# LAND USE PATTERNS AND EFFICIENCY OF CROP PRODUCTION AMONG SETTLERS AND NON-SETTLERS CROP FARMERS IN SOUTH-WEST NIGERIA

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**Abstract**

*This study examined land use patterns and efficiency of crop production among settlers and non-settlers crop farmers in South-West Nigeria. A sample size of 300 small-scale farmers was randomly selected of which 262 were used to conduct the analysis. A well-structured questionnaire was used to obtain data from the farmers. The data was analyzed using descriptive statistics, stochastic frontier analysis, ANOVA and t-test. Efficiency analysis identified seed, fertilizer, herbicides, insecticides and farm size as the major factors contributing significantly to output. The inefficiency model identified farming experience, settlement and age as having a negative but significant relationship with inefficiency. The crop farmers had a mean efficiency of* 0.8037. *The t-test revealed that there was significant difference exists between the costs incurred in the cropping systems. ANOVA result revealed that there was no significant difference between the revenue of the farming system, while there was significant difference between the cost of bush fallowing and crop rotation as well as continuous cropping and crop rotation. But there was no significant difference between the costs of bush fallowing and continuous cropping. Attempts should be made by the government of these states (Ogun and Oyo) to reclaim lands that have been degraded and also to ensure proper distribution of lands for farming purposes.*

**Keywords**: Land-Use-Patterns, Efficiency, Settlers, Non-Settlers, Farmers

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## INTRODUCTION

Land is perhaps the single most important natural resource in the sense that it affects every aspect of people's life such as their food, clothing and shelter (Zahid *et al.,* 2015). It is the base for producing raw materials for the manufacturing industry (Oparinde *et.al* 2018). Land being a renewable natural resource is a key factor in the production process (Ogundari, 2006). Furthermore, all socio- economic activities whether industrial or agricultural take place on land. No nation, city or community can survive without it. Therefore, every person in a community has vital roles to play in the proper distribution and utilization of land, as well as an understanding of its associated problems. Land is becoming increasingly scarce for agricultural production in Nigeria (Oyekale, 2004). In years past, the Federal Government of Nigeria introduced several policy measures and programmes to solve the problem of declining agricultural land amongst which are the 1976 land use act and the farm settlement scheme. Due to poor implementation and inadequate policy back-ups, virtually all the measures are either abandoned or scrapped. As a result of defective enforcement, the land use act is largely defective. Furthermore, as a result of lack of infrastructure, settlers abandoned many of the settlements since the settlements are not better than the rural areas.

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 (Ambali 2012). 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 season or "all-year-round" production (Omonona *et al*, 2010). 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. It is a period of "soil-rest", where all forms of farming activities cease. Crop rotation is a system of farming in which the farmer follows a planting plan or pattern; cultivating different classes of crops at intervals. A popular plan could be "deep-rooted/shallow-rooted/deep-rooted" or "tuber/legume/cereal/vegetables". It should however be noted that a proper understanding of the various farming and cropping systems is key to ensuring increased and efficient productivity.

Sustainable (agricultural) production is achievable only if equitable land distribution and availability is ensured (Ekenta *et al*, 2012). Hence, ensuring land availability for agricultural production is non-negotiable particularly in view of the role it performs in any economy. The role of (equitable) land distribution and availability in any economy include employment and income generation, poverty reduction as well as food security (Oyedipe, 1984; Choi and Feinerman, 1993; Rygnestad and Fraser, 1996; Shi *et al.*, 2005; Zahid *et al.*, 2015) which are all components of the millennium development goals (MDG). Many of these issues were put to thought when Nigerian policy makers adopted the successful Israeli model (of farm settlement).

Hence, the objective of this study is to assess the Influence of Land Use Patterns on Efficiency of Crop Production among Settlers and Non-Settlers Crop Farmers in South-West Nigeria. Specifically, the study is to examine the land use patterns in the study area, analyze the costs and returns across land use patterns; and determine the effect of land use patterns and socioeconomic characteristics of the farmers on efficiency of crop production.

## Methodology

The study was conducted in South-west geo-political zone of Nigeria which comprises of Ondo, Osun, Ekiti, Ogun, Oyo and Lagos States. The climate of the South-west is tropical with relatively high temperatures characterized by very narrow variation in seasonal and diurnal ranges. Commonly cultivated crops in the area include cocoa, coffee, oil palm, rubber, maize, rice, guinea corn, millet, cowpea, groundnut, yam, cassava, potato, onion, chilly pepper, tomato, okra and garden egg.

