

**EFFICIENCY OF SMALL HOLDER COCOA PRODUCERS
IN ONDO STATE NIGERIA; A STOCHASTIC FRONTIER
ANALYSIS**

BY

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ABSTRACT

The main objective of this study is to investigate the technical efficiency of small holder cocoa farmers in Ondo State and to identify the influence and direction of the influence of farmers' socio-economic variables on technical efficiency. To this end, one hundred and fifty cocoa farmers were randomly selected from major cocoa producing area of Ondo State to collect both socio-economic data and cocoa production data, including inputs as well as constraints in cocoa production. The collected data were subjected to both descriptive statistics and econometric analysis using the stochastic frontier production functions to determine the level of technical efficiency of the farmers as well as those factors that influence the level of technical efficiency. For the stochastic frontier model, both Cobb-Douglas and the translog functional forms were estimated and the model that best represented the data was selected.

The result of the analysis indicate that maximum likelihood estimate (MLE) of Cobb-Douglas frontier model presents better representation of the data and hence selected as lead equation. The result shows that apart from shade and pesticides that carry negative coefficient, all other coefficients in the model are highly significant. The results show that farmers age, level of formal education, farming experience, farm size, use of pesticide and use of shade trees are jointly significant influencing the level of efficiencies of the farmers. The result also indicate that older farmers are less technically efficient than the younger farmers, since increase in age leads to decline in technical efficiency. This implies that as the age of cocoa tree increases, the level of technical efficiency would also increase. This is because the yield of cocoa trees normally increases with the age of tree until it reaches a peak before declining. The coefficient of education is also positive, implying that increase in the years of schooling would lead to higher level of efficiency. This result follows a priori expectation as

educated are expected to be more receptive to adoption of new technologies that would likely lead to higher level of productivity.

The wide variation in the level of technical efficiencies of the sampled cocoa farmers implies that there is ample opportunities for raising the current level of efficiency, especially of factors identified in this research work are addressed.



DEDICATION

To:

TAIWO

Toyin, Olumide and Iyiola

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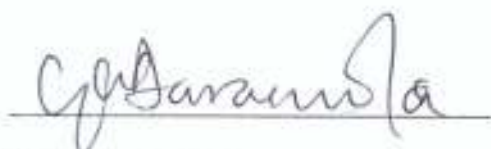
Finally, I thank my mother for her support and infinite love, May she live long to reap the fruits of her labour. And to many others I cannot mention here, I say thank you all and God bless.

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JANUARY, 2000.

CERTIFICATION

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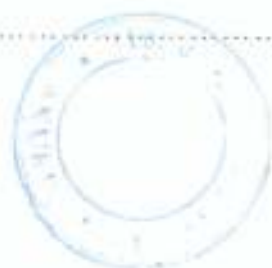
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CHAPTER ONE

1.0 INTRODUCTION

A disturbing feature of the Nigeria's economic performance since the 1970's has been the lag in agricultural production. Prior to the 1970's, the agricultural sector produced large quantities of food and cash crops for export as well as for domestic consumption. Nigeria was the second largest producer of cocoa, after Ghana and the largest producer of palm produce and groundnut. The economic growth which took place from the early 1950 to the early 1970' had agricultural production for export as its main driving force. Not only did the exportation of agricultural products such as cocoa, rubber, cotton, palm produce, groundnut and cashew nuts, generate income within the domestic economy, it also provided most of the foreign exchange which made possible for the importation of machinery and other capital and general development. Indeed, between 1951 and 1960, these crops constituted about 71.02% of all exports valued at ₦198.1m per annum and 61.39% between 1960 and 1970 valued ₦284.0m annually (Akerele, 1992).

However, with the discovery of crude oil the contribution of these cash crops to the Gross Domestic Product (G. D. P.) has reduced tremendously, albeit of all major agricultural production for exports in Nigeria, raw cocoa beans remain the largest in terms of foreign exchange.

1.1 COCOA

Cocoa was introduced into Nigeria from Brazil around 1874 at about the time it was introduced to Ghana, and other West African countries and by the 1950's Ghana and Nigeria had become major producers (Akinwumi, 1996). Between 1960 and 1965, Ghana produced 451,000 metric tonnes on the average followed by Nigeria with 218,000 metric tonnes. The period 1966 – 1970 witnessed a decline in Ghana's output to 394,000 metric tonnes while Cote D'Voire and Brazil showed relatively large increases (41% and 40.9% respectively). From that period, production in all the countries in the West Africa sub-region increased while that of Nigeria has continued to decline steadily (Tables 1 and 2).

Table 1: Long Term Production Trends; The Largest Producers 1961 – 1990

(Thousand Metric Tonnes)

Country	1961 - 65	1966 - 70	1971 - 75	1976 - 80	1981 - 85	1986 - 90
Cote D'Voire	104.7	147.0	208.0	295.4	443.7	689.5
Ghana	451.0	392.3	403.9	309.4	199.0	246.3
Brazil	121.7	171.5	202.7	272.2	340.1	355.7
Malaysia	0.4	1.7	7.5	23.5	71.7	198.6
Nigeria	218.1	226.8	248.9	178.4	153.9	137.0

Source: International Cocoa Conference Organisation 1994/1995 Economic

Trend in Cocoa Production

In view of the prominent position occupied by cocoa in Nigeria, the growth and development of the economy has become crucially linked with a policy to expand the production of this commodity. The pursuance of this policy has brought about the establishment of cocoa processing industries in Ikeja, Ede and Ile-Oluji while private individuals are also encouraged to set up cocoa processing industries (e.g. Starmark Cocoa Processing Industry, Ondo and Egun Industries). Other measures aimed at improving production were, the dissolution of the Commodity Board, liberalisation of commodity trade, the effect of which brought about the birth of Cocoa Association of Nigeria (CAN). The attractions of industrialization, employment generation and value adding encouraged the federal government to put in place a Dollar – dominated Export Stimulation Loan (ESL) from the African Development Bank (ADB) which is being managed by the NEXIM Bank. The disbursement of this loan and other products such as stock piling facility by NEXIM Bank resulted in the emergence of many of these infant processing plant earlier highlighted. Most of these industries were structured to process an average of 100,000 metric tonnes of cocoa per annum.

Government also placed more emphasis on the funding of Cocoa Research Institute (CRIN) for research into developing new technologies. By a continuous process of selection and breeding, new varieties of cocoa which are high yielding and possess desirable commercial qualities and also adapted to various ecological zones are now available. There is the F3 Amazon, which is a general purpose variety. West African Cocoa Research Institute (WACRI) cocoa or Hybrid series II which is a bit superior to F3 Amazon, CRIN establishment Elites which are suitable for marginal and dry cocoa growing zones. There is also the swollen shoot virus tolerant as well as Black pod Resistant / Escape varieties.

There has also been the pioneering pilot schemes of Ciba's Farmers support scheme as well as Owena Bank Plc's pilot project of hand pollination to produce hybrid seeds. Above all government has intensified efforts in the area of better quality control.

Table 2: Average Production of Raw Cocoa Beans in Major Producing Countries of the

World 1989 - 1993 (Metric Tonnes)

Country	Production	Share of Individual Country %
Cote D'Voire	793,000	32.0
Brazil	354,000	14.3
Ghana	296,000	11.9
Malaysia	230,000	9.3
Nigeria	167,000	6.7
Indonesia	126,000	5.1
Cameroun	124,000	5.0
Ecuador	98,000	4.7
Other Countries	289,000	11.7
Total	2,477,000	100.7

Source: Gill and Duffus Cocoa Market Report, May 1994.

1.2 COCOA PRODUCING AREA OF ONDO STATE

Ondo State is the largest cocoa producing area of the country and at present, it supplies more than 65 percent of the total Nigeria cocoa export. Other producing states are Ekiti, Oyo, Ogun, Osun, Edo, Kogi, Kwara, Taraba, Imo and Cross River States. Besides the fact that cocoa has been the main source of income for substantial number of the peasant farmers in these states, it has also provided the main stream of revenue for the government through direct taxes, grading fees, produce sales tax and export duties.

The local government areas of Ondo State which are predominantly noted for cocoa production are Idanre, Ile-Oluji / Oke-Igbo, Odigbo and Owo.

Idanre Local Government Area is located to the North West of the Mainland Ondo State and is the largest supplier of the total Ondo State production. The type of cocoa management is in the form of plantation. Owena Bank PLC and Ciba Geigy Cocoa Chemical Industry have their extension pilot scheme focussed mainly on this local government areas. Some of the farmers have fair access to credit facilities and to a certain extent, obtain advice from government owned management agencies. The major constraint however is the lack of good access road.

The rainfall is in the region of 1350 – 1800mm per annum and is evenly distributed. The altitude is more than 100 – 300m which is more than adequate for cocoa to thrive well. The average temperature is about 28°C and the soil is well drained, high in nutrient content and rich in organic matters.

Ile-Oluji / Oke-Igbo is second to Idanre in cocoa production. The crop has taken over every inch of the community land. It has the same weather condition as Idanre. The farmers have to a certain extent, access to extension services, credit facilities and fairly good road infrastructure. Hence, cocoa is produced predominantly

by small holders. The local government area high rainfall, good fertile soil as well as fairly good marketing facilities.

Cocoa was introduced to Odigbo Local Government Areas particularly, J4, Onigbomudu, Onisere, Aba Akintola, Oluwasola and Onipanu forest reserved areas in the early 1970s. Because of the relative newness of the farms, most of the farm settlements are cropped with hybrid seeds. The rainfall is high and the soil well drained and fertile. The feeder roads are however in poor condition which makes it tedious to bring farm products from the market for sale. This area produced light crop as well as main crops. There is no off season per se.

Table 3: Cocoa Statistics Production Nigeria and World 1964 – 1994 / in Tonne

Year	Nigeria	World	Nigeria % of World Total
1963 / 64	1999978	1,506,000	19.7
1964 / 65	298,000	1,226,000	15.0
1965 / 66	185,000	1,351,000	19.7
1966 / 67	267,000	1,354,000	17.6
1967 / 68	239,000	1,236,000	15.5
1968 / 69	192,000	1,334,000	17.5
Mean 64 – 69	236,200	1,435,000	15.5
1969 / 70	223,000	1,496,000	20.5
1970 / 71	308,000	1,589,000	16.1
1971 / 72	256,000	1,411,000	17.1
1972 / 73	241,300	1,449,000	14.8
1973 / 74	214,900	1,476,000	16.8
Mean 69 – 74	248,640	1,550,000	13.8
1974 / 75	214,500	1,498,500	14.15
1975 / 76	217,500	1,350,400	12.32
1976 / 77	166,400	1,509,200	13.54
1977 / 78	204,400	1,500,300	8.89
1978 / 79	133,400	1,481,680	12.54
Mean 74 – 79	187,240	1,538,200	11.1
1979 / 80	170,400	1,613,200	9.7
1980 / 81	155,536	1,729,000	11.00
1981 / 82	183,536	1,548,000	10.0
1982 / 83	154,000	1,540,000	7.7
1983 / 84	118,800	1,593,820	9.9
Mean 79 – 84	156,527	1,940,000	7.7
1984 / 85	149,500	1,962,000	5.9
1985 / 86	116,300	1,995,000	6.3
1986 / 87	126,300	2,197,000	6.8
1987 / 88	150,000	2,470,000	6.4
1988 / 89	160,000	2,112,800	6.62
Mean 84 – 89	140,420	2,412,000	7.0
1989 / 90	170,000	2,548,000	6.6
1990 / 91	170,000	2,261,000	5.7
1991 / 92	130,000	2,293,000	5.6
1992 / 93	130,000	2,335,000	5.9
1993 / 94	138,000	2,315,800	6.16
Mean 89 – 94	147,000	2350560	5.99
1994 / 95	140,000		
1995 / 96	155,000		
1996 / 97	150,000		
1997 / 98	130,000		
1998 / 1999	130,000		

Source: Quarterly Bulletin of Cocoa Statistics, various issues

1.3 PROBLEM STATEMENT

Over the past few years, Nigeria's production of cocoa has been rising and falling. For example, the production of cocoa as could be seen in Table 3 stood at 308,999 metric tonnes in 1970. This output exhibited a decreasing trend from 1971 – 1994 where it registered 214,000 metric tonnes. Its output registered a slight increase in 1975 where it reached 217,500 metric tonnes. Between 1975 and 1986, the physical output of cocoa experienced erratic fluctuations, reaching its lowest output in 1986 with 126,300 metric tonnes. Again cocoa appeared to be rising in its output in 1987 but this trend was disrupted when its output fell to 130,000 tonnes in 1991. From 1992 to 1994 production experienced a stable trend and reaching its highest output of 155,000 metric tonnes in 1994. The year 1996 witnessed a decline in output, it was believed to be the worst for several years. Adegeye (1996) attributed this to the effect of heavy rainfall and inadequate use of chemical. The world production summary for 1997 / 98 also recorded a downward trend in world cocoa output due to unfavourable weather condition.

