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LAND USE-PATTERNS AND EFFICIENCY OF CROP PRODUCTION AMONG FARMERS IN OGUN STATE, NIGERIA

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Abstract

This study examined land use patterns and efficiency of crop production among farmers in Ogun State, Nigeria. A multistage sampling procedure was used to select respondents for the study. Data were collected using structured questionnaire and interview method. A total of 128 respondents were used for the conduct of the analysis. The analytical tools employed were descriptive statistics such as frequencies percentages, measures of dispersion and measures of central tendency, budgetary analysis as well as the Stochastic Frontier Production Function (SPF). Results of the analysis revealed that majority of the farmers were male, married, highly experienced and formally educated. The predominant cropping pattern was mixed cropping and continuous farming was mostly practiced. Budgetary analysis showed that the farming was profitable. However, with respect to cropping pattern and farming system, sole cropping and crop rotation were most profitable. Seed, labour and herbicide had significant effect on the technical efficiency of the farmers. Farming experience and household size were seen to contribute to the inefficiency level of the respondents. The respondents had a mean technical efficiency of 0.6749, indicating that in order for them to operate on the frontier, they have to overcome an inefficiency level of 32.51%. Laws binding land acquisition should be made flexible, so as to encourage farmers to expand their production and to reduce pressure on lands brought about by mixed farming and continuous cropping systems.

Keywords: *Land use-pattern, efficiency and crop farmers*

Introduction

Land is a major factor of production and also a critical input in agricultural production. Accordingly, its relevance is imposed improve the productivity of land especially by majority poor subsistent farmers that dominate the arable crop production landscape (Raufus, 2010). The relevance of land and land resources cannot be overemphasized as land resources play crucial role in providing people with living space, raw materials for industrial purposes as well constituting man's physical environment. Man depends on land for sustenance, food, clothing and shelter; housing, and manufactured goods, building sites, and recreation opportunities. Land is not only crucial for rural people who have their livelihood based in agriculture, but also a basis of wealth and power (Alawode, 2013). According to Akinbile and Adekunle, (2000), there is a continuous rise in the demand for agricultural produce which has resulted in the increased use of cultivable land coupled with increased level of agricultural productivity.

Land use patterns directly affect the productivity level of the land. Agricultural lands can be subjected to several forms of use in terms of the nature of agricultural practices carried out. These practices range from cropping systems such as mono/sole cropping and mixed cropping to farming systems such as; continuous farming, bush fallowing and crop rotation. In the practice of mono/sole cropping, the farmer is interested in growing a single kind of crop; for instance, a maize farmer, cocoa farmer, cassava farmer; while mixed cropping involves the cultivation of different types of crops on the same piece of land. It could be a two-crop combination (e.g., cassava/maize), three-crop combination (e.g. vegetable/maize/yam), four or more-crop combinations. Continuous farming, as the name implies, is a farming system that is characterized by "incessant" production seasons or "all-year-round" production. Under the bush fallowing system, a piece of land is left "unfarmed" for a period of time in order for it to regain its lost nutrients. Raufus, (2010) asserted that agricultural production in the developing economies depends on land use intensity and resource allocation and this was supported by Udoh *et al*, (2002) that efficient land utilization and management practices ensured achievement of by its accessibility, availability, quantity and quality. Nigeria holds land quality in high esteem and marks it as a major determinant of land productivity. This is due to the problems associated with sourcing artificial amendments that can farm level objectives in term of economic viability, food security and risk aversion. Udoh *et al*., (2011) further opined that land is an important farm resource hence agricultural policies and programmes in Nigeria were aimed at improving accessibility to fertile land by farmers through provision of irrigated lands and land reclamation. Udoh (2000) posited that the accessibility of most agricultural lands especially in the southern part of the country depends largely on land tenure system and the extent of competition by non-agricultural land uses.

Farming in Sub-Sharan Africa is characterized by small land sizes averaging 2-3 hectares, land fragmentation and insecurity in tenurial system. These make land to be one of the major constraints limiting increased agricultural production. In addition, land insecurity nature in land tenure systems make farmers not to invest intensively on these lands. Also, there is high probability of losing their farm lands because most of the farmers are not the real owners of the land.

