

Effects of Farmers' Field School on the Technical Efficiency of Cocoa Farmers in Nigeria

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Abstract

Nigeria is blessed with natural resources, among which cocoa is key. Over the years cocoa production has been declining and various interventions have been directed to improving production and productivity of cocoa in Nigeria. One of these interventions is the Farmers' Field School (FFS) approach. FFS employs a non formal approach to pass across new knowledge of improved and good agricultural practice to farmers. Therefore, the study aimed to examine the effects of Farmer Field School (FFS) on the Technical Efficiency (TE) of cocoa farmers in Cross River and Ondo States, Nigeria. The study areas for this study were the two major cocoa-producing states in Nigeria; Cross River and Ondo States. A total of 120 cocoa farmers were interviewed. This sample size was divided between both states equally. Thus, 60

respondents were selected randomly from around FFS communities for each state. Among the 60 respondents in each state, 30 were FFS participants while the other 30 were Non Farmer Field School (NFFS) participants. The study revealed that the FFS participants had an efficiency score of 0.84 while the NFFS participants' technical efficiency score was 0.77. The study therefore concluded that the FFS participants were more efficient in the use of factors of production than their NFFS counterparts.

Keywords: Farmers' Field School, Efficiency, Cocoa, School, Slack, Nigeria

1. Introduction

Measurement of efficiency and performance of factors of production in Agriculture is very important to researchers as well as farmers. This is because resources are scarce and in some cases very expensive for farmers to purchase. Agrochemicals and labour as factors of production in cocoa business are very scarce. Therefore it is expedient for both the cocoa farmers and the researchers to know whether the cocoa output justifies the resources expended on it. Studies have shown that the main problem identified by cocoa farmers was low yield, which was attributed to several factors (Dormon, Huis, Leeuwis, Obeng-Ofori and Sakyi-Dawson, 2004). Factors of production are said to be productive, if such factor is efficient both in physical and technical terms. Tchale (2009); Chirwa (2007); Mochebelele and Winter-Nelson (2000); Wadud and White (2000); Helfand (2004); Shanmugam and Venkataramani, 2006) amongst others have sought to estimate Technical Efficiency (TE) and its potential determinants in the agricultural sector. Binam et al. (2004) in examining the factors influencing technical efficiency of groundnut and maize farmers in Cameroon observed an average efficiency of 73% and 77% for the two crops, after controlling for environmental effects. Heshmati and Mulugeta (1996) observed a mean TE of 65% for Ugandan matooke producing farms.

In the cocoa sub-sector, Binam, Gockowski and Nkamleu (2008) studied the determinants of technical efficiencies (TE) among cocoa producing communities in West African countries. Using stochastic frontier model and the Meta-stochastic frontier analysis, they estimated TEs for West African Cocoa producing countries and indicated that Nigeria was the most efficient with a TE of 74% and Ghana the least efficient with TE of 44%. Richman, (2010) reported that, the mean technical efficiency among cocoa farmers' in Ghana was 0.442 in 2005/2006 cocoa season. This estimate is same as those observed in Binam et al (2008). This suggests that Ghanaian cocoa farmers produce only 44.2% of the efficient output or are about 56% away from the efficient frontier. This shows that the observed efficiency level of 0.44 for Ghana is lower than those observed in other cocoa producing West African countries. For instance Amos (2007) observed a TE of 0.72 in Ondo State Nigeria and Binam et al (2008) observed 0.74 among Nigerian cocoa farmers. The averages for Cameroun and Côte d'Ivoire were 0.65 and 0.58 respectively (Binam et al, 2008).

Studies by Binam et al, (2008) further showed that, the greatest share of productivity is due to the labour and farm size in Cameroon, farm size, and tree age in Ghana, farm size, labour and tree age in Nigeria and in Cote d'Ivoire. Whereas in West and Central Africa countries, the greatest share of productivity is generally due to the farm size, labour and the age of the

cocoa farm. In the same study by Amos (2007), it was revealed that, the technical efficiencies (TE) among smallholders cocoa farmers in Nigeria ranged between 0.11 and 0.91. Thus, it could be observed that there was presence of technical inefficiency effects in cocoa production in the study area.

