Impacts of Farm Business of School (FBS) Intervention on the Income of the CocoaFarmers in Nigeria

Abstract

This study was designed to empirically investigates the impacts of Farm Business School (FBS) intervention on the income of cocoa farmers in some selected states in Nigeria. Primary data were collected through direct personal interviews, and with the use of a well-structured questionnaire from 300 sampled cocoa farmers.The data analytical techniques employed in this study include descriptive statistics, endogenous switching regression (ESR)and propensity score matching (PSM). The results from the descriptive statistics for participants and non-participants showed that majority of the farmers were relatively old given life expectancy in Nigeria as 52 years. Participants and non-participants in the study area had a mean age of 54 years. The cocoa farming is been dominated by male farmers. The result of ESR was based on the average treatment effects of participants in FBS on income, and this shows that the participation in FBS increases income significantly, and farmers that did not participate, would have benefited significantly had they participated in FBS. PSM analysis indicated that participants in Farmers Business School and The PSM results implies that FBS training has increased income of participants by 343,950.84 point. The results showed that participating in Farmers Business School leads to significant gain and impact on income of cocoa farmers. Also, variables like: level of education, farm size, amount of credit obtained, household size, and number of visit by extension agents have significant impact on the level of participation. Therefore, research institutes and other agencies of government should improve upon their services of creating awareness for cocoa farmers so as to encourage participation of more farmers in the training programme in order to have increased income. The combination of ESR and PSM analysis will also add value and contribute to the literature on the best approach to address impact analysis.

Keywords: Cocoa, endogenous switching regression, income, participants, propensity score matching, Nigeria

1.0 Introduction

In order to improve the earnings and general well-being of Nigeria's smallholder farmers, several methods and tactics are being used to provide technical support. The goal of these farmers' benefits is often achieved through the use of extension services, knowledge sharing, and cash and kind input subsidies and transfers (Oluwalade et al., 2023a). Although the benefits of input subsidies have been well studied (Oseni et al., 2018; Oluwalade et al., 2023b), assessing the effects of extension services is more difficult because of innate problems including knowledge assessment over time, information spillovers, and attrition (Ragasa and Mazunda 2018; Faure et al. 2017; Olutumise et al., 2019). Therefore, the Farmer Field School (FFS), which was first founded as a model for teaching farmers knowledge-intensive pest-management practices, gave rise to the Farm Business School (FBS) (Godtland et al., 2004). TheFBS project was proposed as a business-centric Farming for Success (FFS) adaption to foster business competence among farmers to support the FFS programme. The goal of GIZ's introduction of FBS was to improve smallholder farmers' capacity for entrepreneurship in Africa (Oluwalade et al., 2023a,b). The World Cocoa Foundation and the Bill and Melinda Gates Foundation collaborated to start the programme in 2010, with the original goal of enhancing the entrepreneurial abilities of cocoa growers (GIZ, 2016). The FBS model has been used by other GIZ initiatives and both public and commercial organisations to manage interventions in a variety of food and export commodities across Africa, after the project's successful completion. As a consequence, training has been provided to almost 900,000 smallholder farmers in 16 African countries (Matthess et al., 2017; Akinuli et al., 2023; Yahaya et al., 2023).

According to Adetarami et al. (2020), the German International Corporation (GIZ) launched the Farmer Business School (FBS) in 2010 as part of the Cocoa Livelihood Programme (CLP). The key development partner GIZ is dedicated to helping smallholder cocoa producers in Nigeria and three other West African nations—Ghana, Cameroon, and Cote d'Ivoire—develop their economic skills. The International Institute of Tropical Agriculture/Sustainable Tree Crop Productions (IITA/STCP), Societe de Cooperative pour Le Development International (SOCODEVI), and Thecnoserve are among the development partners working in Nigeria in addition to GIZ. So, understanding how important financial and marketing issues are to increasing their profits, the FBS actively looks into and adopts cutting-edge technology to help farmers improve their standard of living (GIZ, 2015; Oluwalade et al., 2023b). However, the existing literature indicates that FBS has not received as much attention in global research as FFS has.