In recent years, the average cocoa production shows that Cote D'voire produced 840,000 metric tonnes in 1994, Brazil had 300,000 metric tonnes while Ghana came forth with 245,000 metric tonnes. Malaysia was the fifth largest producer with Nigeria coming sixth with 140,000 metric tonnes. The effect of this scenario on the income of Nigeria cocoa farmers can better be imagined than experienced, rising prices notwithstanding. The ever increasing demand for Nigerian cocoa in the world market due to its unique aroma necessitates the need to double output of cocoa in Nigeria. Given this scenario, it becomes imperative to raise production and productivity of Nigeria's cocoa farmers so as to meet the demand both at local and international markets. To raise the productivity however requires

that the current level of productivity is known. This study is therefore designed to measure the level of technical efficiency (a productivity measure) of cocoa farmers in Ondo State of Nigeria. Identification of influence of socio-economic factors and the direction of influence of the factors on technical efficiency would provide policy recommendations that would help in raising production and productivity of cocoa farmers in Nigeria.

1.4 OBJECTIVES OF THE STUDY

The general objective of this study is to investigate the technical efficiency of cocoa farmers in Ondo State and to identify the influence and the direction of the influence of farmer's socio-economic variables on technical efficiency. In order to achieve this broad objective, the study has the following specific objectives:

- (1) To examine the socio-economic characteristics of cocoa farmers in the study area.
- (2) To examine production constraints of cocoa farmers in the study area.
- (3) To estimate technical efficiency of cocoa farmers in the study area.
- (4) To estimate the influence of socio-economic variables on inefficiency of cocoa farmers in the study area.

1.5 JUSTIFICATION OF THE STUDY

Available literature indicates that only few studies have been carried out on productivity of cocoa in Nigeria. However, none of such studies measured the technical efficiency of cocoa production in Nigeria. Therefore, the question is whether cocoa farmers operate at or near their technical efficiency frontier. Their ability to operate at or near their technical efficiency frontier may help to ensure their survival in the future. This is a critical issue in view of the cocoa industry in the state as well as the entire economy. If technical efficiency is low, this will indicate that policy makers will need to devise better and appropriate policies to enhance farmers' levels of technical efficiency. In addition, this study will investigate the influence which some cocoa farmers' specific variables have on technical inefficiency of production.

The outcomes of the findings will surely influence government's agricultural policies. This study therefore becomes important in measuring the level of technical efficiencies of small holder cocoa farmers in the use of their resources and to examine the factors that influence their level of efficiency.

1.6 STATEMENT OF HYPOTHESIS

The study has the following hypotheses:

- (i) Cocoa farmers in the study area are technically efficient and no policy options can raise their present level of technical efficiency.
- (ii) Cocoa farmers' socio-economic variables have no influence on their technical efficiency.



CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 MEANING AND IMPORTANCE OF EFFICIENCY

MEASUREMENT

Efficiency of a production system or unit connotes a comparison between observed and optimal values of its output and input. The comparison can be in the form of the ratio of observed to maximum potential output obtainable from the given input, or the ratio of minimum potential to observed input required to produce the given output or some combination of the two. In these two comparisons, the optimum is defined in terms of production possibilities, while efficiency is technical. It is also possible to define the optimum in terms of the behavioural goal of the production unit. In this case, efficiency is economic and is measured by comparing observed and optimum cost, revenue, profit or whatever the production unit is assumed to pursue, subject to the appropriate constraints on quantities and prices (Battese, 1992; Schmidt and Lovell, 1979).

Measurement of efficiency becomes important for the following reasons: first and foremost, it is a success indicator, a performance measure, by which production units are evaluated. Secondly, only by measuring efficiency and separating its effects from the effects of the production environment can one explore hypotheses concerning the sources of efficiency differentials. Identification of sources of inefficiency is important to the institution of public and private policies designed to improve performance.

Above all, the ability to quantify efficiency provides decision-makers with a control mechanism with which to monitor the performance of the production system or units under his control. In some cases theory provides no guidance or provides

conflicting signals, concerning the impact of some phenomena on performance. In such situations, empirical measurement provides qualitative as well a quantitative evidence (Coelli, 1995).

2.2 THE STOCHASTIC FRONTIER PRODUCTION FUNCTION

The theoretical definition of a production function has been based on expressing the maximum amount of output obtainable from given input bundle with fixed technology. This is regarded as estimating average production function. This definition assumes that technical inefficiency is absent from the production function. Following pioneering but independent works by Aigner, Lovell and Schmidt (1977), Battese and Corra (1977), and Meeusen and Van den Broeck (1977), serious consideration has been given to the possibility of estimating the so-called frontier production functions, in an effort to bridge the gap between theory and empirical work.

The idea of frontier production function can be illustrated with a firm using n inputs (x_1, x_2, \dots, x_n) to produce output y . Efficient transformation of inputs into output is characterized by the production function $f(x_i)$, which shows the maximum output obtainable from various input vectors.

The stochastic frontier production function assumes the presence of technical inefficiency of production. Hence the function is defined by,

$$\begin{aligned} Y_i &= f(x_i; \beta) \exp (v_i - u_i) \\ &= \quad i = 1, 2, \dots, N \end{aligned} \quad (1)$$

where v is a random error which is associated with random factors not under the control of farmers. This model is such that the possible Y_i is bounded above by the

stochastic quantity, $f(x_i, \beta) \exp(v_i)$, hence the term stochastic frontier. The random error v_i are assumed to be independently and identically distributed as $N(0, \sigma^2 v)$ random variables independent of the u_i s, which are assumed to be non-negative truncations of the $N(0, \sigma^2)$ distribution (i.e. half-normal distribution) or have exponential distribution.

Technical efficiency of an individual farm is defined in terms of the ratio of the observed output to the corresponding frontier output, given the available technology. It therefore implies that the frontier output varies with the level of technology employed by the farm.

$$\begin{aligned}
 \text{Technical efficiency (TE)} &= Y_i / Y_i^* \\
 &= f(x_i, \beta) \exp(v_i - u_i) / f(x_i, \beta) \exp(v_i) \\
 &= \exp(-u_i) \tag{2}
 \end{aligned}$$

where Y_i is observed output and Y^* the frontier output.

Technically efficient farm are those that operate on the production frontier and the level by which a farm lies below its production frontier is regarded as the measure of technical efficiency.

Since the above method concentrates on the direct estimation of frontier production functions using single equation methods, there is need for the consideration of alternative dual forms of the production technology, such as the cost or profit function. This is to reflect alternative behavioural objectives, such as cost minimisation. In addition, because any kind of inefficiency leads to an increase in cost, or reduction in profit, it is worth investigating the impact of these inefficiencies on the cost of production and or profit. This study is to estimate the technical efficiencies for the small holder cocoa farmers.

In the deterministic frontiers, all production units share a common family of production, cost and profit frontiers, and all variations in performance is attributed to variation in efficiencies, relative to the common family of frontiers. Although this scenario is in conformity with the theoretical underpinnings of production function, it proves difficult to justify empirically. The notion of a deterministic frontier shared by all production units ignores the possibility that the performance of a production unit may be affected by factors entirely outside its control (such as weather, government policy, etc.), as well as by factors under its control (inefficiency). To lump the effects of exogenous shocks together with the effects of measurement error and inefficiency into a single one-sided error term, and to label the mixture 'inefficiency' is somewhat questionable. These arguments form the basis for the stochastic frontier (also known as the 'composed error') model of Aigner *et. al.* (1977), Meeusen and Van den Broeck (1977) and Battese and Corra (1977). The concept underlying the stochastic frontier permits random variation of the frontier across production units, and captures the effects of measurement error, other statistical noise and random shocks outside the control of the production unit. One sided component captures the effects of inefficiency relative to the stochastic frontier.

The stochastic frontier production model is written as:

$$\begin{aligned}
 Y &= f(x_i; \beta) \exp (v_i - u_i), \\
 &= \quad i = 1, 2, \dots, N
 \end{aligned}
 \tag{3}$$

where v is a random error having zero mean, which is associated with random factors such as measurement errors in production, weather, industrial action, etc. not under the control of the decision making unit.

The model is such that the possible production, Y_i , is bounded above by the stochastic quantity, $f(x_i, \beta) \exp(v_i)$, hence the term stochastic frontier. The random error,

$v_i, i = 1, 2, \dots, N$, were assumed to be independently and identically distributed as $N(0, \sigma^2)$ random variables, independent of the u_i s, which were assumed to be non-negative truncations of the $N(0, \sigma^2)$ distribution, (i.e. half-normal distribution) or have exponential distribution. Both of these distributions have a mode of zero.

The basic structure of the stochastic frontier model is depicted in figure 1 in which the production activities of two farms, represented by i and j , are considered. Farm i uses inputs with values given by the vector, x_i , and obtains the output, Y_i . The frontier output, Y_i^* , exceed the value on the deterministic production function, $f(x_i, \beta)$, because its productive activities is associated with favourable conditions for which the random error, v_i , is positive. However, farm j uses inputs with values given by the vector x_j and obtains the output Y_j , which has corresponding frontier output, Y_j^* , which is less than the value of the deterministic production function, $f(x_j, \beta)$, because its productive activity is associated with unfavourable conditions for which the random error, v_j , is negative. In both cases, the observed production values are less than the corresponding frontier values.