On the other hand, land use pattern determine to a large extent the output of the farm. For instance, continuous cultivation without allowing the land to fallow may drain the soil fertility leading to reduce output of crop farm or crop failure. Since the output of the farm is germane to a large extent in the determination of the technical efficiency of the farmers, hence this study examined assess the land use patterns as well as efficiency of crop production among crop farmers in Ogun State, Nigeria. On the bases of the above relevance of land tenure system and land use pattern, this study is therefore adjudged right and timely.
The broad objective of this study is to assess the land use patterns as well as efficiency of crop production among crop farmers in Ogun State, Nigeria. Specifically, the study is to:

- examine the cropping and farming systems in the study area;

- analyze the costs and returns across land use patterns; and
- ascertain the efficiency of crop farmers in the study area.

Methodology

Study Area

The study was conducted in Ogun State, South-western Nigeria. Ogun State consists of 20 local government areas and it lies approximately between latitude 3º30 N and 4º30N and longitude 6º30 E and 7º 30E. The state shares boundary with Republic of Benin in the West, Lagos State and Atlantic Ocean in the South, Ondo State in the East and Oyo State in the North. It is located within the humid tropical lowland region with two distinct seasons. Average annual rainfall ranges from 1, 200mm in the Northern part to 1,470mm in the Southern part. The monthly temperature ranges from 23^0C in July to 32^0C in February. The mean daily sunshine hours ranges between 3.8 and 6.8. The state has a relative humidity which ranges between 76 percent and 95 percent (coinciding with dry and wet seasons respectively). The northern part of the state is mainly of derived savannah vegetation, the southern part has mangrove swamp vegetation while the central part falls in the rainforest belt. Ogun State is endowed with fertile soil, which supports the growth of food crops, permanent crops and livestock. Ogun State covers a land area of 16,762 sq km with a population of 3, 728, 098 (NPC, 2006). The state has been divided into four agricultural zones by the Ogun State Agricultural Development Programme (OGADEP) which is further divided into blocks while the blocks are divided into cells. The zones are Abeokuta, Ijebu-Ode, Ilaro and Ikenne.

Sampling Procedure

Data for the study were collected using a multistage sampling procedure. The first stage involved the random selection of two (2) blocks from each of the four agricultural zones in the state. The second stage involved a selection of two (2) cells from each of the selected blocks in stage one. In the third stage, nine farmers were randomly selected from each of the cells selected in stage two. These procedures led to a selection of 144 food crop farmers used for the study. However, 128 sets of questionnaire (about 89%) were used for the conduct of the analysis as they provided sufficient information. The range of data collected covered farmers' specific characteristics, inputs and output used in production as well as cropping systems and crop combinations.

Analytical techniques

Data analysis involved the use of descriptive statistics such as frequencies percentages, measures of dispersion and measures of central tendency, budgetary analysis as well as the Stochastic Frontier Production Function (SPF).

Budgetary analysis

Budgetary analysis was used to analyze the cost and return structure of the food crop farmers.

$$GM = \sum Pi\ Qi - \sum Cj\ Xi \quad \text{.................} (1)$$

GM = Farm Gross Margin (Naira)
P_i = Unit price of output for crop i (Naira)
Q_i = Quantity of output for crop i (Kg)
C_j = Unit price of the variable input j (naira)
X_j = Quantity of the variable input j

Straight line method of depreciation was used to calculate the depreciation cost of farm tools and equipment. The formular is given as;

$$Depreciation\ Amount = \frac{Original\ Cost\ of\ Item - Junk\ Value}{Expected\ Life}$$

Stochastic frontier function: The stochastic frontier production function independently proposed by Aigner *et al*. (1977) and Meeusen and Van Den Broeck (1977) assumes that maximum output may not be obtained from a given input or a set of inputs because of the inefficiency effects. A farm household producing a single output Y with n inputs ($x_{I}, ...x_n$) will have (inefficient) transformation of inputs into output characterized by a production function {f(x)}.

