

Original Research Articles

Determinants of productivity among cocoa farmers in Ondo State of Nigeria

## Abstract

The study examined the determinants of cocoa productivity in Ondo State of Nigeria. Primary data were used for the study and collected by using structured questionnaires administered to 150 respondents from three selected local government areas which constituted the sampling blocks of the multistage random sampling technique used. The methods of data analysis employed are both descriptive statistics and inferential. Production function was analysed using Ordinary Least Square (OLS) methods to estimate the parameters of the estimates of the variables specified in the model. The respondents are majorly literates as such can read and write with average of 12 years spent in school. The results of the study also showed that the cocoa production is in stage II of the production in the study area with return to scale (RTS) of 0.956. The RTS is decreasing in nature being less than unity and positive. This shows that the production process in the study area is production with a room for improvement on the side of farmers. The variables such as farm size, quantities of fungicides and fertilizers, age of farmer and farming experience are positively related to cocoa output while other variables insecticides, labour, age of farm (age of cocoa trees), family size and educational status (years spent in school) are negatively related to cocoa output. Of these variables, both fertilizer and educational status are statistically significant while others are statistically insignificant.

Keywords: Productivity, elasticity, return to scale and cocoa.

## 1. INTRODUCTION

Cocoa was introduced into Nigeria in 1874 and it played a significant role in the country's economy [5]. In terms of foreign exchange earnings, no single agricultural commodity has earned more than cocoa in terms of exports. In addition, it is an important source of raw materials for several agro-allied industries as well as source of revenue to governments of cocoa producing states. Series of efforts aimed at boosting cocoa production have been done in the past of recent was the distribution of 26 million seedlings of cocoa in the year 2000 to the 14 cocoa producing states in Nigeria to replace the

old trees. These states are Ondo, Ogun, Osun, Oyo, Ekiti, Kwara and Kogi. Others are Edo, Delta, Cross River, Adamawa, Taraba and Akwa Ibom [16]. Of all these states, the study area, Ondo is among the top five or less in terms of quantity of Cocoa production. Over the years agriculture has been undoubtedly contributed to the economic growth in Nigeria considering its contribution to the GDP. This is so because Nigeria as a country is naturally endowed with fertile land. According to [7, 10], the country has a total land area of about 98.3 million hectares out of which 71.2 million hectares (72.4%) are cultivable but only 34.2 million hectares (34.8%) are under use. Despite the importance of agriculture in the sustenance and ensuring food security in the country the sector has been abandoned to its fate and as such left in the hands of the smallholder farmers who still rely on crude means of production. This has led to unproductive nature of the cocoa sector. Cocoa contributed immensely to the economy of the old western region of Nigeria where the study area, Ondo played a key role before the oil boom the country witnessed in the early 70s. This is not limited to Nigeria, it is on record that 50% of world's population is dependent on subsistence agriculture [8, 10]. However, despite the immense contribution of cocoa to the economic fortunes of the country there has been downward trend in the production owing to decreased productivity caused by subsistence level at which the farmers have been left to operate thereby resulting to the growth rate of cocoa production declining which has given rise to a fall in the fortune of the sub-sector among other reasons. Nigeria was among the leading cocoa producing nations in the early 70s until oil boom of the 1970s [16]. This consequently shifted the attention of government from the potentials and fortunes inherent in agriculture and cocoa especially received its own share of the neglect. [11] noted that cocoa production in Nigeria witnessed a downward trend after 1971 season, when its export declined to 216,000 metric tons in 1976, and 150,000 metric tons in 1986, therefore reducing the country's market share to about 6% and to fifth largest producer to date [13]. However, apart from the general neglect suffered by the agricultural sector the illiteracy level of subsistence farmers in Nigeria has made it difficult for them to adopt new and modern methods of farming as being introduced. [3] posited that the performance of Nigerian

agriculture so far indicates that the farmers have neither used nor absorbed most of the technologies being introduced to them. There are many factors that determine how productive the cocoa enterprise is in Nigeria. This study aims to investigate some of such determinants in Ondo State of Nigeria which happens to be one of the best cocoa production zones in Nigeria considering its climatic condition which is considered favourable to cocoa production.