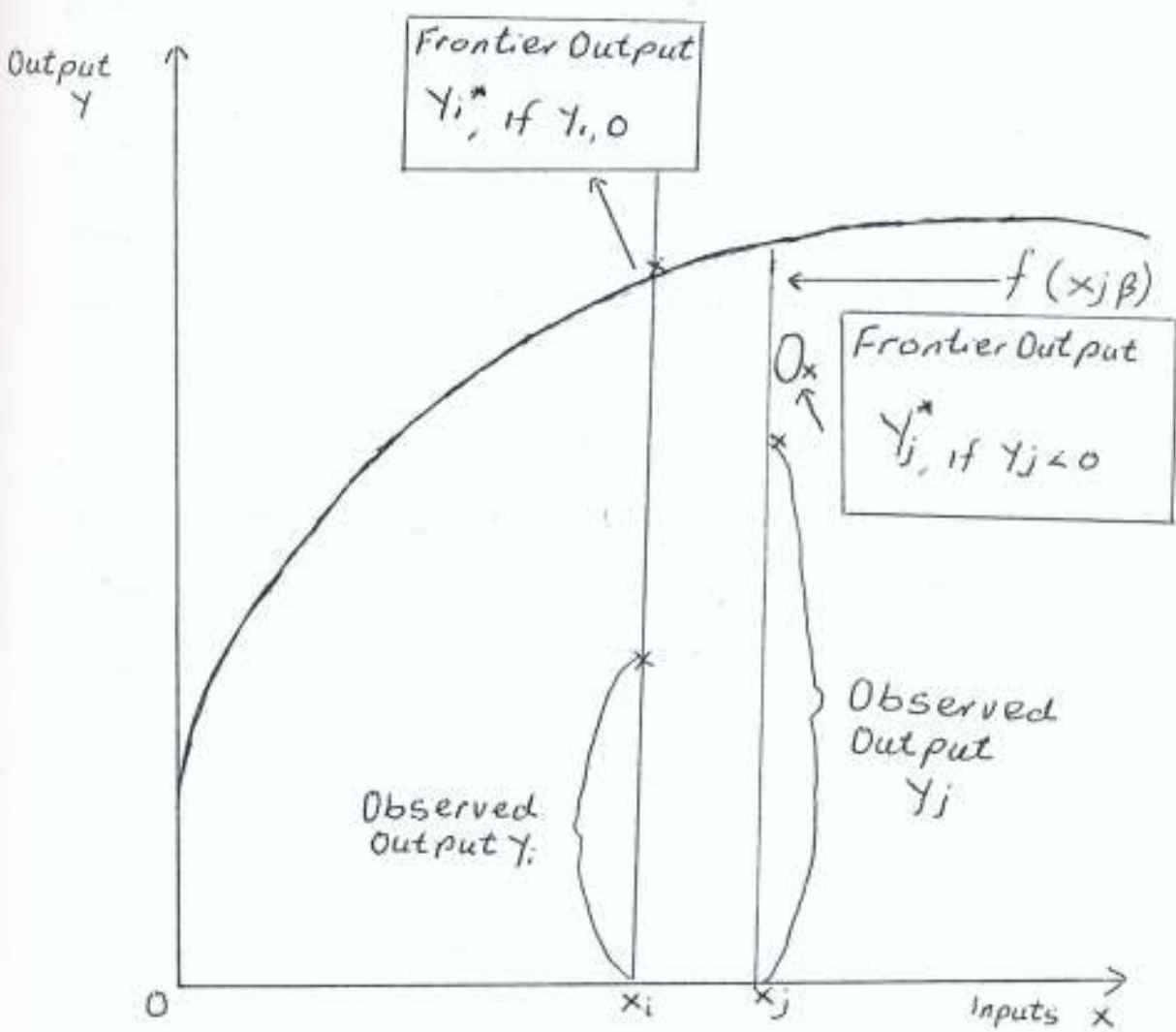


Figure 5: Technical Efficiency of Farms in Input – Output Space

Based on the assumptions of the stochastic frontier model (22), inference about the parameters of the model is obtained using the maximum likelihood estimators. Aigner, Lovell and Schmidt (1977) suggested that the maximum likelihood estimates of the parameters of the model be obtained in terms of the parameterization, $\sigma_v^2 + \sigma^2 = \sigma^2_s$. λ is the ratio of the standard deviation of the $N(0, \sigma^2)$ distribution involved in specifying the distribution of the non-negative u_i s to the standard deviation of the symmetric errors, v_i . Battese and Corra (1977) however considered the parameter, $\gamma = \sigma^2 / (\sigma_v^2 + \sigma^2)$, which is bounded between zero and one.

The technical efficiency of individual farm under the stochastic frontier model, is defined in terms of the ratio of the observed output to the corresponding frontier output, conditional on the levels of input used by that farm. Hence the technical efficiency of farm i is expressed as:

$$TE_i = Y_i / Y^* = f(x_i; \beta) \exp(v_i - u_i) / f(x_i; \beta) \exp(v_i) \quad (4)$$

$$TE_i = \exp(-u_i)$$

The prediction of the technical efficiencies of individual observations associated with the stochastic frontier production function (23), defined by

$$TE_i = \exp(-u_i), i = 1, 2, \dots, n \quad (5)$$

was considered impossible until the work of Jondrow, Lovell, Materove and Schmidt (1982). Their technique was based on the conditional distribution of the non-negative random variable, u_i , given that the random variable, $E_i = v_i - u_i$, was observable. Jondrow *et. al.* (1982) suggested that u_i be predicted by the conditional expectation of u_i , given that the value of the random variable, $E_i = v_i - u_i$. This expectation was derived for the cases that the u_i s had half-normal and exponential distribution.

row *et. al.* (1982) used $1 - E(u_i / v_i - u_i)$ to predict the technical inefficiency of i -th firm. Given the multiplicative production frontier model (23), Battese and Li (1988) however pointed out that the technical efficiency of the i -th firm, $TE_i = \exp(-u_i)$, is best predicted by using conditional expectation of $\exp(-u_i)$, given the value of the random variable, $E_i = (v_i - u_i)$.

EMPIRICAL APPLICATIONS OF FRONTIER PRODUCTION

FUNCTIONS

Frontier production function models have been applied in a number of studies, especially, in agricultural economics. The empirical applications are discussed under four main sections: deterministic frontiers; stochastic frontiers; panel data frontiers and data envelopment analysis (DEA) models. However, the review of applications of frontier production model here would cover literatures within the last two decades.

Russel and Young (1983) applied a deterministic Cobb-Douglas frontier production function to a cross-section of 56 farms in England during 1977 – 1978. The dependent variable was the value of farm output, consisting of crop, livestock and miscellaneous activities on the farms involved. Their results indicates technical efficiencies ranging between 0.42 and 1.0, with a mean technical efficiency of 0.73.

Kontos and Young (1983) in their study applied deterministic frontier production function to data on 83 Greek farms during the 1980 – 81 cropping year. Their predicted technical efficiencies ranges between 0.30 and 1.00, with a mean technical efficiency of 0.57, indicating considerable technical inefficiencies among the sample farms.

The work of Russell and Young (1983), involving 56 farms in England, was revisited by Dawson (1985). Three estimators for the technical efficiencies of the individual farms were presented, with a two-step ordinary least squares method and linear programming technique proposed by Aigner and Chu (1968). The technical efficiency measures obtained by the three methods showed wide variation. Dawson (1985) further indicated that the technical efficiencies were directly related to the size of the farm operation.

Taylor, Drummond and Gomes (1986) applied a deterministic Cobb-Douglas frontier production function to data on Brazilian farmers to study the effectiveness of a World Bank sponsored Agricultural Credit Programme. They reported that the average technical efficiencies for participant and non-participant farmers to be 0.18 and 0.17 respectively.

Bravo-Ureta (1986) estimated the technical efficiencies of dairy farms in the New England region of United States, using a deterministic Cobb-Douglas frontier production function. The parameters of the model were estimated using the linear programming technique involving the probabilistic frontier approach. The results obtained showed technical efficiencies which ranged from 0.58 to 1.00, with an average technical efficiency of 0.82. He concluded that technical efficiency of individual farms was statistically independent of size of the dairy farms operation, measured by the number of cows.

Ali, Battese, Grabowski and Kraft (1987) investigated the technical efficiency of a sample of Illinois grain farms, with input and output variables expressed in revenue terms. The mean technical efficiency for the 88 farms studied was established to be 0.58. The authors concluded that larger farms tended to be more

technically efficient than smaller farms, irrespective of whether acreage cultivated or gross revenue was used to classify the farms by size of operation.

Ali and Chaudhry (1990) estimated deterministic frontier production functions in the analysis of a cross-sectional data on farms in four regions of Pakistan. Using the Cobb-Douglas functional form, the parameters of the models were estimated. Their results showed that although the frontier functions were not homogenous among the different regions, the technical efficiencies in the four regions ranged from 0.80 to 0.87 but did not appear to be significantly different.

Of all the frontier production models, the stochastic frontier has been the most widely applied. Aigner, Lovell and Schmidt (1977) estimated the stochastic frontier production function to United State agricultural data covering 6 years and the 48 coterminous states. For this application, the stochastic frontier production function was not significantly different from the traditional average response function. Similar results were reported by Meeusen and Van den Broeck (1977) in their analyses of ten French manufacturing industries.

Battese and Corra (1977) were the first to apply of the stochastic frontier production function to farm-level agricultural data. Their empirical study involved data from the 1973 – 1974 Australian Grazing Industry Survey and both deterministic and stochastic Cobb-Douglas production frontiers were estimated for the three states in the pastoral zone of Eastern Australian. The variance of the inefficiency effects was found to be a highly significant proportion of the total variability of the logarithm of the value of Sheep production in all states, they concluded. The technical efficiency of farms in the regions was however not addressed in Battese and Corra (1977) study.

Kalirajan (1981) applied the stochastic frontier Cobb-Douglas production function using data from 70 rice farmers in India. The variance of inefficiency effects was found to be a highly significant component in describing the variability of rice yields (with γ parameter being 0.81).

Kalirajan (1982) estimated a similar stochastic frontier production function to that in Kalirajan (1981) in the analysis of data on 91 rice farmers in India as in his study. The technical inefficiency effects in the model were again found to be very highly significant with ($\gamma = 0.93$).

Bagi (1982a) estimated a stochastic frontier Cobb-Douglas production function model to determine whether there were any significant differences in the technical efficiencies of small and large crop and mixed-enterprise farms in West Tennessee. The variability of inefficiency of mixed-enterprise farms was smaller than that for crop farms (about 0.76 against 0.85 respectively). However, there did not appear to be significant differences in mean technical efficiency for small and large farms, irrespective of whether the farms were classified according to acreage or value of farm sales. Bagi (1984) considered the same data set as in Bagi (1982a) to investigate whether there were any significant differences in the mean technical efficiencies of part-time and full-time farmers. No significant differences were apparent, irrespective of whether the part-time and full-time farmers were engaged in mixed farming or crop-only farms.

Bagi and Huang (1983) estimated a translog stochastic frontier production function using the same data on the Tennessee farms considered in Bagi (1982a). The Cobb-Douglas stochastic frontier model was found not to be an adequate representation of the data, given the specifications of the translog model for both crop and mixed farms. The parameters of the model were estimated by corrected ordinary

least-squares regression. The mean technical efficiencies of crop and mixed farms were estimated to be 0.73 and 0.67, respectively. Individual technical efficiencies of the farms were predicted using the predictor $\exp(-u_i)$, where u_i is the estimated conditional mean of the i -th inefficiency effect (suggested by Jondrow, Lovell, Materov and Schmidt, 1982). These technical efficiencies varied from 0.35 to 0.92 for mixed farms and 0.52 to 0.91 for crop farms.

Bagi (1982b) included empirical results in the estimation of a translog stochastic frontier production function using data from 34 share cropping farms in India. The Cobb-Douglas functional form was judged not to be an adequate representation of the data given the assumptions of the translog model. The variance of the inefficiency effects was only a small proportion of the total variance of farm outputs ($\gamma = 0.15$). The individual farm technical efficiencies were predicted to be between 0.92 and 0.95.