The stochastic frontier (production) function for the farm can be represented by:

$$Q_i = [f(x_i\ a)]^{(vi - ui)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (i)$$

where:-
Q_i = output of the ith farm (Kg)
x_i = inputs;
a = parameters to be estimated.
F(x) = a functional form e.g. Cobb – Douglas;
U_i = technical inefficiency in production;
V_i = stochastic error term.

This model is specified in such that the possible production Y_i is bounded above by the stochastic quantity {f(xi, b)} vi hence the term stochastic frontier.

Model Specification.

The SPF for arable crop farmers will be specified as:

$$In\ Q_i = b_0 + b_1 lnX_1 + b_2 lnX_2 + b_3 InX_3 + b_4 InX_4 + b_5 InX_5 + V_i - U_i \text{---}(ii)$$

With the technical inefficiency assumed to be explained by:

$$Mi = b_0 + b_1 AG + b_2 SE + b_3 FE + b_4 HS + b_5 CS + b_6 FS \ldots\ldots\ldots\text{--------------------------------}\ldots\ldots\ldots\ldots\ldots (iii)$$

where:
V_i, U_i, Q_i, M_i, a and b = as previously defined;
X1= Seed (kg);
X2 = Labour (man-days);
X3 = Fertilizer (kg);
X4 = Herbicides (kg);
X5 = Insecticides (kg);
X6 = Farm size (Ha)
AG= Age (years)
SE = Sex (1= male, 0= female)
FE= Farming Experience (years)
HS= Household Size (number of persons)
CS= Cropping System (1 = mixed cropping, 0 = otherwise)
FS= Farming System (1 = continuous farming, 0 = otherwise)

Results and Discussions

Socioeconomic Characteristics of the Farmers

Table 1 revealed that majority (57%) of the farmers were 50 years and below. The result also revealed that the respondents had a mean age of about 49 years and a standard deviation of 11.8 indicating that the farmers were in their active years. This implies that majority of the farmers were in their active age. This corroborates the findings of Udoh *et al*. (2011) that crop farmers have a mean age of about 47 years and hence were in their active years of production. This could have a positively significant effect on their level of production because activeness declines with age and since the farmers were still active, adoption of certain agricultural practices including exploring various patterns of land use would be done with ease. Most of the farmers were married (89.8%). This goes to show that the farmers recognize the usefulness of the spouse with respect to farming as certain farming activities are gender based. This finding agrees with the position of Raufu (2010), where he posited that most crop farmers are married. The results also revealed that majority of the crop farmers were male folks (82%). This might be because males have more access to land than females. According to Udoh *et al*., (2011) among arable farmers in Akwa Ibom State, it was revealed that household heads were dominated by male folks and this was because male culturally dominate the decision making of the family. The table reveals that majority (54.5%) of the farmers have large (>5) family size. The mean household size was 6 persons and the standard deviation was 2.7. The implication is that the farming households would have access to family labour which would in turn reduce the cost of hiring labour for basic farming practices. Large family size also has significant effect on land fragmentation especially in cases where the members of the family are mainly adults. This also agrees with the findings of Odoemenem and Inakwu (2011) that the household size of most farming households is between 6 and 10 and concluded that the large household size encouraged utilization of family labour which reduces cost of hiring labour, eliminates every form of mishap caused by the use of hired labour and facilitates commitment on the part of the family labour. The authors concluded that farming activities are not just seen as farming business, but as a source of livelihood and promotes efficiency. Majority (70.3%) of the farmers had one form of formal education or the other. This implies that there would be easy adoption of improved farming technology sand consequently, increased productivity. This contradicts the findings of Sadiq *et al*. (2013) that most crop farmers are mostly accustomed to non-formal education. Education in the farming business gives the farmers upper hand as against their uneducated counterparts. It also encourages trial of various land use pattern and subsequent adoption of the most beneficial as well as enhances efficiency. The mean years of farming experience is 21 years with a standard deviation of 13.5. This would in the long run have a positive effect on their production as ease of adoption of technology as well as efficiency increases with experience. This supports the findings of Adeyemo *et al.* (2010) that majority of the farmers that have more than 10 years' experience in crop production are expected to be well grounded in the best practices of the enterprise.