A multi-stage sampling technique was adopted with the first stage involving a random selection of 2 States from the South-west geo-political zone. The second stage will involve the selection of 6 farm settlements in the study area. The selection will be based on sampling proportional to size (i.e. the State with the highest number of Settlements will have more sample size). The third stage will be a random selection of 5 communities in the selected settlement using the village-block classification of the States' Agricultural Development Programme (ADPs). In the fourth stage, 10 farmers were sampled from (each) selected village. This altogether give a total of 300 respondents.

The data sourced through focus group discussion (with farmers) and interview schedule using a pre-tested questionnaire. Data collected include:

(i) Farmer specific variables: household consumption expenditure (i.e. different types, quantity, and prices of food and non-food household items), age of the farmers, education, household size and composition off-farm income, membership of association and contact with extension agents.

(ii) Farm specific variables: number of farms, farm size; accessibility to agro-chemicals production, output. Processing and marketing costs as well as yield and produce (selling) price.

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

Stochastic frontier function: A farm household producing a single output Y with n inputs ($x_{I, \ldots\ldots} x_n$) will have (inefficient) transformation of inputs into output characterized by a production function {f(x)} (Oparinde *et al*, 2018).

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

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

where:-

$Q_i$ = output of the ith farm;

$x_i$ = 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.

Assumptions of the SPF:-

1) There is presence of technical inefficiency of production;
2) The error term ($v_i$) account for measurement error and other factors not under the control of the farmer;
3) The error terms ($v_i$) are independently and identically distributed as N(O, $S^2$ V) random variables independent of all $U_{isi}$.
4) The inefficiency of terms ($U_i$) are non-negative truncations of N(O, $S^2$ V) distribution (i.e.) half normal distribution) or have exponential distribution.

SPF approaches: - There are two approaches to the estimation of SPF i.e. the Data Envelopment Analysis (DEA) and the Stochastic Frontier Approach (SFA). The DEA method of frontier analysis is the linear programming approach to efficiency analysis while SFA is the parametric approach. However, the SFA will be adopted for this study primarily due to concern for the (possible) effects of outliers as a result of measurement errors or other factors determining the shape and positioning of DEA frontier, thereby affecting the measures of technical efficiency.

i = 1,2,……………….n.

**Model Specification.**

The SPF for arable crop farmers will be specified as:

$$\ln Q_i = a_0 + b_1 \ln SZ + b_2 \ln TVC + b_3 \ln TFC + V_i - U_i \text{ ----------} \qquad \text{(ii)}$$

With the technical inefficiency assumed to be explained by:

$$M_i = b_0 + b_1 AG + b_2 ES + b_3 FE + b_4 SE + b_5 MS + b_6 ST \ldots\ldots\ldots\ldots \qquad \text{(iii)}$$

where:

$V_i$, $U_i$, $Q_i$, $M_i$, a and b = as previously defined;
SZ = farm size (Ha);
TVC = total variable costs (₦);
TFC = total fixed costs (₦);
AG = age of farmer (years);
ES = Educational status of farmer (years spent in the school as a proxy);
FE = Experience in farming (years)
SE = Settlement
MS = Marital Status
ST = State

**Results and Discussions**

**Socioeconomic Characteristics of the Farmers**

The table 1 revealed that 34 percent of the farmers were within the age range of 41-50 years. The result also revealed that about 49.3 percent o the farmers were in their active years. This implies that majority of the farmers were in their active age. The mean age was 51 years and the standard deviation was 11.5. This corroborates the findings of Ambali (2012) that crop farmers has a mean age of 50 and 49 years. Most of the farmers were married (89.3%). 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 Ambali (2012), where he posited that most crop farmers are married. The results revealed that majority of the crop farmers were male folks (82.1%). This might be because males have more access to land than females.

The table reveals that a high percentage (68.3%) of the farmers has large (≥5) family size. The mean household size was six persons with a standard deviation of 2.4.This agrees with the findings of  This  The implication of this 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. This also agrees with the findings of Oparinde *et.al* (2018) and Ogundari, (2006) that pegged the average household size of farming households at ten (10) and concluded that the large household size encouraged utilization of family labour. Majority (74.5%) 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 result disagrees with the findings of Omonona *et.al* (2010) who opined that farmers are mostly exposed to informal education. The mean year of experience is 22 years and the standard deviation was 13.9. This implies that adoption of new and improved technology would be done with ease and this would in the long run increase productivity.