Kalirajan and Flinn (1983) outlined the methodology by which the individual inefficiency effects can be predicted (with reference to Jondrow *et al.*, 1982) and applied the approach in their analysis of data on 79 rice farmers in the Philippines. A translog stochastic frontier production function assumed to explain the variation in rice output in terms of several input variables. The parameters of the model were estimated by the method of maximum likelihood. The Cobb-Douglas model was found to be an inadequate representation for the farm-level data. The individual technical efficiencies ranged from 0.38 to 0.91. The predicted technical efficiencies were regressed on several farm-level variables and farmer-specific variables. It was concluded that the practice of transplanting of rice seedlings, incidence of fertilization, years of farming and number of extension contacts had significant influence on the variation of the estimated farm technical efficiencies.

Huang and Bagi (1984) used a modified translog stochastic frontier production function to investigate the technical efficiencies of individual farms in India. It was found that the Cobb-Douglas stochastic frontier was not an adequate representation for describing the value of farm products, given the specifications of the translog model. The variance of the random effects was a significant component of the variability of value of farm outputs. Individual technical efficiencies ranged from 0.75 to 0.95, but there appeared to be no significant differences in the technical efficiencies of small and large farms.

Taylor and Shonkwiler (1986) estimated both deterministic and stochastic production frontiers of Cobb-Douglas form for participants and non-participants of a World Bank sponsored credit programme for farmers in Brazil, using the maximum likelihood methods. They assumed that the inefficiency effects had gamma distribution in the deterministic frontier and half-normal for the stochastic frontier. Individual technical efficiencies were estimated for all the frontiers, as suggested by Brown *et al.* (1982). Given the stochastic frontiers, the average technical efficiencies for participants and non-participants were 0.714 and 0.704, respectively, and were not significantly different. However, given the assumptions of the deterministic frontiers, the average technical efficiencies were 0.185 and 0.059, respectively, and were significantly different. Taylor and Shonkwiler (1986) concluded that their results indicated somewhat confusing results as to the impact of the World Bank sponsored credit programme on participant farmers in Brazil.

Huang, Tang and Bagi (1986) adopted a stochastic *profit* function approach to investigate the economic efficiency of small and large farms in two states in India. The variability of inefficiency effects was highly significant and individual farm economic efficiencies tended to be greater for large farms than small farms (the

average economic efficiencies being 0.84 and 0.80 for large and small farms, respectively).

Kalirajan and Shand (1986) investigated the technical efficiency of rice farmers within and without the Kemubu Irrigation Project in Malaysia during 1980. Given the specifications of a translog frontier production function for the output of the rice farmers, the Cobb-Douglas model was not an adequate representation of the data. Maximum – likelihood methods were used for estimation of the parameters of the models and the estimated frontiers for the two groups of farmers were significantly different. They reported that the individual technical efficiencies ranged from about 0.40 to 0.90, such that the efficiencies for those outside the Kemubu Irrigation Project were slightly smaller. They concluded that their results indicated that the introduction of new technology for farmers does not necessarily result in significantly increased technical efficiencies over those for traditional farmers.

Ekanayake and Jayasuriya (1987) estimated both deterministic and stochastic frontier production functions of Cobb-Douglas type of two groups of rice farmers in an irrigated area in Sri Lanka. The parameter of the two frontiers were estimated by maximum – likelihood and corrected ordinary least – square methods. In only the tail reach irrigated area the stochastic frontier appeared to be significantly different from the deterministic model. Individual farm technical efficiencies were estimated for both regions. The estimates obtained for the farms in the head reach area (for which the stochastic frontier appeared not to be significantly different from the deterministic frontier) were vastly different for the two different stochastic frontiers.

Ali and Flinn (1989) estimated a stochastic profit frontier of modified translog type for Basmati rice farmers in Pakistan. After estimating the technical efficiency of individual farmers, the losses in profit due to technical inefficiency were obtained

and regressed on various farmers – and farm – specific variables. Factors which were significant in describing the variability in profit losses were level of education, off – farm employment, unavailability of credit and various constraints associated with irrigation and fertilizer application.

Dawson and Lingard (1989) estimated a Cobb-Douglas stochastic frontier production function to investigate the technical efficiencies of Philippine rice farmers using four years of data. The four stochastic frontiers estimated were significantly different from the corresponding deterministic frontiers. The individual technical efficiencies ranged between 0.10 and 0.99, with the means between 0.60 and 0.70 for the four years involved.

Bailey, Biswas, Kumbhakar and Schulthies (1989) estimated a stochastic model involving technical allocative and scale inefficiencies for cross-sectional data on 68 Ecuadorian dairy farms. The technical inefficiencies of individual farms were about 12%, with little variation being displayed by individual farms. However, the authors found that the losses in profits due to technical inefficiencies ranged from 20% to 25%.

Kumbhakar, Biwas and Bailey (1989) used a system approach to estimate technical, allocative and scale inefficiencies for Utah dairy farmers. The stochastic frontier production function which was specified included both endogenous and exogenous variables. The endogenous variables included were labour (including family and hired labour) and capital (the opportunity cost of capital expenses on the farm), whereas the exogenous variables included level of formal education off - farm income and measures of farm size for the farmers involved. Both types of explanatory variables were found to have significant effects on the variation of farm



production. Technical efficiency of farm was found to be positively related to farm size.

Bravo-Ureta and Rieger (1990) estimated both deterministic and stochastic frontier production functions for a large sample of dairy farms in the North-eastern states of the U. S. A. for the years 1982 and 1983. The Cobb-Douglas functional form was assumed to be appropriate. The parameters of the deterministic and the stochastic frontiers were estimated by linear programming, corrected ordinary least – squares regression and maximum – likelihood methods. The stochastic frontier model has significant inefficiency effects for 1982 but it was apparently not significantly different from the deterministic frontier in 1983. The estimated technical efficiencies of farms obtained from the three different methods used for the deterministic model showed considerable variability but were generally less than those obtained by use of the stochastic frontier model. They however found that the technical efficiencies obtained by the different methods were highly correlated and gave similar ordinal rankings of the farms.

Ferrier and Lovell (1990) applied econometric and programming techniques in the analysis of the structure of production technology and the nature and extent of cost inefficiency in the U. S. banking industry. Their results show that relative to their cost frontier, banks operate inefficiently with observed cost roughly 20 to 30% above minimum for all but the smallest sizes classes.

Huang (1994) estimated a non-neutral stochastic frontier production function for the Taiwan's electronics industry using 1986 data. His results show an average technical efficiency of 82%, with firms' characteristics such as age of the firms, the export ratio, and the R & D expenditure contributing positively and significantly on production efficiency of the industry.

Ajibefun, Battese and Daramola (1996) investigated factors influencing the technical efficiencies of small holder farmers in Nigeria, using farm-level data. The results indicated that the technical efficiency of the sample farmers are significantly related to age, and farming experience of the farmers. However, the inefficiency of the farmers is not significantly related to the size of farming operations. The estimated technical efficiency varied widely among the sample farmers, ranging between 19 and 95%, with an average efficiency of 82%.

Abdulkadri and Ajibefun (1997) estimated technical efficiency for food crop farmers under the National Directorate of Employment in Ondo State. Given the specification of the translog frontier production function, the hypothesis of no technical inefficiency among the sample farmers was rejected. Predicted technical efficiencies vary widely across farms ranging between 21.7% and 87.8%.

Adesina and Djato (1997), applied the stochastic frontier model to measure the relative efficiency of women as farm managers using the profit function. Their results show that the relative degree of efficiency of women is similar to that of men.

Ajibefun (1999) applied both the stochastic frontier production, cost function as well as the data envelopment to estimate technical, allocative and economic efficiency for two hundred small scale food crops farmers in four zones namely: Akoko, Akure, Ondo and Owo. The results indicates that while the level of efficiencies of the respondents farmers vary widely across zones in the study area, the level of efficiency was found to be influenced by farmer's specific socio-economic variables as well as farm specific factors. It was discovered that farmers' age, level of farmer education, farming experience, farm size and the ratio of hired labour to total labour were jointly significant in influencing the level of efficiencies of the farmers.

Schmidt and Lovell (1979) applied the stochastic Cobb-Douglas production and cost frontier functions to 150 privately-owned steam electric-generating plants in the U. S. covering 1947 to 1965. Their study indicated that there was evidence of technical and allocative efficiency among the samples represented by the data, with mean value of 0.10 for technical efficiency and 0.092 for allocative efficiency.

Battese, Coelli and Colby (1989) estimated a stochastic frontier production function for farms in Indian village. Although the stochastic frontier was significantly different from the corresponding deterministic frontier, the hypothesis that the inefficiency effects had half-normal distribution was not rejected. Technical efficiencies ranged from 0.66 to 0.91, with the mean efficiency estimated by 0.84.

Kalirajan and Shand (1989) estimated the time-invariant panel-data model using data for Indian rice farmers over a five-year period. The inefficiency effects were found to be a highly significant component of the variability of rice output, given the specifications of a translog stochastic frontier production function. Individual technical efficiencies were estimated to range from 0.64 to 0.91, with average 0.70. A regression of the estimated technical efficiencies on farm – specific variables indicated that farming experience level of education, access to credit and extension contacts had significant influences on the variation of the farm efficiencies.

Battese and Coelli (1992) applied panel-data model incorporating time – varying inefficiency effects in the analysis of data for paddy farmers in an Indian village over a period of ten years. Given the specifications of a stochastic frontier production function with time-invariant parameters, the hypothesis of time – invariant technical efficiencies of the paddy farmers was rejected. However, given that a linear time trend was included in the stochastic frontier model (Hicksian neutral technical change), then the hypothesis of time-invariant technical efficiencies was accepted. In

addition, the stochastic frontier production function with the time trend included was not significantly different from the average response function which implies that technical inefficiencies could be considered to be absent from the model.

Battese and Tessema (1993) estimated stochastic frontier production function with time-varying technical inefficiency for Indian farmers, covering the period 1975 to 1985. Their results show that the hypothesis that the traditional response function is an adequate representation of the data is accepted in only one of the three villages. The hypothesis of time-invariant technical inefficiency is not rejected in one of the three villages. They concluded that the technical efficiencies of individual farms exhibited considerable variation in the villages.

Battese *et. al.* (1993), estimated a Cobb-Douglas stochastic frontier production function for wheat farmers in Pakistan, with data covering 1986 to 1991. Their results indicates varying patterns of technical inefficiencies. The hypothesis of no technical inefficiency can not be rejected in only one out of the four districts studied.

Battese and Coelli (1995) investigated the technical efficiency of paddy farmers in Indian village using panel data model of stochastic frontier production function, covering a ten-year period. The results indicate that the model for the technical inefficiency effects involving age and schooling of farmers and year of observation, is a significant component in the stochastic frontier production functions.

Gokcekus (1995) investigated the technical efficiency level attained by plants in the Turkish rubber industry using the stochastic frontier production function for 1985 to 1990 period. The results indicate that the improvement in the technical efficiency levels went up while the number of plants operating at low technical efficiency levels declined during the period covered by the study.

Battese *et. al.* (1996) applied the stochastic frontier production function using panel data of wheat in four districts in Pakistan. Their results show that the technical inefficiency effects are highly significant. Their results also show that technical efficiency tends to be smaller for older farmers and those with greater formal schooling. It was also discovered that the levels of wheat production of farmers tend to approach their potential frontier production levels over time, though there was no evidence of technical change. The technical efficiencies were found to vary considerably over time such that the mean technical efficiencies range from 57% to 79% in the districts.