## **2. MATERIAL AND METHOD**

### **2.1 Study Area**

The study was carried out in Ondo State in Western Nigeria with a land area of 14,606 square kilometers (sq.km) and a population of 3.44 million according to 2006 population census [12]. The favourable climate accounts for the very reason why over 80% of the inhabitants are farmers out of which majority are predominantly cocoa farmers. The tropical climate of the state is mainly of two seasons; rainy season (April-October) and dry season (November-March) with temperature ranges between 21°C to 29°C and humidity is relatively high. The state is divided into 18 Local Government Areas (L.G.As) for administrative convenience. The State has an annual rainfall of between 2000mm to 1150mm per annum. They also grow other cash crops such as kolanut, palmtree and coffee. Other crops such as Yams, Maize, cocoyam etc. are also grown mostly at subsistence level just as in the case of cocoa by the farmers.

### **2.2 Sampling Technique**

The multistage random sampling was adopted for this study. The first stage involved a purposive selection of Idanre, Ile Oluji and Odigbo Local Government Areas in Ondo State as sampling blocks. This is because the selected Local Government Areas are reputable for being the leading areas in cocoa production in Ondo State. The second stage involved a simple random selection of fifty (50) farmers from each of the selected local government making up a total of one hundred and fifty (150) cocoa farmers for the study out of which 140 questionnaire were eventually used for the analysis due

to incomplete information in 10 of the questionnaires. Data were collected with the use of structured questionnaires and personal interviews where data on the following variables among others were collected from the farmers;

- Cocoa Output
- Age of farmers (years)
- Educational status of farmers (years spent in school)
- Labour (man days)
- Quantity of insecticides used (litres),
- Quantity of fungicides used (litres),
- Quantity of fertilizers used (tonnes), among other important data.

## 2.3 Data Analysis

Descriptive statistics and inferential analysis are used to analyse the data collected in the study area. Descriptive statistics used include mean, minimum/maximum values and tables. The inferential analysis used OLS estimates to investigate the effects of farmers' socio-economic variables on the output of cocoa in the study area. The t-test was used to test the statistical significance of the variables. The production function of the cocoa farmers is specified by the Cobb – Douglas frontier production function [10, 4, 9, 6].

## 2.4 Model Specification

The production function for the cocoa production in the study area is specified by the stochastic production function model as follows;

$$Y = f(X_i, \beta) \exp(V_i - U_i) \quad (1)$$

Where,

$Y$  = level of cocoa output for  $i^{\text{th}}$  farmer (tonnes),

$X_i$  = vector of inputs and other explanatory variables associated with  $i^{\text{th}}$  farmer,

$\beta$  = vector of parameters to be estimated,

exp= exponential function,

$(V_i - U_i)$  are the error terms,  $V_i$  = random errors,  $U_i$  = non-random errors which accounted for technical inefficiencies in cocoa production [2, 9].

The specified multiplicative production function is specified as;

$$Y = A X_1^{\beta_1} \cdot X_2^{\beta_2} \cdot X_3^{\beta_3} \cdot X_4^{\beta_4} \cdot X_5^{\beta_5} \cdot X_6^{\beta_6} \cdot X_7^{\beta_7} \cdot X_8^{\beta_8} \cdot X_9^{\beta_9} \cdot X_{10}^{\beta_{10}} \cdot \mu \quad (2)$$

The linear transformation of (2) is achieved by taking the natural logarithm of both sides of the equation to obtain (3) as follows;

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + \beta_{10} \ln X_{10} + \mu \quad (3)$$

Where,

Subscripts i refer to the observation of the  $i^{\text{th}}$  farmer = 1, 2, 3, ..., N.

$Y$  = output of Cocoa (tonnes/hectare)

$X_1$  = farm size (ha),

$X_2$  = quantity of insecticide used (litres),

$X_3$  = quantity of fungicide used (litres),

$X_4$  = quantity of fertilizer used (tonnes),

$X_5$  = labour (man day),

$X_6$  = age of the farm (cocoa trees),

$X_7$  = age of farmer (years),

$X_8$  = family size

$X_9$  = farming experience (years),

$X_{10}$  = educational status (years spent in school)

$\beta_1 - \beta_9$  = the parameters estimated,

$\ln$ s = natural logarithms,

$\mu$  = error terms

### 3. **RESULTS AND DISCUSSIONS**

#### 3.1 **Socio-economic Characteristics**

Table 1 shows the distribution of the respondents according to their socio-economic characteristics.