TABLE 1: Socioeconomic Characteristics of the Respondents

Age Range	Frequency	Percentage	Mean	Standard deviation
≤30	7	5.5		
31-40	25	19.5	**49**	**11.8**
41-50	41	32		
51-60	33	25.8		
61-70	18	14.1		
>70	4	3.1		
Gender				
Male	105	82		
Female	23	18		
Marital Status				
Single	4	3.1		
Married	115	89.8		
Divorced	1	0.8		
Widow	8	6.3		
Household size				
1-5	57	44.5		
6-10	68	53.1	**6**	**2.7**
11-15	1	0.8		
16-20	2	1.6		
Education				
None	38	29.7		
Primary	32	25		
Secondary	31	24.2		
Tertiary	5	3.9		
Adult	22	17.2		
Occupation				
Crop Farming	81	63.3		
Crop & animal husbandry	24	18.8		
Civil Servant	7	5.5		
Trading	4	3.1		
Others	12	9.4		
Farming Experience				
1-10	40	31.3		
11-20	33	25.7		
21-30	26	20.3	**21**	**13.5**
31-40	29	22.7		
Total	**128**	**100**		

Source: Computed from Field Survey, 2016

Distribution of Land Acquisition and Land Use-pattern

The result from Table 2 reveals that most (71.1%) of the farmers acquired their farm land from rent/lease. Only 8.6% purchased the land used. These results agreed with the findings of Oladehinde *et.al* (2017) who concluded that land acquisition by rent/lease was predominant in Ogun State. The results from the table also reveal that mixed cropping (77.3%) system was the predominant cropping system in the study area. This, most likely, arises from the fact that most of the crop farmers have food demands to meet at home and considering that the government only rents out a piece of land at a time, as well as the fact that the crop farmers have vested interest in cultivating other food crops both for subsistence and commercial purposes, mixed cropping appears to be the best cropping system. Also, as a result of land acquisition through lease from government, diversification of practice becomes pertinent, mixed cropping system therefore, satisfies that objective. The most commonly practiced farming system is continuous farming (50.8%). This is because arable crops are mostly cultivated and their production period is mostly under a year. Also, considering the need to meet domestic demand for food which is constantly on the increase, crop farmers have to continually grow crops to meet the pressing demand. There is no provision for bush fallowing because the farmer uses the land continuously as a result of lease.

Table 2: Distribution of Land Acquisition and Land Use-pattern

VARIABLES	Frequency	Percentage
Land Acquisition		
Rent/Lease	91	71.1
Purchase	11	8.6
Inheritance	22	17.2
Gift	4	3.1
Cropping System		
Sole/mono cropping	29	22.7
Mixed cropping	99	77.3
Farming System		
Continuous Farming	65	50.8
Crop Rotation	40	31.3
Bush Fallow	23	18
Total	**128**	**100**

Source: Computed from Field Survey, 2016 Bugetary Analysis

Table 3: Cost and Return of Crop Farmers

Items	Amount per Hectare (₦)
Variable cost	
Seed	25, 925. 87
Labour	19, 652. 06
Fertilizer	26, 142. 58
Herbicide	7, 003. 13
Insecticide	1, 341. 60
Total Variable Cost (TVC)	**80, 065. 24**
Fixed Cost	
Depreciation	3, 637. 50
Total Cost (TC)	**83, 702. 74**
Total Revenue (TR)	**1, 509, 337. 99**
Gross Margin (GM)	**1, 429, 272. 75**

Table 3 shows the result of the budgetary analysis of the farmers in the study area. The total variable cost (TVC) was ₦80,065.24, the total fixed cost was ₦3,637.50, the total cost was ₦83,702.74 and the total revenue was ₦1,509,337.99. The gross margin (GM) was ₦1,429,272.75. This shows that crop farming in the study area is profitable. This supports the findings of Udoh *et al.* (2011) that crop farming is a profitable venture.