In 2001, Sustainable Tree Crop Programme (STCP) of International Institute of Tropical Agriculture (IITA) commenced the implementation of a Farmer Field School (FFS) in selected cocoa producing communities on a pilot basis. The purpose is the transfer of the required good agricultural practices needed for improved cocoa production to farmers through the farmer field schools. A FFS consists of a group of farmers (usually 30) with a common interest who get together regularly to study the “how and why” of a particular aspect of agricultural production.

According to Braun et al. (2006), FFS is suited for field studies requiring specific hands-on management skills and conceptual understanding. The Farmers’ Field School (FFS) consist of certain core elements (Braun, Jiggins, Röling, van den Berg and Snijders, 2006; Thiele, Nelson and Sherwood, 2001). These are the group of people with a common interest such as acquisition of technology/expertise, the farm which provides most of the training materials, the facilitator who has some technical knowledge of the subject matter and the curriculum which usually follow the natural cycle of the agricultural production under consideration. FFS had been used previously in Indonesia, Cambodia, China, India, Lao PDR, Philippines, Sri Lanka and Vietnam to address various problems in agricultural production (Braun et al., 2006; Tripp, Wijeratne and Piyadasa, 2005)

An evaluation of the impact of FFS was carried out by STCP in 2009. The evaluation covered impact of FFS on output agricultural practices, and knowledge of Integrated Crop and Pest Management by the cocoa farmers in Cross-river and Ondo States. The FFSs were directed at promoting the spread of Good Agricultural Practices (GAP) in cocoa production. Therefore this study addressed the effect of FFS on the Technical efficiency of cocoa farmers. The specific objectives of this study are to compare the Technical Efficiencies of FFS and non- FFS cocoa farmers as well as estimate and compare the level of inputs used by the two groups of farmers.

2. Materials and Methods

2.1 Study Area and Sample Size

The study covered the two major cocoa-producing states in Nigeria; Cross River and Ondo States (Hamzat, Olaiya, Adedeji, and Sanusi, 2006; MANR, 2006). In Ondo State, seven Local Government Areas (LGAs) were purposively selected based on their level of cocoa production and, more especially, their participation in FFS. These LGAs are Akure North, Idanre, Ifedore, Ile-Oluji/Oke Igbo, Odigbo, Ondo East and Ondo West LGAs. In Cross River State, four LGAs (Akampka, Boki, Obubra and Obudu) were purposively selected for the study based on the same consideration as in the case of Ondo State.

A total of 120 cocoa farmers were interviewed. This was divided between both states equally. Thus, 60 respondents were selected across the LGAs in each of the states. Among the 60

respondents in each state, 30 were FFS participants while the other 30 were NFFS participants.

2.2 Data Collection

The primary data set used in this study was collected by administering a structured questionnaire on sampled cocoa farmers. Information was sought on age, household size, farming experience, farm size of the cocoa farmers; farm input use and output, among others. While the total number of farmers covered by the study was 60 per state, the total number of farms covered for the purpose of measuring farm sizes with the GPS and tree counting through the laying of transects was more than 60 since some of the farmers have more than one cocoa farm. Hand held GPS was deployed to collect some farm specific characteristics. Specifically GPS was used to measure the distance of farmers' homesteads to their cocoa farms. It was also used to estimate the area/size of each cocoa farm through a perimeter walk. The total area estimated by GPS was then compared with farmers own estimate. In order to estimate the number of cocoa trees and shade trees per hectare, three transects were laid on each cocoa farm and the number of cocoa trees were counted in each of the transect. The number of the cocoa trees in the three transects put together was extrapolated to arrive at the number of cocoa trees per hectare. The estimated number of cocoa trees per hectare was multiplied by the GPS estimated area of cocoa farm to arrive at the total number of cocoa trees on the farm. Similarly, in each transect the number of shade trees were counted and this was extrapolated to arrive at the number of shade trees per hectare. A non cocoa tree on a cocoa farm is considered a shade tree when its canopy is higher than that of the cocoa tree. The enumerators that were deployed to carry out this exercise were properly trained. The questionnaire used was pretested and amended as necessary.