##### 3.1.1 **Age of farmers**

Result shows that the age ranges between 0 and 75 years. The mean age of the respondents is 45 years while the modal age group was 31 – 45 years age bracket. This implication of this is that the cocoa farmers in the study area are considerably young.

##### 3.1.2 **Sex**

The result shows that majority of the cocoa farmers in the study area are male who constitute 76.4% while the female constitute 23.6%.

##### 3.1.3 **Religion**

The result shows that majority of the respondents in the study area are muslims and constitute about 67.1% while the remaining 32.9% are Christians.

##### 3.1.4 **Marital Status**

The result indicates that majority of the respondents are married and constitute about 80.7% of the respondents, single and widow constitute 7.9% each while the widower constitutes the remaining 3.6% of the respondents.

##### 3.1.5 **Family Size**

The result shows that the mean family size is 12. The families with greatest number of members have between 11-20 members and constitute 51.4% of the respondents while families with between 1 and

10 members constitute 37.9% and families with between 21-30 members constitute 10.7%. The implication of this is that majority of the respondents have a relatively large family size and this makes the labour readily available for their farm production activities. The relatively large family size prevailing in the study area is not unconnected with the religion beliefs of the respondents as pointed out earlier that majority of the respondents are muslims and as such polygamous families are the prevailing family type in the study area.

### 3.1.6 Farming Experience

The average farming experience in the study area is 18 years. Majority of the farmers have between 11 and 20 years farming experience followed by 39.3% who have between 21 and 30 years of experience. In most cases they have started before they owned their own personal farms. The implication of this is that the farmers are generally experienced as far as cocoa production is concerned in the study area and with the prevailing technology.

### 3.1.7 Educational Status

The average years spent in school by the respondents is 12 years that is secondary school leavers. 65% of the respondent spent between 10 and 14 years in school while a very few (2.9%) spent between 0 and 4 years in school. Also, a lower percentage of 12.1% spent more than 14 years in school that is those who are graduates and 20% spent between 5 and 9 years in school that is primary school holders. The implication of this is that majority of the respondents are literates and as such can both read and right which is one of the reasons why the productivity is very high in the study area because the farmers are able to apply the resources at their disposal in optimal proportions to ensure high turnover.

### 3.1.8 Other Occupation

The result shows that 51.4% of the respondent engage in others occupations such as artisans, transport business, daily hawking, working on other people's farm and other activities outside their primary farming job. 26.4% of the respondents are involved in private businesses and the remaining 22.1% are civil servants working in various government parastatals.

**Table 1: Distribution of respondents according to their Socio-economic characteristics**

| Variables                         | Mean | Frequency  | Percentage |
|-----------------------------------|------|------------|------------|
| <b>Age (Years)</b>                |      |            |            |
| 0 – 15                            |      | 27         | 19.1       |
| 16 – 30                           |      | 06         | 4.2        |
| 31 – 45                           |      | 57         | 40.6       |
| 46 – 60                           |      | 47         | 33.6       |
| 61 – 75                           |      | 03         | 2.1        |
| <b>Total</b>                      |      | <b>140</b> | <b>100</b> |
| <b>Sex</b>                        |      |            |            |
| Male                              |      | 107        | 76.4       |
| Female                            |      | 33         | 23.6       |
| <b>Total</b>                      |      | <b>140</b> | <b>100</b> |
| <b>Religion</b>                   |      |            |            |
| Christianity                      |      | 46         | 32.9       |
| Islam                             |      | 94         | 67.1       |
| <b>Total</b>                      |      | <b>140</b> | <b>100</b> |
| <b>Marital Status</b>             |      |            |            |
| Single                            |      | 11         | 7.9        |
| Married                           |      | 113        | 80.7       |
| Widow                             |      | 11         | 7.9        |
| Widower                           |      | 5          | 3.6        |
| <b>Total</b>                      |      | <b>140</b> | <b>100</b> |
| <b>Family Size</b>                |      |            |            |
| 1 – 10                            |      | 53         | 37.9       |
| 11 – 20                           |      | 72         | 51.4       |
| 21 – 30                           |      | 15         | 10.7       |
| <b>Total</b>                      |      | <b>140</b> | <b>100</b> |
| <b>Farming Experience (Years)</b> |      |            |            |
| 0 – 10                            |      | 12         | 8.6        |
| 11 – 20                           |      | 73         | 52.1       |
| 21 – 30                           |      | 55         | 39.3       |
| <b>Total</b>                      |      | <b>140</b> | <b>100</b> |
| <b>Years in School</b>            |      |            |            |
| 0 – 4                             |      | 4          | 2.9        |
| 5 – 9                             |      | 28         | 20.0       |

