240	100

Source: Field Survey, 2014

Gross Margin of Crops Enterprises

The result of the summary statistics of gross margin presented in Table 2 shows that the mean total variable cost ₦85352.50 was lower than the mean total revenue ₦348,267.12 per hectare. The mean gross margin of crops produced was found to be ₦262,914.62 per hectare, minimum gross margin was ₦51,300.00 and maximum gross was ₦2,046,780.00. This implies that crop production is a profitable enterprise in the study area.

The result in Table 3 summarizes distribution of gross margin of crops enterprises among the respondents. The result showed that 20.9 percent of the farmers had gross margin within the range ₦50,000.00 and below per hectare, 22.2 percent had gross margin within the range of ₦50,000.01 to ₦100,000.00, 14.2 percent of the respondents had gross margin that were within the range ₦100,000.01 to ₦150,000.00 while 42.7 percent of the farmers had gross margin of ₦150,000.01 and above.

Table 2: Summary Statistics of Gross Margin

Variables	Minimum	Maximum	Mean	Std Deviation
Cost of Seed	0.00	61000.00	11059.17	14310.89
Cost of Herbicide	0.00	27500.00	8931.67	7736.68
Cost of Fertilizer	0.00	150000.00	20904.17	21722.41
Cost of Manure	0.00	18000.00	700.00	2584.47
Cost of Urea	0.00	18000.00	2243.75	4727.07
Cost of Labour	0.00	90000.00	20635.42	15955.26
Miscellaneous Cost	900.00	100000.00	19374.17	17164.26
TVC	14200.00	272200.00	85352.50	43271.04
Total Revenue	65500.00	2140000.00	348267.12	303673.41
Gross margin	51300.00	2046780.00	262914.62	285945.10

Field Survey, 2014

Table 3: Distribution of Crop Farmers According to Gross Margin

Gross Margin (₦)	Frequency	Percentage
≤ 50,000.00	50	20.9
50,000.01 – 100,000.00	53	22.2
100,000.01 – 150,000.00	35	14.2
≥ 150,000.01	102	42.7
Total	240	100.0

Source: Field Survey, 2014

Regression analysis for determining maximum profit output level

The cubic functional form gave the best fit and was chosen as the lead equation because it has the highest R^2 value of 0.7 regression line. The empirical form of the cubic function is as shown in equation (17)

$$\prod = 0.000000002816Y^3 - 0.006Y^2 + 84.819Y - 13726.572 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

R^2 is the adjusted coefficient of multiple determinations for profit function. The adjusted coefficient of multiple determination shows that 70.9 % of the variation in profit was due to the changes in output. The remaining 29.1% may be as a result of other factors such as management, environment and market condition not included in the model. Taking the first derivative of the total profit function of equation (26) and equating to zero to meet the first order condition results in equation (36).

$$\frac{\partial \Pi}{\partial Y} = 0.000000008448Y - 0.012Y^2 + 84.819 = 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

$$= (Y - 6510)(Y - 1414000) = 0$$

$$Y = 6510 \text{ or } 1414000$$

The second derivative of the total profit function is indicated in equation (19)

$$\frac{\partial^2 \Pi}{\partial Y^2} = 0.00000001689Y - 0.012 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (20)$$

The second order condition is satisfied at Y equals 6510 because the value of equation (20) is negative but not at Y equals 1414000 where the value is positive. Thus, the total profit maximizing level of output is Y equal 6510 (6510kg of crops). The total profit made at the profit maximizing output level was estimated to ₦284941.44. This implies that operating at the profit maximizing level of output and the same level of technology, requires larger farm size in hectare as such more production resources than the mean output level. This result agrees with that of Alimi *et al*. (2004).

The result in Table 4 shows that the profit maximizing output level (Y= 6510.00) is significantly higher than the mean output level (Y= 3056.5063). The T-test was 17.990 and was significant` at 1% indicating that the profit maximizing output level is significantly higher than the mean output level.

Determining average profit maximizing output level

Average profit function was derived from the total profit function of equation (17) to give equation (21)

$$\frac{\partial \Pi}{Y} = \frac{0.000000002816Y^3 - 0.006Y^2 + 84.819Y - 13726.572}{Y}$$

Profit function = $0.000000002816Y2 - 0.006Y + 84.819 - 13726.572Y\text{-}1$…….. (21)

First order condition requires that

$$\frac{\partial \Pi}{\partial Y} = (5.632 \times 10^{-9})\, Y^3 - 0.006Y^2 + 13726.572 = 0 \text{……} (22)$$

$$= (Y\text{-}1513.6106)\,(Y\text{-}\,1065338.7616)\,(Y + 1511.4631)$$

Thus, maximum profit occurs where either Y = 1513.6106 or 1065338.7616 or -1511.4631. There cannot exist rationally a negative output, therefore, option of output level -1511.4631 was dropped.

For the second order condition to be satisfied equation (40) should be negative at the average profit maximizing output level and this occurs at Y equals 1513.6106 or 1065338 kg of crops

$$\frac{\partial^2 \Pi}{\partial Y^2} = 0.000000005632 - 27453Y^{-3}$$

The result of the analysis indicate that crop enterprises earned economic profit at mean output level, average profit maximizing output level and total profit maximizing output level. Earning of economic profits serves as incentive for either other farmers to enter production or existing farmers to increase their farm size, until the farmers are in the long run equilibrium at no profit, no loss level of operation. Assuming for the purpose of analysis that increase in farm size by the existing is the only option available, then the (∏) in equation () will be zero as in equation (23)

$$\prod = 0.000000002816Y^3 - 0.006Y^2 + 84.819Y - 13726.572 = 0$$

$$= (Y - 163.7298)\,(Y\text{-}14066.7320)\,(Y\text{-}2116451.3563)$$

$$Y = 163.7298 \text{ or } 14066.7320 \text{ or } 2116451.3563$$

Economic theory states that productive capacity expands in the long run for the firms and industry where the existing firms enjoy economic profits (Jhingan, 2003). Therefore, Y = 163.7298 is not rational as it is less than either the average profit maximizing or total profit maximizing level of output where economic profits are made. Thus, the realistic option is either 14066.7320 or 2116451.3563 bags output. This implies that consumers of crops benefit by having access to higher quantity of crop output at possibly lower price. The level of reduction in

prices in the long run is a function of whether the crop enterprise is increasing cost, constant cost or decreasing cost.

Table 3: Maximum Profit Output Level

Types of Profit	Profit Maximizing (Y=6510.00)	Average Profit Maximizing (Y = 1513.6106)
Total Profit (∏)	284941.44	100920.028
Average Profit($\frac{\text{II}}{\text{Y}}$)	43.77	66.675
Average Profit $\frac{(\prod)}{\text{Kg}}$	0.44	0.667

Source: Field Survey, 2014

Table 4: Test of Hypotheses

Study area	**Mean**	**Std. Deviation**	**Mean Difference**	**T**	**Df**	**Sig.**
Full sample (N=240)	3056.5063	2967.78826	-3453.493	-17.990	238	0.000

Source: Field Survey, 2014

CONCLUSION

Proper farm plan is a vital tool for profit making, educating farmers on the need for mixed cropping will help to address the issue of land shortage since land is a vital input for agricultural productivity, the mixture of maize and cowpea was found to be the best optimal farm enterprise.

RECOMMENDATIONS

(i) Crop farmers in the study area should be educated on the need to practice mixed cropping as the best land use pattern.

(ii) Government and financial institutions should make credits available to farmers to acquire more inputs at subsidized rate to enable get more profit.

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