Therefore, agricultural extension and consulting service providers have to place a high priority on the use of cutting-edge extension techniques at educational institutions like the Farmer Business School (FBS) to improve business skills. To boost their farms' profitability, the idea of FBS was created to help cocoa farmers gain business expertise and knowledge. A great deal of Nigerian farmers are ignorant of how to maximise their earnings by taking advantage of market openings and making well-informed choices. Their incapacity to successfully compete in a changing environment is hampered by this ignorance. This study would examine the socioeconomic characteristics, determine the effect of FBS on income, and estimate the treatment effects of participating in FBS.

2.0 Material and Methods

2.1 Study Area

Nigeria has the fourth position in the global cocoa production hierarchy (Ukpe, 2022). Although large-scale crop farming does occur in Nigeria, small-scale farmers oversee the majority of the nation's agricultural operations. This crop still provides rural populations in the areas where it is cultivated with essential sustenance. Approximately 800,000 hectares of land in Nigeria are used for cocoa farming, according to research by the Centre for Public Policy Alternatives (CPPA) in 2017. More than 300,000 cocoa growers are concentrated in the southwest of Nigeria, accounting for around 5% of the world's cocoa production (CPPA, 2017). About 380,000 metric tonnes of cocoa are produced annually in Nigeria, with the states of Osun, Ondo, and Cross River accounting for more than 68% of this total (Folarin, 2022). Nigeria has a tropical climate with alternating seasons of rain and sun. The monthly average temperature normally ranges from 24°C (in December and January) to 30°C (in April). The annual average temperature is 26.9°C. The average yearly precipitation is 1,165.0 mm (World Bank, 2021; Badamosi et al., 2023). Nigeria has rain all year round, with April through October seeing the most precipitation and November to March seeing very little (World Bank, 2021).

2.2 Data Collection

The study used a well-crafted questionnaire to gather data from primary sources. Following Oluwalade et al. (2023a,b), open-ended and closed-ended questions were included in this survey, and in-person interviews with the participants provided the information.

2.3 Sample and Sampling Procedure

A multistage sampling technique was utilised to choose a representative sample of cocoa farmers within the study area. The three states (Ondo, Cross River and Osun) that produced the most cocoa (CPPA, 2017; Oluwalade et al., 2023a,b) were purposively selected for the study. The second phase consisted of a random selection of nine communities engaged in cocoa production, with three communities chosen from each State. In the third stage, proportionate sampling was adopted to select the cocoa farmers who were participants of FBS. 10% of the 200 registered participants of FBS from each community of Ondo and Cross River States and 10% of the 100 registered participants of FBS from each community of Osun State were selected. The last stage employed a snowball sampling method to select 20 nonparticipants of FBS from the three communities of Ondo and Cross River States. In contrast, 10 were selected from each of the three communities of Osun State. This sums up to a total of three hundred (300) respondents (150 participants and 150 nonparticipants).

2.4 Data Analysis and Model Specifications

2.4.1 Endogenous Switching Regression Model

Endogenous Switching Regression model was combined with the Propensity Score Matching (PSM) to examine the effect of FBS intervention on the income of cocoa farmers. In addition to the selection bias associated with non-randomness in technology adoption, heterogeneity of technology impacts is another important econometric problem (Oparinde and Olutumise, 2022; Olutumise, 2023a). Under such conditions the standard econometric method of using a pooled sample of participants and non-participants might be inappropriate as it assumes that the set of regressors have the same impact on participants and non-participants (Kassie et al., 2010; Olutumise, 2023a). A number of recent empirical analyses that measured the impact of agricultural technologies (e.g., Asfaw *et al.* 2012; Khonje *et al.* 2015; Olutumise, 2023b) also indicated the significance of unobservable factors under impact evaluation. Hence, ESR was implemented to control for unobservable variables that affect both the participants and outcome variables. The ESR framework follows two stages: The first stage is estimation of the selection equation, the decision to participate in FBS. Following Khonje *et al.* (2015), the selection equation for the adoption of FBS is specified as:

$$M_i^* = \beta X_i + u_i \text{ With } M_i = \begin{cases} 1 \ if \ M_i^* > 1 \\ 0 \ otherwise \end{cases}, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where: M^*_i is the latent variable for the participation in FBS and M_i is its observable counterpart, X_i are vectors of observed characteristics determining the participation of farmers in FBS and ui is the error term.