Ajibefun, *et.al* (1998) estimated stochastic frontier production function for Japanese rice farm households using panel data covering 1984 to 1994. Given the translog frontier model, the Cobb-Douglas frontier function was found to be inadequate in the analysis of the data. The technical inefficiency effects were found to be statistically significant but time invariant. The analysis also indicates evidence of neutral technological change. Technical efficiencies of the average rice farm households in the prefectures are quite high, with the mean technical efficiency of 74.5%. The returns to scale parameters is estimated to be significantly different from unity and indicated constant returns to scale.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 STUDY AREA AND THE DATA

The study used farm-level data of 150 cocoa farmers in Ondo State. Ondo State remains the highest cocoa producing state in Nigeria. Apart from the high volume, cocoa emanating from the state is of high grade quality variety. The fermentation devices used by farmers have distinguished Ondo State for high quality and internationally acceptable flavour.

Ondo State is one of the thirty-six states of Nigeria and is situated in the Southwestern part of Nigeria. Within the state, there are three ecological zones. The mangrove forest in the south, the rainforest in the middle belt and the derived savanna to the North.

Due to its strategic location, the state witness two main weather patterns in the cocoa producing belt, cutting across the southern parts of the state and another for central districts. For instance, Odigbo and Okitipupa zones experience a weather pattern equivalent to what obtained in the cocoa producing part of Cote D'voire while Ondo, Akure, Idanre and Ile-Oluji zones upwards to Owo and Edo State share a particular weather pattern equivalent to what obtains in Ghana, Ogunjobi (1988). The weather differentiation partly accounts for the crop performance vis-à-vis high quality.

Most cocoa farmers in Ondo State are small holders whose average farm sizes are just above 3.5 hectares. Also except for few cases of farm estates (like Oda and Onisere in Akure North and Odigbo zones respectively), cocoa farming is basically of farm stead type.

3.2 SAMPLING TECHNIQUES

For this study, cocoa farmers in the three local government areas, Idanre, Ile-Oluji / Oke-Igbo and Odigbo were investigated to collect data on their production and output as well as their socio-economic characteristics. Together, these zones account for 60 percent of the total cocoa production in the state. For this reason 15 villages were randomly selected (see Table 4) and 150 farmers were drawn from the population for interview based on the consideration that there were several farms in the same farming region. It was therefore impossible to cover all these farms for the simple reason of cost, more effort and time constraints. Hence, a sample of representative farms were chosen in such a way that information from it meets the purpose of the survey.

3.3 DATA COLLECTION

In the collection of data, structured questionnaire were used during the survey. Questionnaire bordered on both the socio-economic and production activities of the sample farmers for analysis. Therefore, the data collected include information on farmers' characteristics such as level of education, age, family size, family members available for farming activities, etc.

In a nutshell, the key economic variables considered for estimation of cocoa production function are as follows:

1. Cocoa (dried) bean output
2. Block areas in hectares
3. Age of cocoa trees



4. Number of cocoa trees per farm
5. Number of different types of shade tree per farm
6. Labour used (for maintenance and harvesting in mandays)
7. Quantity of chemical
8. Farmers age
9. Level of education

Cocoa (dried) beans output depends on the number of cocoa trees actually producing. Initially when cocoa trees are planted, spacing of trees varies from farmer to farmer and among zones. Different trees derives mainly result from spacing differences, effects of diseases, pests, and long dry spells. To account for the actual number of cocoa trees producing, information on trees that are actually producing as well as senile and immature trees were collected. In this analysis, only those trees actually producing were taken into account.

A cocoa tree is economically productive for 15 to 30 years. The old amelonado cocoa varieties started producing at about 4 – 5 years after planting, and reached full capacity production of about 7 to 10 years of age. In the early 1980s new cocoa hybrids were developed and disseminated to farmers.

The new hybrids started producing at the age of 3 years after planting but the yields are variable for the first two years after which they become more uniform and reach their maximum levels of production at 6 years. According to Tam (1989) the new hybrid cocoa varieties is promising producing 1.3 to 1.4 tonnes of dry beans per hectare under plantation condition and 1.2 tonnes of dry beans per hectare on small holder farms, 4 years after planting. Densley and Wheeler (1978) reported that in areas of little disease problems and properly maintained farms, cocoa trees can be economically productive for between 15 to 30yrs. Conversely, in areas where pests

and disease problems are severe and farms are not properly maintained, the economic life of a cocoa tree is limited to only 10 – 15 years of age. Little information is however available on the productive life of these new hybrids.

Cocoa yields vary considerably with ages of trees. Cocoa trees start producing at a certain age after plantation, reach a maximum and remain fairly constant for some years, then start declining. Thus, to account for age of trees and the total bearing cocoa trees in the production function analysis both these variables will be incorporated into a single explanatory variable. This is done by giving weights to the bearing trees according to the age groups.

The total weights trees variables is defined by:

$$\text{TWT} = W_1T_1 + W_2T_2 + W_3T_3 + W_4T_4 + W_5T_5 + W_6T_6 + W_7T_7$$

where TWT represents the number of weighted trees

T_1 , T_2 , T_3 , and T_4 represents the number of trees age 2, 3, 4 and 5 years respectively, T_5 , T_6 and T_7 represents the numbers of trees age 6 to 9 years, 10 to 15 years respectively. W_i s are unknown weights and is assumed to be no longer than 1.0.

Shade trees, to a certain extent are considered an important factor in improving cocoa output, particularly when they are in their early stages of growth. However, too much shade is not desirable when the trees are and can sustain all weather condition. The major trees are kolanut and plantain.

In 1989, Peter studied the status of coffee growing in Malaysia and concluded that shade has always been a controversial subject worldwide. The question of whether to use shade trees or not depends on many factors and is basically a trade off between maximum production and some level of protection. Peter (1989) recommended that under typical small holder conditions, a 10 – 30 percent shade is probably beneficial to compensate for lack of inputs (e.g. mulching and fertilizer). It

decreases yield but helps the plant to survive during periods of stress. Cocoa is very much similar to coffee in terms of growth and production. They are both perennial crops and such studies can be useful for cocoa growing.

Ahenkorah and Adri (1974), studied the effect of shade on cocoa yields in Ghana and concluded that both shade and lack of shade were unsuitable for maintaining high yields of cocoa for more than 8 to 10 years.

In the Southwestern part of Nigeria, including Ondo State, dry spell sometimes go on for months. Whether this has any significant effect on yields of cocoa is a question that has to be tested empirically. Thus, in this study, the number of shade trees is included as an explanatory variables to determine if shade has any significant effect on output. Labour is a key factor input in the small holder cocoa production in Ondo State.

Table 4: Showing the List of Farming Communities covered by the Study as well as

the Number of Respondents from each Farming Community

Zones	Communities	Respondents
Idanre:	(a) Jimbe	10
	(b) Onisere	10
	(c) Ofosu	10
	(d) Aromobi	10
	(e) Alade	10
Ile – Oluji / Oke-Igbo:	(a) Igbo Olodumare	10
	(b) Bamikemo	10
	(c) Olorunsola	10
	(d) Eyingun	10
	(e) Lalepa	10
Odigbo	(a) Kajola Oju Irin	10
	(b) Lamudifa	10
	(c) Aba Akintola	10
	(d) Onigbomudu	10
	(e) Onipaanu	10
Total	15	150



Figure 2: Map of Ondo State showing the Study Areas

3.3.1 Method of Data Collection

Random sampling technique was used to select village while farmers were chosen based on their willingness to give information. Some farmers were interviewed on the farm while some were interviewed at home (farm steads). In all, one hundred and fifty questionnaire were given out and the whole one hundred and fifty were recovered and analysed for this study.

3.3.2 Data Limitation

The survey was conducted by the researcher in conjunction with agricultural extension officers who were already known to the farmers. Hence farmers co-operation particularly in the areas of chemical used. However, most farmers hesitated to give information on their business and financial transactions. Apart from this, time and financial constraints could not allow the study to cover a larger sample space.

3.4 ANALYTICAL TECHNIQUES AND MODEL

For this study, both descriptive statistics and econometric *analytical technique* using the stochastic frontier production function were used. For the stochastic frontier production function, both Cobb-Douglas frontier model and the translog frontier model were estimated and the model that best represents the data was selected as the lead equation.

Model 1: Cobb-Douglas Frontier Model:

This model is assumed to be defined by:

$$\ln Y_i = \beta_0 + \beta_1 \ln (TWT_i) + \beta_2 \ln (Labour_i) + \beta_3 \ln (Shade_i) + \beta_4 \ln (Other\ cost_i) + \beta_5 (WHT_i / TWT_i) + V_i - U_i \dots\dots\dots (6)$$

where the subscript i indicates that the observation involved refers to the i -th farmers in the sample.

- In - indicates logarithms are taken to the base E .
- Y - represent the total dry cocoa bean output (kg)
- TWT - represents the total weighted cocoa trees of bearing, age
- Labour - represents the amount of labour in standard days used
- Shade - indicates the total number of kolanut trees and other shade trees
- WHT - represents the number of weighted hybrid tree of bearing age
- Other cost - represents other production cost not included in the other variables
- The β_s - are unknown parameters to be estimated
- The V_{is} - are random variables which are assumed to be independent and identically distributed as normal random variables with zero and unknown variance σ_v^2 , and U_{is} are assumed to be independently and identically distributed non-negative random variables which are obtained by the truncation at zero of the normal distribution with unknown mean μ and unknown variance σ^2 .

Model 2: Translog Model. The translog frontier model to be estimated is assumed to be defined by:

The models is defined by:

$$\begin{aligned}
 \ln Y_i = & \beta_0 + \beta_1 \ln (TWT_i) + \beta_2 \ln (Labour_i) + \beta_3 \ln (Shade_i) + \\
 & \beta_4 \ln (Other\ cost_i) + \beta_5 (WHT_i / TWT_i) + \beta_{11} [\ln (TWT_i)]^2 + \\
 & \beta_{22} [\ln (Labour_i)]^2 + \beta_{33} [\ln (Shade_i)]^2 + \beta_{44} [\ln (Other \\
 & cost)]^2 + \beta_{55} [WHT_i / TWT_i]^2 + \beta_{12} [\ln (TWT_i) \ln (Labour_i)] \\
 & + \beta_{13} [\ln (TWT_i) \ln (Shade_i)] + \beta_{14} [\ln TWT) \ln (Other\ cost)] \\
 & + \beta_{15} [\ln (TWT) (WHT_i / TWT_i) + \beta_{23} [\ln Labour (\ln shade)] \\
 & + \beta_{24} [\ln Labour (\ln other\ cost)] + \beta_{25} [\ln Labour (WHT_i / \\
 & TWT_i) + \beta_{34} [\ln shade (\ln other\ cost)] + \beta_{35} [\ln shade \\
 & *WHT_i / TWT_i) + \beta_{45} [\ln other\ cost (WHT_i / TWT_i)] + \\
 & V_i - U_i \dots\dots\dots (7)
 \end{aligned}$$

where the subscript *i* indicates that the observation involved refers to the *i*-th farmers in the particular local government area being considered.

- ln - indicates logarithms are taken to the base E
- Y - represents the total dry cocoa bean output
- TWT - represents the total weighted cocoa trees of bearing age
- Labour - represents the amount of labour in man days used for
- Shade - indicates the total amount of kolanut trees and plantation shade trees
- Other cost - represents other production cost not included in the other variables

- WHT - represents the number of weighted hybrid trees of bearing age
- The β s - are unknown parameters
- The V_i s - are random variables which are assumed to be independent and identically distributed as normal variables with zero and unknown variance σ^2 , and the U_i s are assumed to be independent and identically distributed non-negative random variables which are obtained by the truncation at zero of the normal distribution with unknown mean μ and unknown variance σ^2 .