2.3 Method of Data Analysis

The data analytical techniques used in this study are descriptive statistics and Data Envelopment Analysis (DEA) model. Cocoa farmers' socioeconomic and farm specific characteristics such as age, income from cocoa, income from non-cocoa production, number of cocoa trees, number of shade trees, etc. were examined using descriptive statistics. DEA model was employed to ascertain the productivity as well as technical efficiency levels of the cocoa farmers.

DEA is a multi-factor productivity analysis model for measuring the relative efficiencies of a homogenous set of decision making units (DMUs) that is, in this case cocoa farmers. Coelli (1995) indicated that the two main advantages of DEA are that it does not require the assumption of a functional form to specify the relationship between inputs and outputs and it does not require the distributional assumption of the inefficiency term. The former implies that one can avoid unnecessary restrictions about functional form that can affect the analysis and distort efficiency measures (Fraser and Cordina, 1999). . Coelli, Rao and Battese (1998), stated that constant returns to scale (CRS) DEA model is appropriate only when the farm is operating at an optimal scale. This is however assumed to be impossible in a developing country such as Nigeria due to many reasons which include financial constraints, imperfect competition, and inadequate farm inputs, etc. A variable return to scale (VRS) DEA is more flexible and envelops the data in a tighter way than the CRS DEA. The VRS DEA model was

hence developed by Banker, Charnes and Cooper (1984).

An input oriented VRS DEA model was used in this study to estimate the technical efficiency of cocoa farms in the study area. Following Coelli et al. (1998), an input oriented variable return to scale DEA model for estimation of technical efficiency is specified as:

Min Θ, λ

Subject to: $-y_i + Y\lambda \geq 0$

$$\Theta x_i - X\lambda \geq 0$$

$$N1/\lambda = 1$$

$$\lambda \geq 0$$

where

Y = cocoa output matrix for N farms.

Θ = the input technical efficiency score having a value $0 \leq \Theta \leq 1$.

X = an input matrix for N farms.

λ = N by 1 vector of weights which defines the linear combination of the peers of i^{th} farm.

y_i = quantity of cocoa output of i^{th} farm (kg)

The inputs (X) considered are size of cocoa farm (hectares), cost of hired labour (Naira), cost of fungicide (Naira) and cost of insecticide (Naira).

3. Results and Discussions

3.1 Descriptive Statistics of Key Variables

Table 1 describes the key characteristics of cocoa farmers in the study area. From the table, the mean age of the cocoa farmers was about 55 years for the FFS participants while that of the NFFS participants was approximately 56 years. From this result, it could be seen that the difference in mean ages of these two groups is not much, such that the mean age for the two groups of farmers combined was 55.03 years. In Nigeria, household size is an important factor in agribusiness. This is because family labour is very important to these small holdings (World Bank, 2008). This study reveals that the FFS farmers in Nigeria had an average household size of 6 individuals while results from the NFFS reveal that the mean household size was 7. It could also be seen here that the difference between the mean household sizes is not much. Farmers' level of education as shown in Table 1 reveals that FFS farmers had a mean value of 8 years, while their NFFS counterpart had a mean of 7. The mean age of cocoa trees on the sampled farms was 25.83 years while the mean size of those cocoa farms was 2.62 ha (GPS estimate). This indicates that most cocoa enterprises in Nigeria are small holdings. A survey of farmer's estimate of farm size was done to see if there would be disparities between the farmer's estimates and the GPS estimates of farm size. Interestingly, Table 1 shows that cocoa farmers' estimate of their farm size gave a mean farm size of 7.26 ha, which is almost three