This stage of the ESR framework is estimated using the Logistic regression model. For the ESR model to be identified, it is important to include selection instruments that affect the participation decision but not the outcome variable (Shiferaw *et al.* 2014; Oparinde and Olutumise, 2022).

In the second stage of the ESR framework, an Ordinary Least Squares regression with selectivity correction is used to examine the relationship between the outcome variable and a set of explanatory variables conditional on the participation decision. The two outcome regression equations faced by the farmers: to participate (regimes 1) and not to participate (regimes 2) can be expressed as:

$Regime$ 1 (Participants): $Y_{1i} = \beta_1 X_i + \varepsilon_{1i} if I_i = 1$ ………………………………………… (2)

$Regime$ 2 (Non-participants): $Y_{2i} = \beta_2 X_i + \varepsilon_{2i} if I_i = 0$…………………………………… (3)

where Y_{1i} is the income per farmer equivalent in each regime i.e. the dependent outcome variable, X_i represents a vector of exogenous variables expected to affect income per farmer equivalent, and these includes: age of the respondents, household size, farming experience, farm size (in hectares), education (years of formal schooling), amount of credit obtained (naira), total distance from house to center (km), number of extension visits (days), age of cocoa trees (years), and non-farm income; β_1, and β_2, are parameters that show the direction and strength of the relation between the outcome variable and the independent variables. ε_{1i} and ε_{1i} are error terms.

Further estimations of treatment effect were made. Average Treatment effect of the Treated, (ATT), and of the Untreated, (ATU), are computed by comparing the expected values of the outcomes of participants and non-participants in actual and counterfactual scenarios. Following Di Falco et al. (2011) and Asfaw *et al.*, (2012), the expected values of the dependent variable for participants and non-participants in actual and counterfactual scenarios are computed as follows:

$$E(Y_{1i} \mid I_i = 1, X_{1i}) = \beta_1 X_{1i} + \sigma_{\epsilon 1u}\rho_1 \frac{\varphi(Z\alpha)}{\Phi(Z\alpha)} \quad \ldots\ldots (4)$$

$$E(Y_{2i} \mid I_i = 0, X_{2i}) = \beta_1 X_{2i} - \sigma_{\epsilon 2u}\rho_1 \frac{\varphi(Z\alpha)}{\left(1 - \Phi(Z\alpha)\right)} \quad \ldots\ldots (5)$$

$$E(Y_{2i} \mid I_i = 1, X_{1i}) = \beta_2 X_{1i} + \sigma_{\epsilon 2u}\rho_2 \frac{\varphi(Z\alpha)}{\Phi(Z\alpha)} \quad \ldots\ldots (6)$$

$$E(Y_{1i} \mid I_i = 0, X_{2i}) = \beta_2 X_{2i} - \sigma_{\epsilon 1u}\rho_2 \frac{\varphi(Z\alpha)}{\left(1 - \Phi(Z\alpha)\right)} \quad \ldots\ldots (7)$$

Then ATT is calculated as the difference between the expected value outcome variable from equation (5) and (7). It is the difference between the expected value of the dependent variable for participants and if they had not participated. ATU is the difference between equations (7) and (6) estimating the difference between the expected value of the outcome variable for non-participants and if they had participated.

According to Oparinde (2019) and Olutumise (2023a), credit constraint and adoption decision may be jointly determined and this is capable of causing potential endogeneity problems in Endogenous Switching Regression Model. There may be bias estimates if such potential endogeneity problems are not accounted for. In view of this, the endogeneity issue is accounted for using two-stage procedure of Blundell and Smith (1989) since the dependent variable is dichotomous. The first stage involved the specification of potentially endogenous variable (credit constraint) as a function of all other independent variables including a set of instruments as in equation 8.

$Pr[Vi = 1] = Gi + \tau' Ti + e$ ……………………………………………………………… (8)

where *Vi*is a vector of the potential endogenous variables, *Gi* is a vector of independent variables, while *Ti* is a vector of instruments that are correlated with the given endogenous variable, but uncorrelated with the error terms in equation 8. A variable that influences credit constraint but does not influence the outcome variables was included in equation 8 for identification purpose. Possession of collateral which influences credit constraint but not the outcome variable was used as an instrument in the credit constraint specification. However, the second stage involved the inclusion of the values of credit constraint as well as their corresponding residuals from equation 8 in ESR model. Therefore, consistent estimation of the parameters in the presence of potential endogenous variable in *Ti* is possible. A simple t-test for the significance of the coefficient vector is a test for the exogeneity of these variables (Wooldridge, 2010).