**Table 1: Socioeconomic Characteristics Settlers and Non-Settlers**

| Age Range | Frequency | Percentage | Mean | Standard deviation |
|---|---|---|---|---|
| ≤30 | 9 | 3.4 | | |
| 31-40 | 40 | 15.3 | | |
| 41-50 | 89 | 34.0 | | |
| 51-60 | 73 | 27.9 | | |
| 61-70 | 40 | 15.3 | | |
| 71-80 | 10 | 3.8 | | |
| >80 | 1 | 0.4 | | |
| **Total** | **262** | **100.0** | 51 | 11.5 |
| **Gender** | | | | |
| Male | 215 | 82.1 | | |
| Female | 47 | 17.9 | | |
| **Total** | **262** | **100** | | |
| **Marital Status** | | | | |
| Single | 7 | 2.7 | | |
| Married | 234 | 89.3 | | |
| Divorced | 4 | 1.5 | | |
| Widow | 17 | 6.5 | | |
| **Total** | **262** | **100** | | |
| **Household size** | | | | |
| 1-4 | 83 | 31.7 | | |
| 5-9 | 162 | 61.8 | | |
| >9 | 17 | 6.5 | | |
| **Total** | **262** | **100** | 6 | 2.4 |
| **Education** | | | | |
| None | 67 | 25.6 | | |
| Primary | 68 | 26.0 | | |
| Secondary | 77 | 29.4 | | |
| Tertiary | 22 | 8.4 | | |
| Adult | 28 | 10.7 | | |
| **Total** | **262** | **100.0** | | |
| **Farming Experience** | | | | |
| ≤20 | 79 | 30.2 | | |
| 21-30 | 69 | 26.3 | | |
| 31-40 | 46 | 17.6 | | |
| 41-50 | 40 | 15.3 | | |
| 51-60 | 23 | 8.8 | | |
| Above 60 | 5 | 1.9 | | |
| **Total** | **262** | **100** | 22 | 13.9 |

Source: Field survey, 2017

## Distribution of Land Acquisition and Land Use-pattern

### *Distribution of Respondents on the Basis of Land Acquisition*

The result from Table 2 reveals that most (45.4%) of the farmer acquired their farm land from the government while 25.2% rented their land from individual. Only 5.7% purchased the land used. The reason behind the huge percentage of respondents acquiring land from the government could be because the government in the study area understands the relevance of agriculture and its contribution to communal development; hence, stringent policies that could hinder acquisition of land are avoided and farmers are encouraged to go into production by promoting easy access to farm lands. This could also account for the low number of farmers operating on a large scale as regulations are placed on the size of land leased out per time to ensure continuous availability to intending farmers. This results does not agree with the findings of Ekenta *et.al* (2012) who concluded that land acquisition by inheritance was predominant and one of the reasons for large scale production by farmers in Osun State. Another implication of land acquisition from government is that, as opposed to purchase, limitation is placed on the farming system adopted. Bush fallowing, for instance, would be difficult, if not impossible to practice as such lands are leased out by government for the purpose of cultivation not fallowing. Also, continuous system of farming will be prevalent and this can have negative impact on the soil condition and eventually, crop production.

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

| **Land Acquisition** | **Frequency** | **Percentage** |
|---|---|---|
| Rent/Lease from Individual | 66 | 25.2 |
| Rent/Lease from Government | 119 | 45.4 |
| Purchase | 15 | 5.7 |
| Inheritance | 54 | 20.6 |
| Gift | 8 | 3.1 |
| Total | 262 | 100 |
| **Cropping System** | **Frequency** | **Percentage** |
| Sole/mono cropping | 52 | 19.8 |
| Mixed cropping | 210 | 80.2 |
| **Total** | **262** | **100** |
| **Farming System** | **Frequency** | **Percentage** |
| Continuous Farming | 122 | 46.5 |
| Crop Rotation | 110 | 42.0 |
| Bush Fallow | 30 | 11.5 |
| **Total** | **262** | **100** |

**Source: Field survey**

### *Distribution of Respondents on the Basis of Cropping System*

The results from Table 2 also reveal that mixed cropping (80.2%) 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.

### *Distribution of Respondents on the Basis of Farming System*

The most commonly practiced farming system is continuous farming (46.5%). 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 is “on the clock” as a result of lease.

### *Budgetary Analysis*

Table 3 shows the result of the budgetary analysis of the farmers in the study area. The total variable cost (TVC) is ₦9,414.83, the total fixed cost is ₦401.53, the total cost is ₦9,816.37 and the total revenue is ₦897,773.15. The gross margin (GM) is ₦888,358.31. This show that crop farming in the study area is profitable.