Model 3: Inefficiency model

$$i.e \mu = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3$$

where δ_x are the coefficient to be estimated in the inefficiency model.

z_1 = age of cocoa

Z_2 = farmer's age

Z_3 = farmer's education

The estimates for the Cobb-Douglas version of this model for the three local government will also be obtained by using ordinary least – square regression. This have been assumed by Battese and Coelli (1998, 1992) for their analysis of panel data Ajibefun (1997) also adopted the assumption.

The inclusion of the U_i s in the model is assumed to account for the existence of technical inefficiency of production. Without the inclusion of the random variable,

the production frontier will only be a traditional average response function. Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977) were the first to propose stochastic frontier production function. Battese and Cora (1977) empirical application of the stochastic production function was significantly different from the traditional average response model.

The technical efficiency of the i -th farmer is defined as the ratio of realised production to corresponding frontier output. Given the specification of the frontier model (1), the technical efficiency of the i -th farmer is defined by:

$$TE_i = \exp(-u_i) \dots\dots\dots (8)$$

The technical efficiencies are thus, less than unity or equal to unity. If the technical inefficiencies are absent from model (1), the technical efficiencies of all farmers would be unity. The implication is that farmers are producing at the frontier production given their level of technology. The parameters of the frontier model (1) can be estimated by the use of computer programme FRONTIER Version 4.0. This programme can be used for analysing cross-sectional as well as panel data. The programme also predicts the technical efficiencies of individual farmers, given by equation (8).

The stochastic frontier model (1) reduces to the traditional average response function if the parameters μ_i and $\gamma = \sigma^2 / \sigma_v^2$ are equal to zero, where $\sigma_v^2 = \sigma^2 + \sigma_u^2$. There is therefore, the intention to test the null hypothesis that these two parameters are simultaneously zero. Further, the Cobb-Douglas model is obtained if the coefficient of the second order terms in the translog model (1) are zero. Hence, a test of the null hypothesis

Ho: The Translog Frontier model is not a good representation of the data in this study

$$\begin{aligned} \text{i.e. } \beta_{ij} &= 0 \quad \text{for all } i \text{ and } j \\ &= N = 1, 2, \dots, N \text{ is also of particular interest.} \end{aligned}$$

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 SOCIO – ECONOMIC CHARACTERISTICS

The socio-economic characteristics of interest in this study were age distribution of the farmers, their household size, level of education, farm sizes and farming experience. These are presented in bar charts and shown in the appendix.

Table 5: Age Distribution, Frequency of Farmers Ages

Age Interval	Frequency	Cumulative Frequency	Percentage (%)
< 30 years	0	0	
31 – 40 years	60	60	40
41 – 50 years	30	90	20
51 – 60 years	25	115	17
> 60 years	35	150	23
Total	150	415	100

Source: Field Survey, 1998

The age distribution of the farmers is presented in Table 5 above. It shows that farmer's ages ranged between 32 and 70 years. There were no "relatively young" farmers between ages of 21 – 30 years while those of "middle age" (31 – 50) were about 60 percent. This indicates that most of the cocoa farmers were middle age people. This study indicates that most of the respondent migrated from the neighbouring states like Oyo, Osun and Edo to establish cocoa plantation in Ondo State. This implies that the ageing and aged farmers constitute the majority of cocoa

crop farmers. This fact is expected to have significant impact on production as adoption of new innovation may not be wholly complied with by this group of people.

Table 6: Family Size of Farmers

Size	Frequency	Cumulative Frequency	Percentage (%)
1 - 4	30	30	20
5 - 8	50	80	33
9 - 12	40	120	27
> 12	30	150	20
Total	150	380	100

Source: Field Survey, 1998

The Table 6 above shows that 20 percent of the total farmers had a family size between 1 and 4 while majority of the farmers had between 5 and 8. Despite the sizes of family, most farmers were discovered to have engaged hired labour who stayed in the farm all year round.

Table 7: Level of Education

Level of Education	Frequency	Cumulative Frequency	Percentage (%)
No Education	90	90	60
Non-Formal Education	20	110	13
Primary Education	30	140	20
Secondary Education	10	150	7
Total	150	480	100

Source: Field Survey, 1998

The Table 7 shows that about 60 percent of the respondents had no education while 33 percent have had either non-formal education or at least primary school education while just 7 percent had secondary education and non had tertiary. Education is known to have positive influence on farmers' production and productivity as there is positive correlation between education and adoption of technology.

Table 8: Farming Experience

Years	Frequency	Cumulative Frequency	Percentage (%)
1 - 30 years	30	30	20
31 - 60 years	90	120	60
> 60 years	30	30	20
Total	150	180	100

Source: Field Survey, 1998

Result showed that 20 percent of the farmers had between 1 – 30 years of cocoa farming experience while 60 percent had between 31 – 60 years and 20 percent had more than 60 years of experience.

From the table above, it can be observed that quite a number of the farmers have minimum number of years of experience in farming. This account for old ages of cocoa trees particularly in Idanre and Ile-Oluji farm plantations.

Table 9: Total Farm Size

Farm Size (Hectare)	Frequency	Cumulative Frequency	Percentage (%)
0.1 – 3.0 ha	30	20	20
3.1 – 4.5 ha	60	90	40
4.6 – 5.9 ha	60	150	40
Total	150	260	100

Source: Field Survey, 1998

The Table 9 shows distribution of farm sizes of farmers. 20 percent had farm size between 0.1 – 3.0 hectares, 40 percent had between 3.1 – 4.5 hectares while another 40 percent was between 4.6 – 5.9 hectares of cocoa farm. This was however, unexpected as some of the farmers had different farms located on different blocks scattered all over the local government areas. This is particularly rampant in Ile-Oluji / Oke- Igbo and Odigbo local government areas.

Consequently, the results of the study showed that majority of the farmers engaged in plantation particularly in Ile-Oluji and Odigbo farm sites. This was discovered to have had positive effect on cocoa output. This informed the need to have an annually paid labour who reside in the farm settlement all year round. Payment for labour were

generally made by dividing cocoa output into three while the labourer takes one-third while the owner of the farm takes two-third of the proceed.

Table 10: Uses of Shade Trees

Level	Frequency	Cumulative Frequency	Percentage (%)
Plantain	40	40	27
Kolanut	90	130	60
Others	20	150	13
Total	150	320	100

Source: Field Survey, 1998

Shade trees, to a certain extent are considered an important factor in improving cocoa output, particularly when they are in their early stages of growth. The study showed that 27 percent of the farmers have plantain tree as shade while 60 percent use kolanut trees. While the former was usually for subsistence, the latter serve as other means of income earning for the farmer particularly when cocoa is yet to be ripe for harvest.

Other crops used as shade include coffee and cocoyam. Obviously the purpose is to earn additional income as well as meeting other needs of the family during cocoa "off season".

4.2 RESULTS OF THE STOCHASTIC FRONTIER PRODUCTION FUNCTIONS

The results of the Maximum Likelihood Estimates of the Stochastic Cobb-Douglas Frontier Production Function is presented in Table 11.

Table 11: Stochastic Frontier Production Function, Maximum Likelihood Estimates

Cobb-Douglas Model

The Final MLE

Variable	Parameter	Coefficient	Standard Error	t-ratio
Constant	β_0	0.555	0.00001	553.87
$\ln X_1$	β_1	0.973	0.235	0.4129
$\ln X_2$	β_2	5.615	0.199	2.823
$\ln X_3$	β_3	-0.00759	0.489	-0.159
$\ln X_4$	β_4	-300.540	0.102	-0.293.672
$\ln X_5$	β_5	0.00927	0.213	0.435
Variance	Sigma Squared	1629.326	0.100	0.1629.33
	Gamma γ	0.743	0.100	0.743
	Mu μ	-0.299	0.100	-0.299
LLF	-1405			

* Significant at 5%

Table 12: Translog Model

Variable	Parameter	Coefficient	Standard Error
Constant	β_0	0.3760	0.1140
$\ln X_1$	β_1	0.2141	0.0851
$\ln X_2$	β_2	0.1137	0.2271
$\ln X_3$	β_3	-0.0172	0.0044
$\ln X_4$	β_4	0.0099	0.0076
$\ln X_5$	β_5	0.3811	0.2881
$\ln (X_1)^2$	β_{11}	0.0017	0.0251
$\ln (X_2)^2$	β_{22}	0.0025	0.002
$\ln (X_3)^2$	β_{33}	-0.0171	0.01003
$\ln (X_4)^2$	β_{44}	-0.0194	0.0421
$\ln (X_5)^2$	β_{55}	0.0321	0.2257
$\ln (X_1 \cdot X_2)$	$\beta_1 \cdot \beta_2$	0.0079	0.0011
$\ln (X_1 \cdot X_3)$	$\beta_1 \cdot \beta_3$	-0.0035	0.0072
$\ln (X_1 \cdot X_4)$	$\beta_1 \cdot \beta_4$	-0.0112	0.0015
$\ln (X_1 \cdot X_5)$	$\beta_1 \cdot \beta_5$	0.0351	0.0015
$\ln (X_2 \cdot X_3)$	$\beta_2 \cdot \beta_3$	0.0052	0.0032
$\ln (X_2 \cdot X_4)$	$\beta_2 \cdot \beta_4$	0.0072	0.0011
$\ln (X_2 \cdot X_5)$	$\beta_2 \cdot \beta_5$	-0.0119	0.0025
$\ln (X_3 \cdot X_4)$	$\beta_3 \cdot \beta_4$	0.0035	0.0147
$\ln (X_3 \cdot X_5)$	$\beta_3 \cdot \beta_5$	-0.0195	0.1131
$\ln (X_4 \cdot X_5)$	$\beta_4 \cdot \beta_5$	0.0011	0.0721
δ^2	δ^2	0.897	0.214
Gamma	γ	0.635	0.035
Log Likelihood $\ln L$	LLF	-1961.32	

* Significant at 5%.

The Maximum Likelihood Estimates (MLE) of the stochastic frontier production functions are presented in Tables 11 and 12. Table 11 presents the MLE for the Cobb-Douglas frontier model (Model 1) while Table 12 presents the MLE for the translog frontier model (Model 2). Given the log likelihood functions of the 2 models, the Cobb-Douglas frontier model (Model 1) presents better representation of the data and hence selected as the lead equation.