2.4.2 Propensity Score Matching

In addition to ESR, Propensity Score Matching (PSM) was used to check the robustness of the estimated treatment effect results from ESR for different assumptions. PSM helps to adjust for initial differences between the two groups by matching each participants unit to a non-participants unit based on similar observable characteristics (Rosenbaum and Rubin, 1983).
This method compared the income of participating cocoa farmers in FBS with their counterparts that did not participate in FBS.

The propensity score is define P (T_1) as the conditional probability of receiving treatment given pre-treatment characteristics:
$P(T_1) = prob(D_1 = 1/T_1) = E(D_1/T_1); P(T_1) = F(T_1)$……………………..…………………(9)
In equation 14, T_1 denotes a vector of pre-treatment characteristics of respondents i; E is the expectation operator; and F(T_1) represents normal or logistic cumulative distribution frequency.

According to Becker and Ichino (2002), average treatment effect on the treated (ATT) is the parameter of interest in propensity score matching analysis. ATT is computed by matching participants and non-participants that are closest in their propensity scores. In this study, the treated group are referred to as participating farmers in FBS and the ATT is calculated as follows:
ATT= E (T/1=1)= E(Y/1)/D=1) –E(Y(0)/D=1………………………………………………(10)
where:
E(Y/1)/D=1) represents the expected outcome of participants;
D is whether cocoa farmers participate in FBS or not; and
E(Y(0)/D=1 is the unobserved income
The counterfactual estimates represent what the participants in FBS would be, if they have not participated in Farmers Business School.

A number of matching techniques have been suggested in the literature to match enterprise and non-enterprise households of similar propensity scores to compute the ATT. Caliendo and Kopeinig (2008) listed a number of matching estimators including the Nearest Neighbor (an individual from a comparison group is chosen as a matching partner for a treated individual that is closest in terms of propensity score), Caliper (where an individual from the comparison group is chosen as a matching partner for a treated individual that lies within a given caliper) and Kernel (a non-parametric matching estimator use weighted averages of all individuals in the control group to construct the counterfactual outcome).
However, this study employ the use of nearest neighbor matching, stratification method, and radius matching technique. The radius matching technique uses all of the comparison units within a pre-determined radius. The advantage of this method is that it uses as many comparison units available within the radius, thus allowing for the use of extra units when good matches are available and fewer units when they are not. Stratification divides the common support of propensity scores into a set of intervals or strata and calculates the impact in each strata by taking the mean difference in outcomes between treated and control groups. Nearest Neighbor Matching was conducted with replacement, whereby all observations in the treated group are matched with the nearest observations in the control group using propensity scores.