**Table 3: Monthly Cost and Return of both Farm Settlers and Non- Settlers**

| Items | Amount (₦) |
|---|---|
| Variable cost | |
| Seed (₦) | 3247.27 |
| Labour (₦) | 1656.53 |
| Fertilizer (₦) | 3259.08 |
| Herbicide (₦) | 946.41 |
| Insecticide (₦) | 305.54 |
| Total (₦) | 9414.83 |
| Fixed Cost | |
| Depreciation | 401.53 |
| Total Cost (TC) | 9816.37 |
| Total Revenue (TR) | 897773.15 |
| Gross Margin (GM) | 888358.31 |

Source: Field survey, 2017

Table 4 presents the results of budgetary analysis across various farming systems in the study area. Sole cropping has a gross margin of ₦1,165,985.53, while mixed cropping has a gross margin of ₦1,684,003.42. It is evident from the results that mixed cropping is more profitable than sole cropping. Also, continuous farming has a gross margin of ₦553,328.45, crop rotation is ₦1,395,878.23 and bush fallow has a gross margin of ₦387,709.28. 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.

**Table 4: Cost and Return across the cropping and farming system**

| Variable Cost | Cropping System | | Farming System | | |
|---|---|---|---|---|---|
| | Sole/Mono | Mixed | Continuous | Crop Rotation | Bush Fallow |
| Seed | 5460 | 38635 | 2212.73 | 4570.19 | 2603.72 |
| Labour | 22304.46 | 102411.6 | 1542.73 | 1764.10 | 1724.92 |
| Fertilizers | 21500 | 5500 | 2119.54 | 3635.11 | 1640.83 |
| Herbicides | 4250 | 1100 | 740.54 | 895.23 | 546.53 |
| Insecticides | 3200 | 1000 | 902.66 | 1839.09 | 750.00 |
| Fixed Cost | | | | | |
| Depreciation | 5950 | 2850 | 398.91 | 443.56 | 258.07 |
| Total Cost | 62664.46 | 151496.57 | 7917.11 | 13147.28 | 7524.07 |
| Total Revenue | 1222700 | 1832650 | 560846.65 | 1408581.95 | 394975.28 |
| Gross Margin | 1165985.53 | 1684003.42 | 553328.45 | 1395878.23 | 387709.28 |

**Source: Field survey, 2017**

### *Distribution of Efficiency Score across the Socioeconomic Characteristic of the Famers*

The table 5 presents the efficiency scores of farms across their socioeconomic characteristic. The mean efficiency of the farms was 0.80, indicating that in order for them to operate on the frontier; they have to overcome an inefficiency level of 20%. The farmers with formal education had more efficiency score (0.8368) than those with no formal education, although both groups of farmers were efficient. This agrees with the findings of Omonona *et.al* (2010).Farmers with no formal education are least efficient because they are not exposed to improved farming technology and even when exposed, the likelihood of adoption and diffusion of such technology is next to none as they lack the intellectual wherewithal.

**Table 5: Efficiency Score of the farms across Socioeconomic Characteristic of the Famers**

| Educational Level | Efficiency Score |
|---|---|
| No Formal Education | 0.7923 |
| Formal Education | 0.8368 |
| **Gender** | |
| Male | 0.8211 |
| Female | 0.7997 |
| **Household size** | |
| 1-4 | 0.7936 |
| 5-9 | 0.8305 |
| >9 | 0.7982 |
| **Age Range** | |
| ≤30 | 0.7397 |
| 31-40 | 0.7931 |
| 41-50 | 0.8337 |
| 51-60 | 0.8568 |
| 61-70 | 0.8493 |
| 71-80 | 0.6605 |
| >80 | 0.5096 |
| **Total** | **0.8037** |

**Source: Field survey, 2017**

Male had mean efficiency score of 0.8211 while that of female was 0.7997. It is evident from the result that male are more efficient than the female. This agrees with the findings of Omonona *et.al* (2010) and Okoruwa *et.al* (2006). Farming as an occupation is fraught with arduous tasks and given the energy requirement of some farming activities, females would find it difficult to cope with such tasks and this would in turn affect their efficiency. Males, on the other hand, have the energy required to cope with certain strenuous activities and hence, displays more efficiency than female folks. The findings of Nwaru and Ndukwu (2011) contradict this result. They were of the view that female potatoes farmers were more technically efficient that the male folks.