times higher than the GPS estimate. Effect of distance from homestead to the farm on cocoa output may be positive or negative. Farmers tend to search for virgin lands to cultivate in attempt to secure more fertile and hence productive land. Such lands are necessarily far away from the homestead. Thus cocoa farms that are far away from the homestead should ordinarily be the more fertile and hence more productive. Hence a positive relationship between distance and cocoa output could be expected. On the other hand, a negative relationship between distance and cocoa output may be hypothesized because farmers and hired labour may have to trek long distances before getting to such farms. This may discourage the farmers and, especially, hired labour leading to inadequate and untimely attention being given to the farms. Inadequate and untimely attention may result in low output (Ofuoku & Ebebor, 2012). The mean distance from the farmers' homestead to the farm was 19.56 km with a standard deviation of 101.81 km. The mean distance from the farmers' homestead to the farm for the NFFS farmers was higher than that of the FFS farmers. There were few cases of farms being located at very far distances from the homestead. The relationship between cocoa output and total number of shade trees may be negative due to the fact that high density of shade trees on cocoa farm may promote fungi infection which in turn reduces output. However, given the various benefits of shade trees (Asare, 2005), the relationship between total number of shade trees and cocoa output may be positive. From Table 1, the mean number of shade trees per ha of cocoa farm was 208.96. Table 1 also reveal that the mean yield of cocoa for the FFS farmers in the study area was 550.43 kg/ha, while the mean cocoa yield of the NFFS farmers was 861.06kg/ha. Though both groups had almost the same natural production characteristics, it is amazing to see that the cocoa yield of the NFFS farmers was more than that of the FFS farmers.

Table 1. Socioeconomic Characteristics of Cocoa Farmers in the Study area

	FFS		NFFS		Total	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Age(Yrs.)	54.38	14.22	55.67	14.04	55.03	14.08
Household Size	6.47	2.3	6.82	2.29	6.64	2.29
Education (Yrs)	8.05	5.06	7	4.18	7.53	4.65
Age of Cocoa Trees (Yrs)	25.78	16.51	25.88	15.34	25.83	15.87
Cocoa Farm Size (GPS estimate) (ha)	2.61	2.44	2.63	2.13	2.62	2.28
Cocoa Farm Size (farmers' estimate)	7.55	7.5	6.97	8.21	7.26	7.84
Distance from home to Farm	14.77	60.07	24.36	131.35	19.56	101.81
Shade Trees per hectare (Number/ha)	241.25	186.43	176.67	184.5	208.96	187.51
Cocoa Output per hectare (kg/ha)	550.43	532.42	861.06	952.67	705.75	784.12

Source: Field Data (2009)

3.2 Cocoa Farmers' Efficiency Score

Input oriented variable return to scale DEA model was used in this analysis to estimate the technical efficiency of cocoa farms. In addition, descriptive analysis was done to compare the result of the DEA analysis. For the purpose of this discussion we only considered the VRSTE output. The VRSTE output showed that FFS farmers had a mean technical efficiency of 0.84

while the NFFS farmers' mean technical efficiency was 0.77. This indicates that FFS farmers are more technically efficient than the NFFS farmers, (see Table 2). In Table 1, it was shown that the NFFS participants had a higher yield, however, yield as a means of measuring productivity only look at one input and the only output i.e. kilogram of cocoa produced per hectare. The technical efficiency calculated in this section takes into consideration the various inputs that go into cocoa production as well as the relationships between these inputs. It determines the optimum input-output combination based on the existing technology that is being used by the farmers in the sample and compares the performance of each farmer with this optimum. Based on this comparison, it determines the efficient and non-efficient farmers. In effect, the DEA provides information on the relative TE of all the farmers in the sample.