3.0 Results and Discussion

3.1 Describe the Socioeconomics Characteristics of the Respondents

Table 1 presented the socioeconomic characteristics of the cocoa farmers in the area. It was revealed that the average age of the Farmers Business School (FBS) participants and non-participants was about 54 years. The average life expectancy in Nigeria is 52 years (World Fact Book, 2015; Olutumise and Ajibefun, 2019). This shows that majority of these farmers are too old. This might tend to affect their farming activities which may make them rely on hired labour. The result shows that participants and non-participants were majorly males with 80% and 84%, respectively. Sabo et al. (2017) reported that women undertook 60.0 – 90.0% of the rural agricultural product processing and marketing, thereby providing more than two thirds of the workforce in agriculture. More energy-demanding tasks such as spraying of agro-chemicals, pruning, and harvesting of ripe cocoa pods were men tasks in the study area. In other words, it implies that cocoa farming is a male-dominated enterprise (Oseni et al., 2018). About 93.3% and 92% of participants and non-participants in the study area were married. The implication of this is that farmers in the study area are matured and can effectively take crucial decisions jointly with their spouses. This will also afford them the opportunity of getting family labour to be used on the farm (Oseni and Adams, 2013; Ogunyemi et al., 2022; Badamosi et al., 2023; Adegoroye et al., 2023).The results also indicated that majority (90.7%) of the FBS participants had at least primary school education while about 88.7% of the non-participants had at least primary school education. This implies that, cocoa farmers are literates and communication among them will be easier. They might be ready and willing to adopt innovation in cocoa production. This results is in agreement with Fregeneet al. (2011) and Oseni et al. (2018). The participants and non-participants had a mean household size of 8.01 and 8.02 persons, respectively. A large family size is significant in the agricultural sector (Sule et al. 2002; Adegoroye et al., 2021), in terms of reducing the cost of hiring labour and thereby increasing profitability. The participants had an average of 29 years farming experience while non-participants had an average of 25 years of farming experience. However, Ohenet al.(2014), Bankole et al. (2018) and Oladoyin et al. (2023)opined that farmers with reasonable level of experience in farming have sound decision making. Farming experience among the group differ significantly, it was also found out that cocoa farmers in Cross river and Ondo state are more experienced in cocoa production practices than cocoa farmers in Osun state.GPS was used to identify the sizes of cocoa farms in the study area. The farm size of both participants and non-participants of FBS was small, but the participants still display a larger farm size than its counterpart. Participants and non-participants had a mean farm size of 2.16 and 1.81 ha respectively. Therefore, Adisa and Adeloye (2012) opined that most small cocoa farms might be connected with the land fragmentation caused by inheritance. The study also showed that Ondo state displayed a large farm size among the selected three states which is also similar to the findings of Ajayi and Olutumise (2018) and Ijigbade et al. (2023) in Ondo State and Southwest, Nigeria, respectively.

Table 1: Summary of the Socioeconomic Characteristic of the Respondents

Variable	FBS Participants	Non-participants
Age (years)		
Mean	54.33	54.03
Minimum	34	29
Maximum	74	75
Sex		
Male	80%	84%
Marital Status		
Married	93.4%	91.9%
Level of Education		
Educated	91.7%	81.7%
Mean	3.32	3.26
Household Size		
Mean	8.01	8.02
Minimum	1	3
Maximum	25	23

Farming Experience (Years)		
Mean	28.96	24.9
Minimum	10	2
Maximum	58	48
Farm Size (Hectares)		
Mean	2.16	1.81
Minimum	0.50	0.50
Maximum	15.00	8.00

3.2 Distribution of Respondents According to Effect of FBS Intervention on the Income of Cocoa Farmers

3.2. 1 Determinants of Participation and Effect of Determinants on Income

The results from both the ESR and PSM techniques were presented in table 2, 3 and 4. The result of the ESR model was reported in Table 3. The second column of table 3 reports the estimated coefficient of selection on participants in FBS or not. Household size has a negative and significant on the decision to participate in FBS. This implies that an increase in household size of participants will increase the probability for non-participation.

Education have a positive significant association with farmer's decision to participate. This means that an increase in the years spent in school, the higher the probability of farmer's participation. This will as well increase the knowledge and orientation of cocoa farmer's participation. According to FAO (2011) and Oluwalade et al. (2023a,b), materials for the FBS are specially designed for farmers with limited resources, who need to be basically literate and numerate but who do not necessarily have any significant formal education. Education tends to have positive association with new technology adoption among farmers because of better access to and comprehension of information on the technologies (Norris and Batie, 1987; Oladoyin et al., 2023). Huffman (2001), however, argues that when an intervention has been there for relatively long time education may not significantly affect decision to participate.Amount of credit obtained has a significant impact on the participation of farmers in FBS. Deressa *et al.,* (2009) and Olutumise (2023a) found the same result for value of asset and farm income. An increase in the amount of credit received will increase the probability of farmer's participation.Extension contacts has a positive impact on the decision to participate in FBS. This is attributable to the fact that farm business extension agents are one of the fundamental principles of FBS, they ensure the smooth running of the school and ensure that all materials and activities are covered. Increase in the number of days of extension visit, will increase the probability of the farmers to participate in FBS School.Age of cocoa trees showed a positive impact on the decision to participate in FBS. The implication is that increase in the age of farmers will increase the probability of farmer's participation. This conformed to the findings of Zamasiya*et al.,* (2014), that age could be used to measure experience in farming. Therefore, farmers with large farm size has more probable to participate than others. Previous studies indicated mixed results on the association of farm size and probability of adoption of technology (Bradshaw *et al.,* 2004; Deressa *et al.,* 2009; Khonje *et al.,* 2015, Olutumise et al., 2020; Oparinde et al., 2023).The coefficient of farm size was also statistically significant and negatively related to the participation of farmers in FBS. This implies that an increase in the size of cocoa farm will increase the likelihood for non-participants. This is justifiable because farm size indicates the capacity to purchase external inputs such as improved cocoa varieties as farm land is a proxy for wealth in rural area. This result is in line with the research of Wainaina et al. (2016).Non-farm income has negative and significant impact on the decision to participate in FBS. An increase in the non-farm income will lead to increase in the probability for non-participation. This result agrees with the findings of Olutumise (2023a) that participation in non-farm activities may constrain the amount of labour hour available for farm activities.Another important finding is the sign and significance of the correlation coefficients ρ1 and ρ2. The results show that the coefficients are statistically significant for both participants and non-participants indicating the existence of self-selection bias in FBS due to unobservable factors. The estimate is also negative for non-participants indicating a lower income and performance in cocoa production. The model diagnosis also shows a significant indicating the existence of joint dependence between the outcome and selection equation between participants and non-participants.