The farm efficiency score by household as presented in the table 3 revealed that the households with 5-9 members are most efficient. This is contrary to the findings of Okoruwa *et.al* (2006), who opined that those with household size of range 10-20 were more efficient. This goes against the prior expectation that a larger household size would be more efficient since family labour would be used to replace the cost of hiring labour. The reason for this shift could either be that those with very large household size have members that are among the dependent category (either too young or too old to farm) or the household members lack interest in farming and do not possess the technical know-how. The table also shows that farmers between the age of 51 and 60 years are most efficient with a score of 0.8568. This implies that majority of the farmers are in their active years and have overtime, gathered a lot of experience which has helped increased their level of efficiency. Okoruwa *et.al* (2006) support the finding that the upland rice famers within the age range of 50-59 were more technically efficient. Omonona *et.al* (2010) presented a contrary view, they were of the opinion that those with the age of ≤50 were more efficient.

**Table 6: Efficiency Score of the farms across zones and settlement**

| Zone/Settlement | Efficiency Score |
|---|---|
| Ilora Settlement | 0.8085 |
| Non-Settlement | 0.7839 |
| Ogomosho Settlement | 0.8231 |
| Non-Settlement | 0.6262 |
| Akufo Settlement | 0.8815 |
| Non-Settlement | 0.7963 |
| Sawonjo Settlement | 0.8342 |
| Non-Settlement | 0.8004 |
| Ikenne Settlement | 0.8808 |
| Non-Settlement | 0.7992 |
| Ajegunle Settlement | 0.8266 |
| Non-Settlement | 0.8012 |
| **Total** | **0.8037** |

**Source: Field survey, 2017**

Table 6 shows the efficiency scores across the various zones and farm settlement. In all the farm settlements, settlers are more efficient than non-settlers. However, the settlers at Akufo have the highest level of efficiency at 0.8815. Several factors could have contributed to their attainment of this high efficiency level; some of which could be; ease of land acquisition, good cropping system and good farming system.

The table 7 shows the efficiency scores across the two states. In Ogun state, settlers are more efficient than non-settlers. The experience is the same with that of Oyo state. From the result, settlers in Ogun have the highest efficiency score (0.8139) when both states are compared. Some of the reasons could also be; ease of land acquisition, good cropping system and good farming system.

**Table 7: Efficiency Score of the farms across States and settlement**

| State/Settlement | Efficiency Score |
|---|---|
| Ogun Settlement | 0.8139 |
| Non-Settlement | 0.8006 |
| Oyo Settlement | 0.8047 |
| Non-Settlement | 0.7788 |
| **Total** | **0.8037** |

**Source: Field survey, 2017**

Table 8 presents the result of the efficiency score of the farmers by state. The results shows that the farmers in Ogun state with efficiency score of 0.8264 are more efficient than farmers in Oyo state with efficiency score of 0.7809; a factor which also contributed to the high efficiency score of Ogun settlement.

**Table 8: Efficiency Score of the farmers across State**

| State | Efficiency Score |
|---|---|
| Ogun | 0.8264 |
| Oyo | 0.7809 |
| **Total** | **0.8037** |

**Source: Field survey, 2017**

The table 9 presents the result of the efficiency score of the farmers by settlement. The results shows that settlers with efficiency score of 0.8217 are more efficient than non-settlers with efficiency score of 0.7878.

**Table 9: Efficiency Score of the farms across Settlement**

| Settlement | Efficiency Score |
|---|---|
| Settlement | 0.8217 |
| Non-Settlement | 0.7878 |
| **Total** | **0.8037** |

Source: **Field survey, 2017**

The table 10 presents the result of the efficiency score of the farmers by cropping system. The results showed that the farmers that practice sole cropping had efficiency score of 07949 compared to farmers that practiced mixed cropping with efficiency score of 0.8395. It is therefore recommended that farmers should involve in mixed farming since it draws them more closely to the production frontier.

**Table 10: Efficiency Score of the farms across Cropping System**

| Cropping System | Efficiency Score |
|---|---|
| Sole/Mono Cropping | 0.7949 |
| Mixed cropping | 0.8395 |
| **Total** | **0.8037** |

Source: **Field survey, 2017**

The table 11 presents the result of the efficiency score of the farmers by Farming system. The results showed that the farmers that practiced continuous farming had the least efficiency score of 0.8267 has the least efficiency score while those that practiced crop rotation had the highest efficiency score of 0.8278. This stems from the fact that continuous farming exerts more pressure on soil resources, thereby affecting its productivity; while crop rotation, when properly done conserves soil resources and promotes crop growth and productivity.