Table 4: Cost and Return per Hectare across Cropping and Farming Systems in Naira

Variable Cost (₦)	Cropping System		Farming System		
	Sole/Mono	Mixed	Continuous	Crop Rotation	Bush Fallow
Seed	29, 964. 55	24, 742. 83	23, 241. 02	26, 216. 64	33, 007. 83
Labour	25, 044. 33	18, 072. 51	20, 916. 07	18, 900. 82	17, 386. 38
Fertilizers	16, 989. 66	28, 823. 74	18, 553. 08	43, 390	17, 595. 65
Herbicides	6, 325. 86	7, 201. 52	5, 706. 15	9, 062. 50	7, 086. 96
Insecticides	1, 020. 69	1, 435. 61	1, 232. 69	1, 927. 50	630. 43
TVC (A)	79, 345. 09	80, 276. 21	69, 649. 01	99, 497. 46	75, 707. 25
Fixed Cost					
Depreciation	4, 512. 93	3, 381. 06	3, 718. 77	3, 721. 25	3, 262. 17
Total Cost (B)	**83, 858. 01**	**83, 657. 26**	**73, 367. 78**	**103, 218. 72**	**78, 969. 43**
Total Revenue (C)	**3, 731, 766. 28**	**858, 323. 73**	**875, 932. 59**	**3, 269, 776. 21**	**237, 765. 30**
Gross Margin (C–A)	**3, 652, 421. 20**	**778, 047. 53**	**806, 283. 58**	**3, 170, 278. 74**	**162, 058. 05**

Table 4 presents the results of budgetary analysis across various cropping and farming systems in the study area. Sole cropping has a gross margin of ₦3,652,421.20, while mixed cropping has a gross margin of ₦778,047.53. It is evident from the results that sole cropping is more profitable than mixed cropping. Also, continuous farming has a gross margin of ₦806,283.58, crop rotation is ₦3,170,278.74 and bush fallow has a gross margin of ₦162,058.05. This shows that the farming system of crop rotation is the most profitable farming system. Crop rotation, when properly practiced, can improve fertility of the soil, which in turn increases productivity. Continuous farming on the other hand, puts pressure on the soil and exhausts the soil nutrient having a negative impact on productivity. Bush fallowing, a practice of "leaving the soil to rest" helps the soil regain its lost nutrients; however, the land is not being utilized during the fallow period as there is cessation of production. Mono/Sole cropping promotes focus and specialization; hence, the farmer is able to adopt specific technology that would cause an increase in productivity and efficiency.

Determinants of Technical Efficiency among Crop Farmers

This section presents the result of the analysis of the factors influencing technical efficiency of the crop farmers. The estimated results of the Maximum Likelihood Estimates (MLE) of the parameters of the Cobb Douglas Stochastic Frontier Production Function (SFPF) and the inefficiency model are presented in Table 5. From the Table, the sigma squared was statistically significant ($p<0.01$), which indicates the correctness of the specified assumption of the distribution of the composite error term. Also, the major factors that influenced the output of crop farmers in the study areas were; seeds, labour and herbicides. These also contributed significantly to the technical efficiency of the respondents. The co-efficient of seed was significant ($p< 0.01$) and positive, which implies that increase in output of crop farmers, can be achieved by increasing the quantity of seeds planted. This finding acquiesces with Ogundele and Okoruwa (2006) who examined technical efficiency differentials in various production technologies in Nigeria. They reported that the coefficient of seed was positive and significant and that increase in seed would increase output levels of rice farmers. Also, the co-efficient of labour was positive and significant ($p< 0.01$), which indicates the relevance of labour to output. Good and efficient labour management is a prerequisite to eventual production efficiency. Therefore, crop farmers should strive to promote proper labour management. This agrees with the findings of Amaza and Maurice (2005) and Oniah *et al*. (2008) who reported that coefficient of labour was positive and significant and that increase in labour usage would result in increase in output levels in farm production. The coefficient of the cost spent on herbicide use was also positive and significant ($p< 0.05$), indicating the relevance of weed control in crop production. Weeds are known to compete with crops for a lot of growth resources like, water and nutrients; hence eradication of weeds would in the long run ensure efficient production. Farm size, fertilizer and insecticides did not contribute significantly to technical efficiency. This result contradicts the finding of Muhammad *et al*. (2009) who worked on the technical efficiency of youth participating in agriculture programme in Ondo State, Nigeria. In their study, they stated that farm size was positive and significant and that increase in the farm size would eventually increase output level of farmers. The contradiction could be due fact that youth are very energetic and may be operating on a large scale. From the result of the inefficiency model, the major factors which influenced the inefficiency of the respondents were; farming experience and household size. Farming experience was found to have a negative and significant co-efficient ($p< 0.05$). The implication of this is that as the respondents' farming experience increases, their inefficiency declines. Although, this result is consistent with a priori expectation that, the more time a person spends doing a particular thing, the better he gets at it; it however contradicts the findings of Ogundele and Okoruwa (2006) who examined technical efficiency differentials in rice production technologies in Nigeria and reported that technical efficiency was not affected by any of the socio-economic variables. Household size had a negative and significant co-efficient ($p< 0.1$). The implication of this is that as the respondents' household size increases, their inefficiency declines. This could most likely be as a result of the utilization of family labour as a replacement for hired labour. Hence, reducing the cost of labour and coupled with the fact that great care is taken during performance of farm activities as a result of the high sense of ownership possessed by family labour (a factor absent in hired labour). This finding, however disagrees with Mohammed *et al*. (2009) who opined that as family size increases the technical efficiency decreases. Usman (2012) also corroborated their findings in his study on profitability and technical efficiency of swamp rice production in Niger state, Nigeria, where he reported that as family size increases, technical inefficiency o the farmers also increases.