The model estimates of the variables against farmer income for participants and non-participants are presented on the third and fourth column of Table 2. Age shows a positive and significant impact for participants. Zamasiya*et al.*, (2014) and Olutumise (2022), found similar results that age could be used to measure experience in farming. The knowledge and orientation of cocoa farmer will improve their income.Farm size has a positive and significant impact on income for participants and non-participants. This is because increase in farm size will encourage farmers to invest and indicates the capacity to purchase external inputs such as improved cocoa varieties. Education has a positive impact on the income of participants. Amount of credit obtained, access to extension contacts and age of cocoa tree also has a positive impact on the income of participants and non-participants.

The coefficient of farming experience was significant and has a positive impact on income for non-participants. However, this farming experience does not have a significant impact on the income of participating cocoa farmers. Also, level of awareness about FBS exhibit negative but significant relationship with participation, this implies that the level of awareness about FBS and training are likely to increase cocoa farmers chance to participate. However, credit constraint and pond system are positive and significant in ESR model, which indicates that being credit constrained tend to reduce the probability of participation. This result is in support of outcome of study by Oparinde (2019) and confirmed by Deressa *et al.* (2010) and Olutumise (2023a) who reported that access to credit will increase adoption of various risk management strategies.

Table 2: Full Information Maximum Likelihood Estimates of Endogenous Switching Regression Model for Cocoa Farmer's Income

Explanatory Variables	Selection		Participants		Non-Participants	
	Coefficient	***P*-value**	**Coefficient**	***P*-value**	**Coefficient**	***P*-value**
Constant	-4.924	1.811	9743.3	0.963	-19467.1	0.275
Age	0.094	0.907	275713.0***	0.000	-95294.1	0.358
Marital status	-0.041	0.301	306936.4	0.480	-166582.5	0.228
Household size	-0.068*	0.075	-65789.7**	0.040	-34243.8**	0.012
Farming experience	-0.067	0.452	464.849	0.965	6739.3**	0.024
Farm size	-0.053*	0.069	142123.7*	0.097	305676.7***	0.000
Level of Education	2.040***	0.000	27261.4***	0.000	10256.9	0.109
Amount of credit obtained	2.123***	0.009	1.244**	0.014	3.1***	0.006
Extension contacts	0.023**	0.015	211898.7**	0.010	145642.7**	0.024
Age of cocoa tree	0.379***	0.000	6222.9***	0.000	5002.9**	0.046
Total distance from house to center	-0.0009	0.082	3005.8	0.001	-177582.4	0.208
Access to non-farm income	-4.924***	0.007	-1946717	0.275	9743.3	0.963
Awareness level	-0.325**	0.038				
Credit Residual	0.042	1.16				
$\boldsymbol{ln\sigma_1}$			14.2***	0.000		
$\boldsymbol{\rho_1}$			1.0**	0.040		
$\boldsymbol{ln\sigma_2}$					12.7***	0.000
$\boldsymbol{\rho_2}$					-0.3***	0.000

Log likelihood	-4368
Wald Chi^2	20.21**
Prob > chi^2	0.0167

***, **, * denote significance level at 1%, 5% and 10%

3.2.2 Estimation of ESR based average treatment effects of participants in FBS

Table 3 presents ESR based average treatment effects of participants in FBS on income. Results show that the participation in FBS increases income significantly. As shown in the Table, farmers that did not participate, would have benefited significantly had they participated in FBS.