**Table 11: Efficiency Score of the farms across Farming System**

| Farming System | Efficiency Score |
|---|---|
| Continuous | 0.8267 |
| Crop Rotation | 0.8278 |
| Bush Fallow | 0.8270 |
| **Total** | **0.8037** |

**Source: Field survey, 2017**

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 12. 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, herbicides, insecticide and farm size. 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. However, the importance of quality should not be neglected. Similarly, the co-efficient of insecticide cost was positive and significant ($p< 0.01$), which indicates the relevance of insect pest eradication to output as it is important for the farmer to ensure that crop damaging pests are eradicated to ensure efficient production of crops. The coefficient of the cost spent on herbicide use was positive and significant ($p< 0.1$), 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. Also, Farm Size was statistically significant and positive ($p< 0.05$) indicating that the larger the farm size, the more efficient the farmers. Therefore, as quantity of seeds required for cultivation increases, the need to treat seeds against pests (both insects and weeds) also increases, which also increases the size of farm needed and ultimately the output obtained. Labour use, depreciation, fertilizer and herbicide cost did not contribute significantly to technical efficiency.

**Table 12: Determinant of Inefficiency among Settlers and Non-Settlers**

| Variables | Coefficient | t-value |
|---|---|---|
| Constant | 2.6038*** | 3.3402 |
| Seed cost | 0.1314*** | 3.3789 |
| Labour | 0.4624 | -0.0891 |
| Depreciation | -0.0161 | -0.6470 |
| Fertilizer cost | -0.0961* | 1.4444 |
| Herbicide cost | 0.1804** | 2.0916 |
| Insecticide cost | 0.2129*** | 2.3223 |
| Farm size (Ha) | 0.2325** | 2.4726 |
| **Inefficiency** | | |
| Constant | -0.0042 | -0.0044 |
| Age | -0.0016 | -0.2934 |
| Sex | -0.0697 | 0.4923 |
| Farming Experience | -0.0128** | -2.5329 |
| Occupation | 0.0837 | 0.7669 |
| Settlement | -0.4289*** | -3.2970 |
| Marital Status | -0.0655 | -0.3670 |
| Household size | 0.0159 | 0.6586 |
| Education | -0.2268* | -1.8108 |
| Land Acquisition | -0.0988 | -0.8811 |
| Continuous Farming | -0.0171 | -0.0445 |
| Crop rotation | -0.0012 | -0.0033 |
| Bush fallowing | -0.0028 | -0.0072 |
| Mixed Cropping | -0.0857 | -0.1449 |
| Mono/Sole Cropping | 0.0730 | 0.1244 |
| State | -0.2756** | -2.3585 |
| **Sigma-Squared** | **0.5432*****| **9.7456** |
| **Gamma** | **0.00000012** | **0.00000174** |

**Source: Field survey, 2017**

Log likelihood Function = -282.912

From the result of the inefficiency model, the major factors which influenced the inefficiency of the respondents were; farming experience, education, settlement and state. 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. This agrees the with Omonona *et.al* (2010). 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; this does not exclude the practice of farming. Education was also found to be significant with a negative coefficient ($p < 0.1$). The more educated an individual is, the more the ease of adoption of improved technology. Education sharpens the mind of individuals and makes them easily able to think outside the box as far as his practice is concerned. Farmers who are well educated are usually teachable, especially when it comes to adopting technology that would help them increase their efficiency. State was also found to have a negative but statistically significant coefficient ($p<0.05$). Also, Settlement had a negative co-efficient which was significant ($p<0.01$); indicating that the more settled a farmer is, the less inefficient he becomes. Settlers are more efficient than non-settlers.

The table 13 shows the distribution of technical efficiencies among farmers. Most of the farmers (46.46%) had technical efficiencies that ranged from 0.64000 to 0.82999 while few farmers (11.02%) had technical efficiencies that ranged from 0.45000 to 0.63999. The mean technical efficiency was 0.8037, indicating that they had an inefficiency level of 19.63%.