The yield per hectare as a measure of productivity is a partial analysis in that only one input i.e. land is taken into consideration. Whereas the DEA considers all the inputs - land, insecticide, fungicide and labour, simultaneously. Considering the amount of other inputs used by NFFS in relation with the quantity of cocoa produced, on almost the same amount of land, it could be seen that the NFFS participants use more agrochemicals. In summary, while the NFFS participants were able to obtain higher quantity of cocoa per hectare of land, the result of the DEA reveals that the FFS participants better optimized the use of inputs.

Table 2. Cocoa Farmers' Efficiency Score

Training Category	VRSTE
<i>FFS</i>	0.84
<i>NFFS</i>	0.77

Source: Field Data (2009)

3.3 Classification of Efficient farms

An efficiency score of 1 indicates that a particular farm is efficient while a score less than 1 implies that the farm is inefficient. From Table 4, 73.33% (i.e. 44 out of 60) of the FFS farmers had an efficient score of 1, which implies that only 26.67% of the FFS farmers were inefficient. On the other hand, 60% (36 out of 60) of the farmers were efficient. This clearly shows that more FFS farmers were technically efficient compare with NFFS farmers.

Table 3. Classification of Efficient farms by Participation in Farmer Field School

Farms	FFS (%)	NFFS (%)	TOTAL
Efficient	73.33	60.00	66.67
Non-efficient	26.67	40.00	33.33
Total	100.00	100.00	100.00

Source: Field Data (2009)

3.4 Excess Input Used

Since a slack indicates excess of an input use, a farm can reduce its expenditure on an input by the amount of slack without reducing its output. Table 4 show that there are opportunities for some of the farms to reduce their expenditures without reducing their outputs. Farm size

displayed a mean slack of 0.47ha among the FFS farmers, while the NFFS farmers were using an excess of 0.29ha of land for their farming operations. This conforms to the earlier result in which the yield per hectare was higher for NFFS than FFS. The FFS farmers spent an excess of ₦ 3 925.73 on hired labour, while the NFFS farmers spent an excess of ₦ 10 682.35. FFS farmers spent an excess of ₦3 902.40 on fungicide while the NFFS farmers spent an excess of ₦7 830.18. On insecticide, FFS farmers spent an excess of ₦ 3 044.69 while the NFFS farmers spent an excess of ₦ 11 679.40. Overall, these findings reveal that the NFFS farmers had higher slacks for inputs, that is, utilize factors of production more excessively compared with FFS farmers. Specifically, the NFFS farmers used land more efficiently than FFS farmers while the FFS farmers used fungicide, insecticide and labour more efficiently.

Table 4. Mean Input Slack

Input	Mean Slack		Mean Input used	
	FFS	NFFS	FFS	NFFS
Farm Size (ha)	0.47	0.29	2.61	2.63
Cost of Fungicide (₦)	3 902.40	7 830.18	10 380.50	15 205.00
Cost of Insecticide(₦)	3 044.69	11 679.40	5 813.58	20 152.94
Cost of Hired Labour (₦)	3 925.73	10 682.35	21 513.33	39 421.67

Source: Field Data (2009)

4. Conclusions and Recommendations

From the study it was observed that NFFS farmers made use of significantly more insecticides and fungicides. FFS farmers had been trained to “optimise” the use of agrochemicals and to rely more on appropriate cultural practices like pruning of chupons and optimal shading level to control blackpod and mirids, the two major pests limiting the yield of cocoa in the study areas. The heavy use of these agrochemicals, irrespective of the effects on the environment, may have been responsible for higher yield per hectare recorded by the NFFS farmers compared with FFS farmers. The input oriented Data Envelopment Analysis, which was used to assess the relationship between cocoa output and all purchased inputs, namely; farm size, cost of hired labour, and the amounts spent on fungicide and insecticide, however shows that FFS farmers had a mean technical efficiency of 0.84 while the NFFS farmers’ mean technical efficiency was 0.77. This indicates that FFS farmers are more technically efficient than the NFFS farmers. More FFS farmers (73.33%) were technically efficient compared with the NFFS farmers (60.00%).

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