Table 3: ESR based average treatment effects of participants in FBS

Variable	Participant	Non-Participant	ATT
Income	787916.2	631131.5	156784.7***

Note: *** denote significance level at 1%
Source: Field Survey, 2020

3.2.3 Respondents matching quality indicators before and after matching

To check the robustness of the ESR findings, the PSM technique was adopted. This is in line with the Ahmed *et al.,* (2017) on the impact analysis on productivity and wellbeing of smallholder farmers. The predicted scores used to match participants with non-participants ranges from 0.093540 to 0.943586. The propensity scores for non- participants varies between 0.093540 and 0.894551 and for participants between 0.242016 and 0.943586. Thus the common support region, where the values of propensity scores of both treatment and common groups found is between 0.242016 and 0.894551. This region of common support for the propensity scores is also clear from the density distribution for the two groups of participants and non-participants.

In estimating the effect of participants on the income of cocoa farmers on the treated groups with the PSM, the study performed some diagnostic tests to examine the quality of the matching process after predicting the propensity for both participating and non-participating cocoa farmers. Figure 1 provides a density distribution of propensity score for participants and non-participants, showing that there is a considerable overlap of distribution for both the participants and non-participants. Thus, the common support condition is satisfied. The upper and bottom sections of the histogram indicate the propensity score distribution of the participants and non-participants, respectively. The distribution densities of the score are indicated on the vertical axis (y-axis). Nevertheless, the reliability of the common support condition depends on the extent to which the matching techniques can construct resemblance between the treated and the control group conditioned on the covariate.

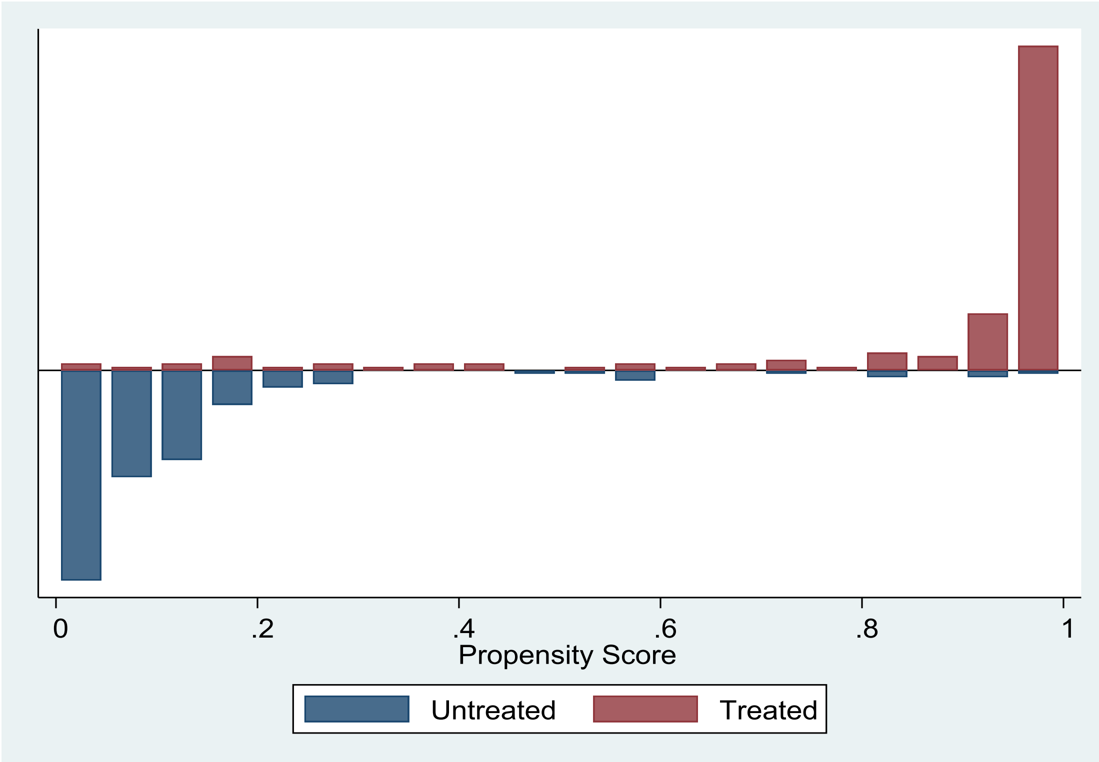

Figure 1: Propensity score distribution and common support. Treated on support indicates the individuals in the participants group who find a suitable match, and Untreated indicates non-participants.