**Table 13: Distribution of Technical Efficiency among Farmers**

| Range | Frequency | Percentage (%) |
|---|---|---|
| 0.45000-0.63999 | 28 | 11.02 |
| 0.64000-0.82999 | 108 | 42.52 |
| Above 0.829999 | 118 | 46.46 |
| **Minimum** | **0.4689** | |
| **Maximum** | **0.9994** | |
| **Mean** | **0.8037** | |

**Source: Field survey, 2017**

**LSD for Fallowing ($M_1$) and Continuous ($M_2$) Revenue**

LSD = $t_{\alpha/2}(\sqrt{MSE}(1/N1 + 1/N2))$

Where

$t_{\alpha/2}$= 1.96

LSD =$1.96(\sqrt{3}.15 \times 10^{\wedge}13(1/30 + 1/122))$

LSD = 2241778.22

**Difference between mean of Fallowing and Continuous cropping**

$|M_1 – M_2|$ = |394975.3 – 560846.7|

= |-165871.4|

**LSD for Fallowing ($M_1$) and Rotation ($M_3$) Revenue**

LSD =$1.96(\sqrt{3}.15 \times 10^{\wedge}13(1/30 + 1/110))$

LSD = 2265783.74

**Difference between mean of Fallowing and Crop Rotation**

$|M_1 – M_3|$ = |394975.3 – 1408582|

= |-1013606.7|

**LSD For Continuous Cropping ($M_2$) and Rotation ($M_3$)**

LSD =$1.96(\sqrt{3}.15 \times 10^{\wedge}13(1/122 + 1/110))$

LSD =1146368.85

**Difference between mean of Continuous Cropping and Crop Rotation**

$|M_2 – M_3|$ = |560846.7– 1408582|

= |-847735.3|

**Table 14: Difference between Means of Cost for Cropping Systems**

| t-Test: Paired Two Sample for Means | | |
|---|---|---|
| | MIXED | MONO |
| Mean | 8222.520217 | 1593.844511 |
| Variance | 53398124.57 | 16104641.19 |
| Observations | 262 | 262 |
| Pearson Correlation | -0.448614345 | |
| Hypothesized Mean Difference | 0 | |
| Df | 261 | |
| t Stat | 10.96132033 | |
| P(T<=t) one-tail | 1.50602E-23 | |
| t Critical one-tail | 1.650712727 | |
| P(T<=t) two-tail | 3.01204E-23 | |
| t Critical two-tail | 1.969094666 | |

Source: **Field survey, 2017**

**Table 15: Difference between Means of Revenue for Cropping Systems**

| t-Test: Paired Two Sample for Means | | |
|---|---|---|
| | *MIXED* | *MONO* |
| Mean | 483397.298 | 414375.848 |
| Variance | 5.58113E+12 | 2.6318E+13 |
| Observations | 262 | 262 |
| Pearson Correlation | -0.016590995 | |
| Hypothesized Mean Difference | 0 | |
| Df | 261 | |
| t Stat | 0.196573596 | |
| P(T<=t) one-tail | 0.422157106 | |
| t Critical one-tail | 1.650712727 | |
| P(T<=t) two-tail | 0.844314211 | |
| t Critical two-tail | 1.969094666 | |

**Source: Field survey, 2017**

**LSD FOR FALLOWING ($M_1$) AND CONTINUOUS ($M_2$) COST**

LSD $=1.96(\sqrt{38424740.7(1/30 + 1/122)})$

LSD = 2475.96

**Difference between mean of Fallowing and Continuous cropping**

$|M_1 - M_2| = |6772.74 - 8200.5|$

$= |1427.76|$

**LSD FOR FALLOWING ($M_1$) AND ROTATION ($M_3$) COST**

LSD $=1.96(\sqrt{38424740.7(1/30 + 1/110)})$

LSD = 2502.47

**Difference between mean of Fallowing and Crop Rotation**

$|M_1 - M_2| = |6772.74 - 12387.51|$

$= |5614.77|$

**LSD FOR CONTINUOUS CROPPING ($M_2$) AND ROTATION ($M_3$)**

LSD =1.96( √38424740.7(1/122 + 1/110))

LSD =1597.46

**Difference between mean of Continuous Cropping and Crop Rotation**

$|M_1 – M_2|$ = |8200.5– 12387.51|

= |4187.1|

**Table 16: Analysis of Variance and Least Significant Difference (LSD) For Revenue among Different Farming Systems**

| ANOVA *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups | 5.01354E+13 | 2 | 2.50677E+13 | 0.794625 | 0.452849025 | 3.030651254 |
| Within Groups | 8.17056E+15 | 259 | 3.15466E+13 | | | |
| **Total** | **8.2207E+15** | **261** | | | | |