Table 5: Determinant of efficiency among Crop Farmers

Variables	**Coefficient**	**t-value**
Constant	7.5544***	4.50
Seed	0.5085***	2.92
Labour	0.0024***	2.86
Fertilizer	-0.0887	-1.59
Herbicide	0.1160**	2.17
Insecticide	0.0653	1.20
Farm size (Ha)	-0.5234	-1.03
Inefficiency		
Constant	0.4041	0.41
Age	-0.0847	-1.15
Sex	0.9440	0.78
Farming Experience	-0.0490**	-2.32
Household size	-0.3700*	-1.98
Cropping System	0.0903	0.08
Farming System	0.0423	0.06
Sigma-Squared	**3.7529*** **	**6.15**
Gamma	**0.1187**	**0.79**

Log likelihood Function = -263.526

Distribution of Technical Efficiency among Farmers

The table above shows the distribution of technical efficiencies among farmers. Majority of the farmers (71.9%) had technical efficiencies that ranged from 0.5000 to 0.8999. The mean technical efficiency was 0.6749, indicating that they had an inefficiency level of 32.51%.

Table 6: Distribution of Technical Efficiency among Farmers

Range	Frequency	Percentage (%)
0.1000-0.4999	23	18.0
0.5000-0.8999	92	71.9
Above 0.8999	13	10.2
Minimum	**0.1530**	
Maximum	**0.9975**	
Mean	**0.6749**	

On the basis of land rotation pattern, it was shown in table 7 below that farmers who practiced crop rotation were more technically efficient than others who practiced other forms of land rotation pattern. It was revealed that those who practiced crop rotation had a mean efficiency score of about 0.72, indicating that they had to overcome an inefficiency of about 28 percent to be on the production frontier .

Table 7: Distribution of Technical Efficiency Among Land Rotation Pattern

Pattern	**Frequency**	**Mean Technical Efficiency**
Continuous cropping	65	0.6800
Crop Rotation	40	0.7158
Bush Fallowing	23	0.5893
Total	128	

Conclusion

The food challenge faced by Nigeria is reflected in both quantity and quality. Accompanying low agricultural production is poverty of farming households. It is therefore pertinent that farmers use available resource economically and efficiently. As shown in this study, the efficiency of the respondents is affected by various factors among which are household size and experience. The study revealed that experience provided a platform for the farmers to explore all available options with respect to various patterns of land use. Of all the patterns of land rotation available to the farmers, farmers were more technically efficient with crop rotation. The predominant farming system is continuous farming and mixed cropping is the most adopted cropping system. According to Swinton *et al*. (2003), land management pursued by households may cause both an increase and decrease in resource degradation (in this case, land) and hence, it is needful that an investigation such as this, that examines the various patterns of land use by farmers be carried out. Laws binding land acquisition should be made flexible, so as to encourage farmers to expand their production and to reduce pressure on lands brought about by mixed farming and continuous cropping systems.

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