The estimated Cobb-Douglas frontier model is presented as the lead equation as follows.

$$Y = 0.5557 + 0.9731 \ln X_1 + 0.5615 \ln X_2 - 0.7646 \ln X_3 - 0.3005 \ln X_4 + 0.927 \ln X_5 + \Sigma_i$$

(0.100)	(0.235)	(0.199)	(0.0481)	(0.102)	(0.213)
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δ^2	=	0.163	(0.1001)
μ	=	-0.2988	(0.1002)
γ	=	0.7443	(0.1001)

The lead equation presented above shows that all the coefficients in the model are significant at 5 percent level. Apart from X_3 (shade) and X_4 (pesticides) that carry negative coefficient, every other coefficient has positive sign. The highest coefficient comes from X_1 (total weighted cocoa trees of bearing age). The coefficient (of X_1) 0.973 implies that an increase in the number of cocoa trees of bearing age by 1 percent would lead to about 0.97 percent increase in the total bean output. This will consequently lead to increased farm income. This variable is therefore important in improving farmer's income at the current level of technology. The 0.561 coefficient of labour (X_2) implies that an increase in labour use by 1 percent would lead to an increase of about 0.56 percent in the quality of cocoa beans output. The third variable, shade (X_3) has a negative value of 0.765. This implies that an increase in the number of shade trees on the farm by 1 percent would lead to a reduction in cocoa

bean output by about 0.76 percent. This may be explained by the fact that if the use of shade trees is above the optimum level, any increase in the number of the shade trees would negatively affect the performance of cocoa trees (as they compete for limited resources) and hence a reduction in the output of cocoa beans. The variable X_4 (pesticides) also has a negative coefficient with a value of -0.301 . This value implies that if the quantity of pesticide increases by 1 percent, cocoa beans output would decline by about 0.3 percent. Finally, the variable X_5 (the ratio of hybrid cocoa trees to total cocoa trees) has a high positive coefficient of 0.9275 . This coefficient indicates that an increase in the number of hybrid cocoa trees by 1 percent would cause an increase of about 0.93 percent in cocoa beans output. This variable has thus proved to be very important in raising cocoa beans output and hence farmers' income. Hybrid cocoa trees are known to be traditionally better than the local types in terms of productivity (yield) and resistance to pests and diseases.

For the estimated model, the variance parameters, μ and γ , are both highly significant at 5 percent level, implying that the fitted model has properly described the data.

In order to discuss the factors that influence the level of technical efficiency of the sample cocoa farmers, three variables were identified. The identified variables are: age of cocoa trees, farmer's age and level of education of farmers. Although there could still be some other variables that may influence the level of efficiency, our data set would however, only permit us to include the three variables. The coefficient of the three variables in the inefficiency model is as presented below.

$$\mu_0 = 0.253 + 0.142 (\text{cocoa age}) - 0.374 (\text{farmer's age}) + 0.294 (\text{farmer's education}$$

(0.104) (0.012) (0.013) (0.112)



Given the estimated inefficiency model, which is presented in the lead equation above, the coefficients of all the variables are significant at 5-percent level. While the coefficient of farmers age is negative, the other two variables, age of cocoa trees and level of education have positive coefficients. The negative coefficient of farmers' age implies that older farmers are less technically efficient than the younger farmers, since increase in age leads to increase in technical inefficiency. The positive coefficient of age of cocoa trees implies that as the age of cocoa trees increases, the level of technical inefficiency would also increase. This is expected because the yield of cocoa trees normally increases with the age of the tree until it reaches a peak and then begins to decline. The coefficient of education is also positive. However, this does not follow the apriori expectation as increase in the year of schooling is expected to lead to reduction in inefficiency. However, the result obtained in this study could be due to the fact that most of the respondents have no formal education. The computed technical efficiencies vary between 0.21 and 0.94, with a mean technical efficiency of 0.63 and standard deviation of 0.15. This implies wide variation in the level of technical efficiencies of the farmers. This wide variation is an indication that ample opportunities still exist to improve the current level of efficiency and output of cocoa in the study area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

Cocoa occupies a prominent position in the Nigerian crop sub sector that generate not only employment but also substantial foreign exchange earnings for the nation's economic development.

This study was carried out to investigate the technical efficiency of cocoa farmer in Ondo State with a view to recommending ways of eliminating technical inefficiency so as to raise productivity among coca farmers in the area.

In carrying out this study, 150 cocoa farmers were randomly selected from major cocoa producing areas of Ondo State to collect both socio economic data and cocoa production data, including inputs as well as constraints in cocoa production in the area. The collected data were subjected to both descriptive statistics and econometric analysis using the stochastic frontier production functions to determine the level of technical efficiency of the farmers as well as those factors that influence the level of technical efficiency. For the stochastic frontier model, both Cobb-Douglas and the translog functional forms were estimated and the model that best represented the data was selected.

Results of analysis show that farmers' age ranged between 32 and 70 years. There were no "relatively young" farmers between ages of 21 – 30 years while those of "middle age" (31 – 50) were about 60 percent. While 60 percent of the respondents had no education 33 percent had either non-formal education or at least primary school education while just 7 percent had secondary education and none had

tertiary. For the farm size of respondents, 20 percent had farm size between 0.1 – 3.0 hectares, 40 percent between 3.1 – 4.5 hectares while another 40 percent was between 4.6 – 5.9 hectares of cocoa farm. This was however unexpected.

For the econometric analysis, the Cobb-Douglas frontier model provided the better representation. The results of the stochastic frontier analysis shows that all the coefficients in the model are highly significant at 5 percent level. Apart from X_3 (shade) and X_4 (pesticides) that carry negative coefficient, every other coefficient has positive sign. The highest coefficient comes from X_1 (total weighted cocoa trees of bearing age). The coefficient (of X_1) 0.973 implies that an increase in the number of cocoa tree bearing age by 1 percent would lead to about 0.97 percent increase in the total cocoa bean output. This will consequently lead to increase in farm income. This variable is therefore important in improving farmer's income at the current level of technology. The 0.561 coefficient of labour (X_2) implies that an increase in labour use by 1 percent would lead to an increase of about 0.56 percent in the quality of cocoa beans output. The third variable, shade (X_3) has a negative value of - 0.765. This implies that an increase in the number of shade trees on the farm by 1 percent would lead to a reduction in cocoa beans output by about 0.76 percent. This may be explained by the fact that if the use of shade trees is above the optimum level, any increase in the number of the shade trees would negatively affect the performance of cocoa trees (as they compete for limited resources) and hence a reduction in the output of cocoa beans. The variable X_4 (pesticides) also has a negative coefficient with a value of - 0.301. This value implies that if the quantity of pesticide increases by 1 percent, cocoa beans output would decline by about 0.3 percent. Finally, the variable X_5 (the ratio of hybrid cocoa trees to total cocoa trees) has a high positive coefficient of 0.9275. This coefficient indicates that an increase in the number of

hybrid cocoa trees by 1 percent would cause an increase of about 0.93 percent in cocoa beans output. This variable has thus proved to be very important in raising cocoa beans output and hence farmers' income. Hybrid cocoa trees are known to be traditionally better than the local type in terms of productivity (yield) and resistance to pests and diseases.

For the factors that determine the efficiency of the farmers, the negative coefficient of farmers age implies that older farmers are less technically efficient than the younger farmers, since increase in age lead to decline in technical efficiency. The positive coefficient of age of cocoa trees implies that the level of inefficiency increases as the cocoa trees becomes old. This is expected because the yield of cocoa trees normally decreases with age of the tree after reaching a peak. The coefficient of education is also positive, implying that increase in the years of schooling would lead to increase in inefficiency. This is explained by the fact that most of the respondents had no formal education.

The computed technical efficiencies vary between 0.21 and 0.94, with a mean technical efficiency of 0.63 and standard deviation of 0.15.

5.2 CONCLUSION

Given the fact that there is a wide variation in the level of technical efficiencies of the sampled cocoa farmers in Ondo State, there is ample opportunities for the majority of the farmers to raise their current level of efficiency, especially if those factors identified in this research work are addressed.

5.3 RECOMMENDATIONS

Based on the findings of this research work, the following recommendations are made:

- (1) Given the fact that the highest and most significant coefficient comes from total weighted cocoa trees of bearing age, it is recommended that government efforts at raising cocoa output should include encouragement of farmers to expand their cocoa farms as well as revamp abandoned cocoa farms.
- (2) Given the fact that farmers' age, level of education of cocoa farmers as well as age of cocoa trees affect the level of technical efficiency, government campaign for increased production and productivity in the cocoa sub-sector should adequately cover these factors:

- (i) firstly by encouraging younger people to go into cocoa production. In this case the idea of revamping the farm settlement scheme would be a good policy in the right direction,
- (ii) secondly, enlightenment / training programme should be carried out from time to time for coca farmers in order to raise their present level of awareness, education and enlightenment.