|                         |            |            |
|-------------------------|------------|------------|
| 10 – 14                 | 91         | 65.0       |
| >14                     | 17         | 12.1       |
| <b>Total</b>            | <b>140</b> | <b>100</b> |
| <b>Other Occupation</b> |            |            |
| Civil Servant           | 31         | 22.1       |
| Private Business        | 37         | 26.4       |
| Others                  | 72         | 51.4       |
| <b>Total</b>            | <b>140</b> | <b>100</b> |

Source: Field Survey, 2012

### 3.2 Production function analysis

The results showing the level of output of cocoa as accounted for by the explanatory variables are as shown in table 2. The results **show** that there is positive relationship between the total output and farm size, age of farmer, fertilizers and fungicides used, farming experience. The policy implication of this is that as more of these variables are employed the total output of cocoa will increase. This result is in congruent with [14, 10]. However, the results show that there is negative relationship between the total output of cocoa and family size, which is consistent with [1] and also insecticides used, and age of farm (age of cocoa trees), educational status (**ie.e** years spent in school) and labour. The positive relationship between the output and age of the farmer is unexpected considering the fact that the more ageing the farmer becomes the more unproductive but it might however be connected with the experience the farmer has gardered with his increasing age. The reationship between the output and farm size, fungicides, age of farm, farming experience and fertilizer are expected and in line with the a priori expectation. However, the relationship that exists between output and insecticides, labour, age of farmer, family size and educational status (i.e years in school) are unexpected and not in congruent with a priori expectation. The negative relationship that exist between output and insecticides, labour and family size might have resulted from misuse and misapplication of the affected resources due to many factors by the farmers. Also, the positive relationship between output and age of farmer might have been as a result of experienced gained over time due to increased age of the farmer and lastly the

negative relationship that exists between the output and educational status though unexpected but might have been due to other factors such as abuse and misuse of resources in some cases that has nothing to do with the educational status of the farmers concerned.

From the results on table 2 also, it is evident that only quantity of fertilizer used and educational status are significant while other variables in the model are statistically insignificant in explaining the level of output of cocoa production in the study area at 5%.  $R^2$  is 0.95 which indicates that 95% of the changes in the output were explained by the explanatory variables as specified in the model. This result is in congruent with those of [10, 15, 1].

**Table 2: Estimates of the production function**

| Variables                            | Parameter        | Coefficients | Standard error | t-value  |
|--------------------------------------|------------------|--------------|----------------|----------|
| <b>Production function Model</b>     |                  |              |                |          |
| Constant                             | ( $\beta_0$ )    | 1.520        | 0.884          | 1.719    |
| Farm Size (ha)                       | ( $\beta_1$ )    | 0.034        | 0.092          | 0.786    |
| Insecticide quantity (litre)         | ( $\beta_2$ )    | -0.031       | 0.009          | -0.849   |
| Fungicide quantity (litre)           | ( $\beta_3$ )    | 0.026        | 0.005          | 0.780    |
| Quantity of fertilizer used (tonnes) | ( $\beta_4$ )    | 0.957        | 3.024          | 21.986** |
| Labour (man day)                     | ( $\beta_5$ )    | -0.030       | 0.002          | -1.653   |
| Age of Farm/cocoa trees (years)      | ( $\beta_6$ )    | -0.002       | 0.041          | -0.150   |
| Age of Farmer (years)                | ( $\beta_7$ )    | 0.001        | 0.011          | 0.082    |
| Family Size                          | ( $\beta_8$ )    | -0.001       | 0.024          | -0.033   |
| Farming Experience                   | ( $\beta_9$ )    | 0.014        | 0.020          | 0.899    |
| Educational status                   | ( $\beta_{10}$ ) | -0.026       | 0.032          | -2.151** |
| <b>Diagnostics Parameters</b>        |                  |              |                |          |
| $R^2$                                | 0.950            |              |                |          |
| Adjusted $R^2$                       | 0.947            |              |                |          |