**Source: Field survey, 2017**

The results from table 14 revealed that there was significant difference between the means of cost of the cropping system. This implies that with respect to cost consideration, the farmer has to consider the cropping system to adopt and should opt for the system that minimizes cost. Table 15 showed no significant difference between revenue generated from the different cropping system. It was also revealed from the result that among the various farming systems, there was no significant difference between the means of revenue generated from each farming system. There was a significant difference between the mean of cost of bush fallowing and crop rotation ($p < 0.05$). This implied that the farming system adopted by the farmers played a major role in determining the level of profit. Farmers should therefore be encouraged to carry out farming practices that helped minimize cost so that profit can be maximized. In this case, more cost was incurred by farmers practicing crop rotation compared to those practicing bush fallowing and such cost difference cannot be ignored. The results also revealed that there was a significant difference between the mean of cost of continuous cropping and crop rotation ($p < 0.05$). Farmers who practiced crop rotation incurred more cost than those who practiced continuous farming and such cost implication cannot be ignored as it goes a long way to affect the profit of the farmers. There was no significant difference between the mean of cost of bush fallowing and continuous farming.

**Table 17: Analysis of Variance and Least Significant Difference (LSD) for Cost among Different Farming Systems**

| ANOVA Source of Variation | SS | Df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between Groups | 1320974616 | 2 | 660487308.1 | 17.18911556 | 9.78156E-08 | 3.030651254 |
| Within Groups | 9952007841 | 259 | 38424740.7 | | | |
| Total | 11272982458 | 261 | | | | |

Source: **Field survey, 2017**

**SUMMARY STATISTICS**

**Table 18: LSD FOR REVENUE AMONG DIFFERENT FARMING: Farming System**

| FARMING SYSTEM | MEAN | FALLOWING (M1) | CONTINUOUS CROPPING (M2) | CROP ROTATION (M3) |
|---|---|---|---|---|
| | | (394975.3) | (560846.7) | (1408582) |
| FALLOWING (M1) | (394975) | 0 | 165871.4$^{NS}$ | 1013606.7 $^{NS}$ |
| CONTINUOUS CROPPING (M2) | (560847) | | 0 | 847735.3 $^{NS}$ |
| CROP ROTATION (M3) | (1408582) | | | 0 |

**Source: Field survey, 2017**
**NS- Not Significant**

**Table 19: LSD FOR COST AMONG DIFFERENT FARMING: Farming System**

| FARMING SYSTEM | MEAN | FALLOWING (M1) | CONTINUOUS CROPPING (M2) | CROP ROTATION (M3) |
|---|---|---|---|---|
| | | (6772.74) | (8200.5) | (12387.51) |
| FALLOWING (M1) | (6772.74) | 0 | 1427.76$^{NS}$ | 5614.77$^{**}$ |
| CONTINUOUS CROPPING (M2) | (8200.5) | | 0 | 4187.1$^{**}$ |
| CROP ROTATION (M3) | (12387.51) | | | 0 |

**Source: Field survey, 2017**
**NS- Not Significant**
****Significant at 5%**

## Summary

This study examined the relationship between land use patterns and efficiency of crop production among settlers and non-settlers crop farmers in South-West Nigeria. Results showed that majority of the food crop farmers were in their active age, male, married, educated and were strictly crop farmers. The predominant farming system is continuous farming and mixed cropping is the most adopted cropping system. Maximum likelihood estimation (MLE) shows that seed cost had the highest production coefficient and was statistically significant at 1 percent level of significance. Results of the inefficiency analysis showed farming experience, settlement, education and state to have negative coefficients that were statistically significant at 5%, 1%, 10% and 5% level of significance respectively. Marital status was positively significant at 1% level of significance. Farmers in Ogun state were more efficient than their counterparts in Oyo State. The farmers had a mean efficiency of 0.80, indicating that in order for them to operate on the frontier, they have to overcome an inefficiency level of 20%.

This study reveals the impact of several cropping and farming systems on both the income of the farmers and their level of efficiency. The results also revealed that while there was significant difference between the means of cost of the cropping system, no significant difference existed between revenue generated from the different cropping system. It was also revealed from the result that among the various farming systems, there was no significant difference between the means of revenue generated from each farming system. There was a significant difference between the mean of cost of bush fallowing and crop rotation ($p < 0.05$). The results also revealed that there was a significant difference between the mean of cost of continuous cropping and crop rotation ($p < 0.05$). There was no significant difference between the mean of cost of bush fallowing and continuous farming.

**Conclusion**

Attempts should be made by the government of these states (Ogun and Oyo) to reclaim lands that have been degraded and also to ensure proper distribution of lands for farming purposes. 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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