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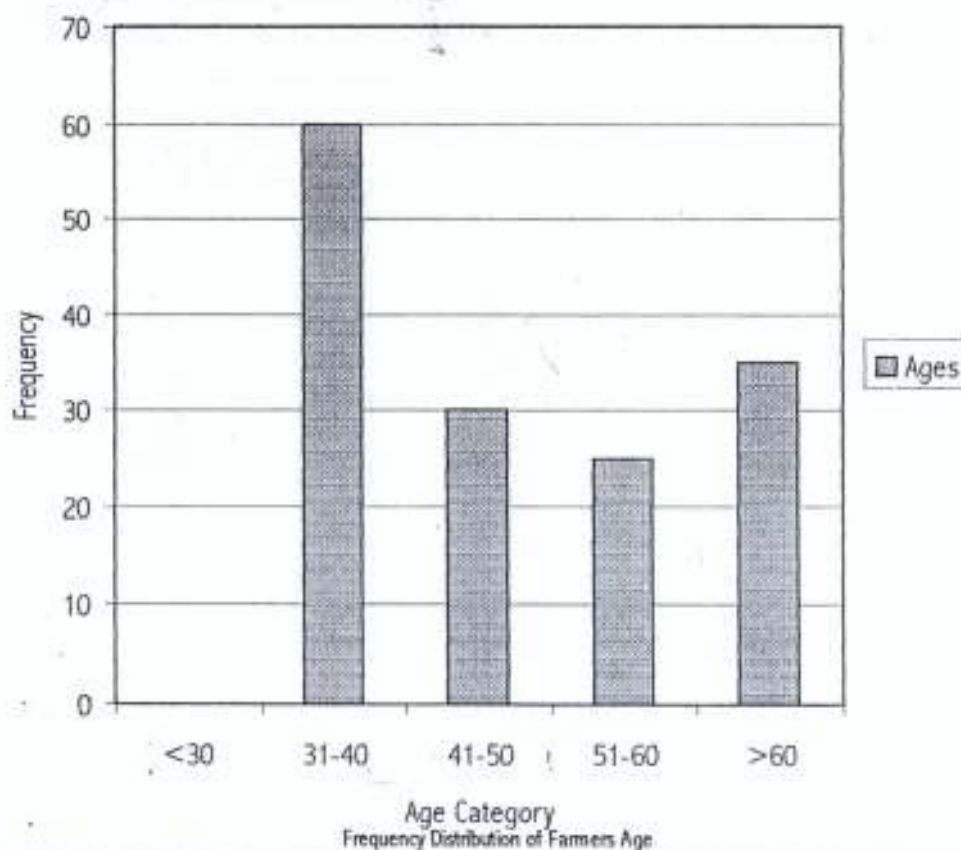
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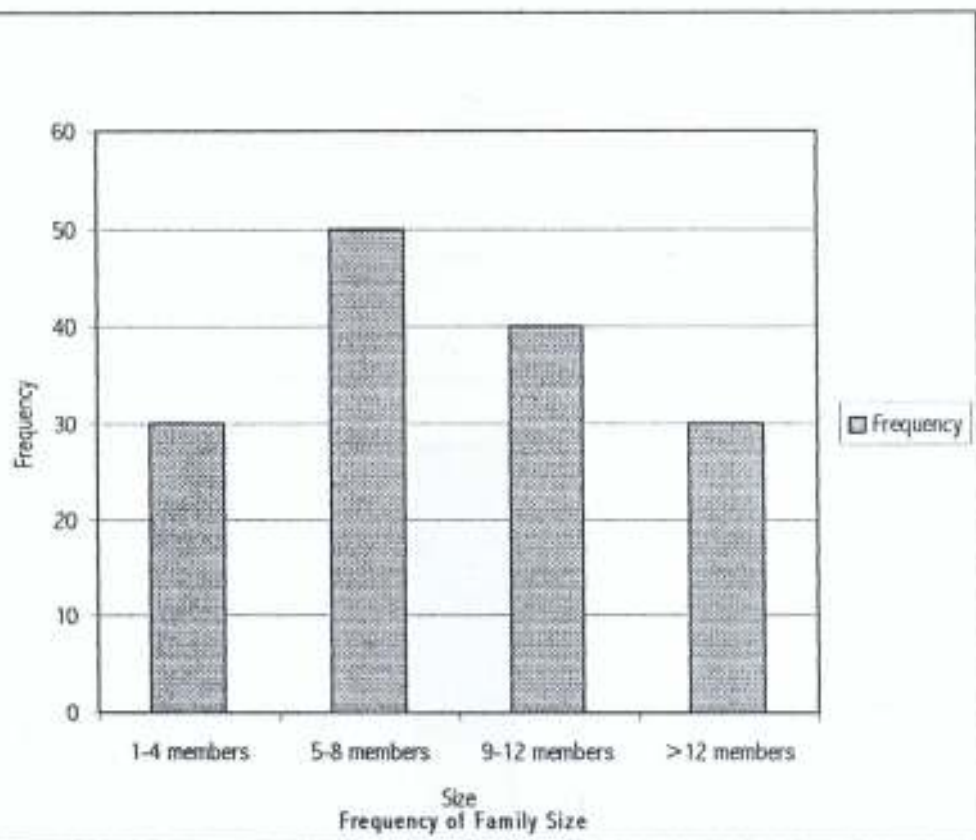
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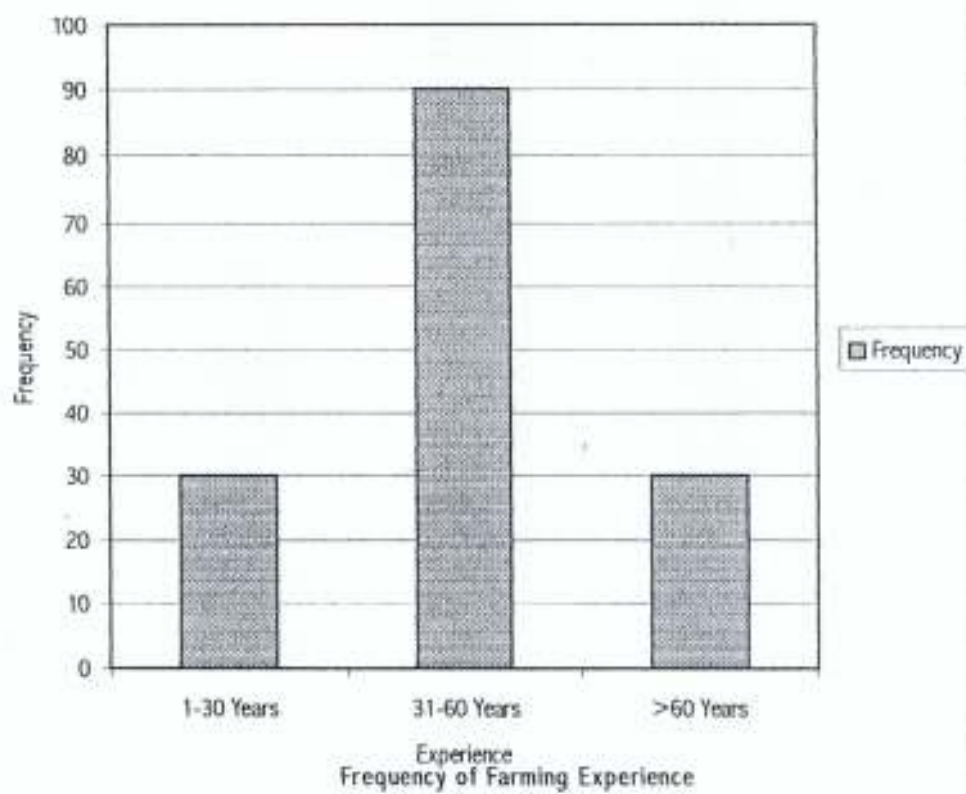
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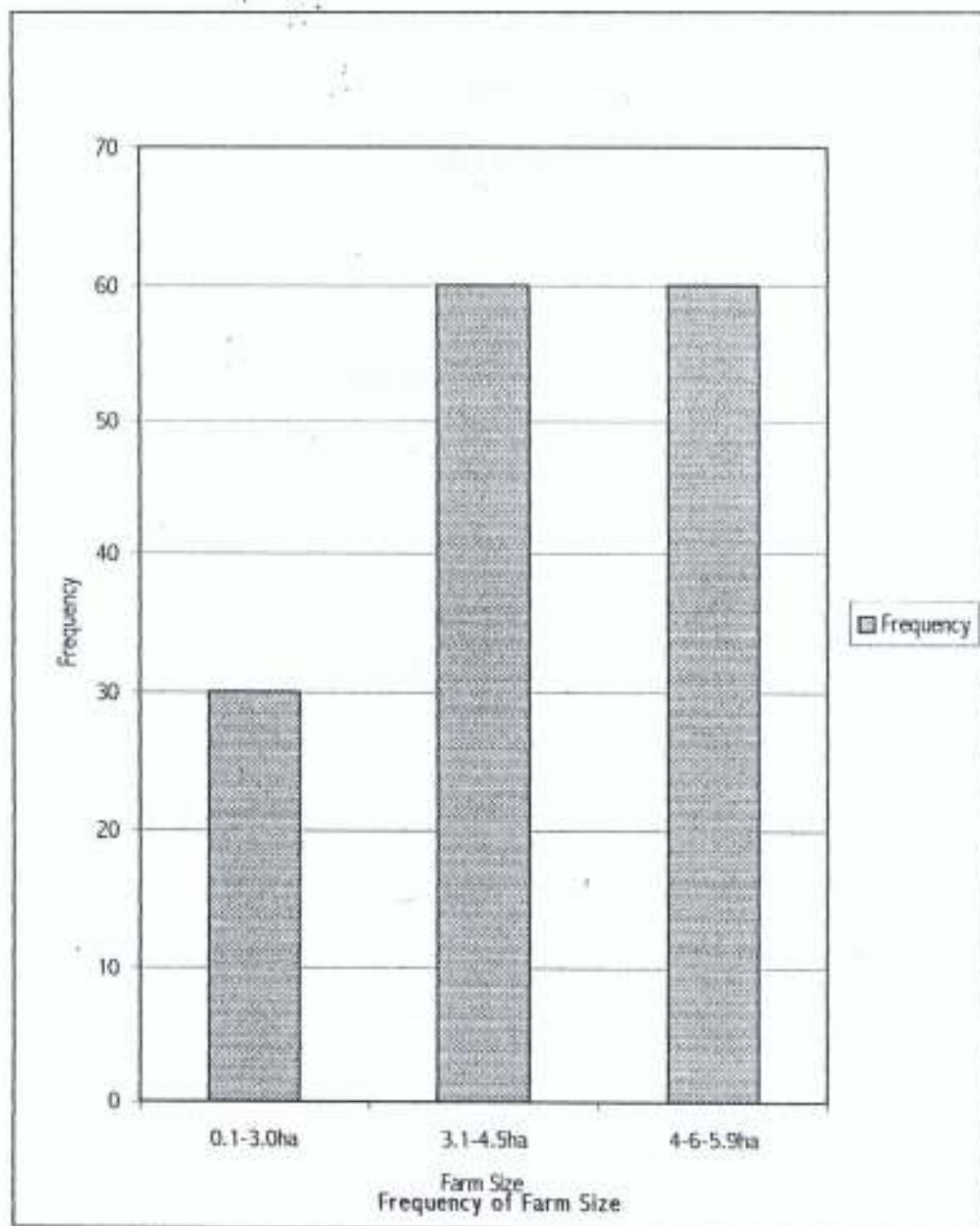
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APPENDIX A

FREQUENCY DISTRIBUTION TABLES







APPENDIX B
QUESTIONNAIRE

PERSONAL DATA

NAME:.....

INDICATE YOUR AGE (YEAR):.....

MARITA STATUS:.....

NUMBER OF WIFE:.....

NUMBER:.....

HIGHEST LEVEL OF EDUCATION:.....

(a) Primary School No of years

(b) Secondary School No of years

(c) Higher Institution No of years

(d) Adult Education No of years

WHAT OTHER BUSINESS DO YOU DO BESIDE FARMING?

i. ii.

iii. iv.

v.

HOW MANY YEARS HAVE YOU BEEN FARMING?

Years

FARM INPUT DATA

How much Farm land do you have for farming?.....

How did you acquire the land for farming?

i. Renthectares Acres

- ii. Bought/lease hectares A
- iii. Inherited hectares Ac
- iv. Family farm hectares Ac
- v. Gift..... hectares Ac
- vi. Others..... hectares Ac

TREES

11. How many cocoa tree stand do you have on your farm? (Give average)
- b. What is the size of your cocoa farm? ()
- c. How many pods does each plant / tree produced per season? ()

AGE OF TREES

12. How old are your cocoa trees ? ()
13. How often do you plant new seedling ? ()
14. Do you have other trees in your Cocoa farm ? Yes () No ()
- a. If yes, which type:
- b. Do they serve as shade for your cocoa farm? Yes () No ()
15. What is total number of the shade tree stand in your cocaf farm?

FINANCE

16. Do you borrow to finance any part of your farming business? Yes () No ()
- a. If yes, which source did you borrow from? Please specify.....
17. How much did you borrow in the lastt cocoa season? N.....

LABOUR

18. Do you have problem getting labour for your farm activities

Yes..... No

19. What duty(s) do they undertake in your farm?

1. Weeding only ()

2. Chemical Application ()

3. Harvesting ()

4. (1 X 2) ()

5. (1 X 3) ()

6. (2 X 3) ()

20. How much did you pet head / hour / day? N.....

21. How much did you spend on overhead during the last season?

CHEMICALS AND TOOLS.

22. What type of chemical do you use?

i. Gamelin 20

ii. Copper Sulphate

iii. White Lino

iv. Basadin

v. Ridomil

vi. Others

How much did you send on chemical application in the last season?

Do you apply fertilizer to your cocoa tree ? Yes No

If yes, What types ? Urea () NPK ()

TOOLS

Name the types of farm impliment you use

How much did you buy each of them ?

FARM OUTPUT DATA

What is your toatl production per year ?

Have you noticed any fall in production Yes () No ()

What is the figure of fall per year ?kgmetric tonnes

How many kg / Tonnes of Cocoa did you harvest last season ? ()

How much did you sell per kg / tonne ?

Where did you sell your cocoa bean ?

How do you determine the price to sell your farm produce ?

- i. According to current market prices.....
- ii. According to cost of production
- iii. Buy bargaining with each buyer
- iv. Buyer dictates the prices.....
- v. Others (specify)

Do you store your farm produce after harvest ? yes No

If yes, please give reasons

1. to take advantage of better prices
2. because of low demand

3. Others

b. How much do you pay for renting the storage facility/ N per annum

If no please give reasons

1. because of very bad prices at harvest
2. because of high demand at harvest
3. because of contract buyers
4. because of lack of storage facilities
5. because of high cost of storage
6. Others specify.

OTHER INFORMATION

Do you have more land for expansion ?

Yes..... No

can you easily obtain money for your farming activities ?

Yes No