**Source: Field Survey, 2012**

\*\* indicates significance at 5%

**Table 3: Descriptive Statistics**

| Variables                  | Mean  | Minimum | Maximum | SD   |
|----------------------------|-------|---------|---------|------|
| Output (tonnes)            | 20.98 | 8.99    | 37.88   | 8.04 |
| Age of farm (years)        | 12.7  | 10      | 17      | 2.34 |
| Age of farmer (years)      | 45.25 | 26      | 61      | 9.10 |
| Family Size                | 12.28 | 1       | 29      | 6.01 |
| Farming experience (years) | 18.06 | 4       | 30      | 6.37 |
| Educational status (years) | 12.13 | 4       | 16      | 2.97 |

**Source: Field Survey, 2012**

### 3.3 Productivity analysis

**This shows** how the inputs are being used in the process of cocoa production in the study area and the respective elasticity of each input are as presented in table 4. The result **shows** that farm size, fertilizer and fungicides are positive and less than unity which indicates decreasing positive returns to scale. This means that these inputs are efficiently being utilized and as such are still in rational stage of production (STAGE II). Also, the return to scale (RTS) is 0.956. This means that the overall cocoa production in the study area is in rational stage of production that is stage II. The production is efficient and the return to scale is decreasing in nature. The economic implication of this is that for a percentage increase in the combined inputs used in production processes in the study area there is 0.956% increase in cocoa output.

**Table 4: Elasticity of Production and Return to scale (RTS)**

| Variables    | Elasticity   |
|--------------|--------------|
| Farm Size    | 0.034        |
| Labour       | -0.030       |
| Fertilizer   | 0.957        |
| Insecticides | -0.031       |
| Fungicides   | 0.026        |
| <b>RTS</b>   | <b>0.956</b> |

**Source: Field Survey, 2012**

#### 4. CONCLUSION

This study examines the determinants of cocoa productivity in Ondo state of Nigeria. The study used multistage random sampling technique by purposive selection of three local government areas in the state that are renowned for high quantities of cocoa output followed by random selection of 50 respondents from each local government making 150 respondents using structured questionnaire out of which only 140 questionnaires were used for analysis with the remaining 10 questionnaires discarded due to incomplete information. The three local government areas are Idanre, Ile Oluji and Odigbo. The methods of analysis are descriptive statistics and inferential. The descriptive statistics used include mean, mode and minimum/maximum values and the inferential analysis used to estimate the parameters of inputs specified in the model is ordinary least square estimates criterion popularly referred to as OLS estimates criterion in the literature. The production function was specified as in stochastic form using Cobb-Douglas transformed into linear form to estimate the units of inputs used to attain the level of cocoa output in the study area through their respective coefficients estimated by OLS. The results showed that the majority of the respondents in the study area are relatively young and still energetic for cocoa production with the average age of 45 and modal age ranges between 31 and 45 years. The respondents are majorly men and are married. The prevailing family size in the study area is relatively large with average of 12 members. This is due to religion affiliation of the respondents in the study area who are predominantly muslims and the family type is mostly polygamous. Majority of the respondents are educated and spend average of 12 years in school and as such can read, write and experienced in farming with most of them having got involved in cocoa farming even before they own theirs in some cases. Almost half of the respondents (51.4%) are engaged in other occupations aside from farming. The results also showed that of the variables specified in the model, both the quantity of fertilizer used and that of educational status (years spent in school) are statistically significant while others are insignificant. The  $R^2$  is 95% the implication of which is that 95% of changes in the output are accounted for by the explanatory variables. The

elasticities of inputs were equally estimated and summed up to give the return to scale value of the cocoa production in the study area which was estimated as 0.956. The economic implication of this is that the production process is in stage II of production which is still considered rational in the literature. The return to scale (RTS) is decreasing being less than unity and positive.

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