The study performed a balancing test of covariates to ensure that FBS participants have similar pre-exposure characteristics as the non-participants. Rosenbaum and Rubin (1983) indicated that a balancing test should include balancing across the inferior bounds and performing the mean equality tests across the covariates.

Another indicator to confirm the quality of the matching technique is the mean standardized test before and after matching (Rubin, 1974). Table 4 presents the matching quality of the combined covariates. The *p-values* of the likelihood ratio test indicate that the joint significant cannot be rejected before and after matching (*p-values =0.000*). There is a substantial reduction in the value of *Pseudo* R^2, from 0.672 before matching to 0.52 after matching. The standardized mean difference for the overall covariates reduces from 39% before matching to about 4.94% after matching, resulting in a total bias reduction of about 88%. This result confirms the statistical validity of the comparison as the mean standardized value is less than 5% after matching (Rosenbaum and Rubin, 1983). Hence, specification of the propensity score estimation process is successful regarding balancing the distribution of covariates between participants and non-participants.

Table 4: Matching quality indicators before and after matching

Sample	**Pseudo R^2**	**LR (χ2)**	**P>(χ^2)**	**Mean standardized Bias**	**Bias**	**Total % Bias Reduction**
Unmatched (before matching)	0.672	27.99	0.000***	39.0	291.7	
Matched (after matching)	0.520	2.36	0.000***	4.94	238.3	88

******* denotes significance level at 1%

3.3 Respondents PSM-ATT of participants on the income of cocoa farmers

The effect of participants on the income of cocoa farmers were estimated using nearest neighbor, radius, and stratification method. The PSM (NNM, RM, and SM) results presented in Table 5 indicated that FBS training had a positive and statistically significant effect on income. The estimated effect on income ranges from 256,550.44to 600,501.28 depending on the matching technique. The result implies that FBS training has increased income of participants by 343,950.84 point. Other studies also indicated similar links between the adoption and impact of improved seed varieties in different parts of the world (Mendola (2007) in Bangladesh, Khonje *et al.,* (2015) in Zambia and Asfaw *et al.*, (2012) in Tanzania and Ethiopia).

Generally, the PSM and ESR model results indicated that FBS training had a positive effect on income. However, compared with the ESR model estimations, the PSM results were lower, which could have been because of the unobservable heterogeneity not accounted for in the PSM. Similar inconsistencies between PSM and ESR results have been observed in other studies (Shiferaw *et al.* (2014) and Mojo *et al.* (2017), which also found insignificant PSM estimates, and significant ESR estimates.

Table 5: PSM-based average treatment effects of participants on the income of cocoa farmers

Matching estimators	ATT for outcome variables	t-test
Nearest neighbor matching (NNM)	600501.28 (520400.91)	1.063*
Radius matching (RM)	355256.14 (165000.52)	2.072**
Stratification method (SM)	256550.44(178323.81)	0.740*

**,* denote significance level at 5% and 10%

4.0 Summary and Conclusion

To increase income among cocoa farmers, there is need to facilitate learning through specific knowledge and skills, and experiment learning framework. Thus, this study was designed to analyse the impacts of Farm Business School intervention on the income of cocoa farmers in some selected states in Nigeria. Primary data was collected through direct personal interviews, and with the use of a well-structured questionnaire from 300 sampled cocoa farmers (participants and non-participants in Farmers Business School in the study area).The data analytical techniques employed in this study include descriptive statistical techniques, Endogenous Switching Regression, and Propensity Score Matching. The results from the descriptive statistics for participants and non-participants showed that majority of the farmers were relatively old given life expectancy in Nigeria as 52 years. Participants and non-participants in the study area had a mean age of 54 years. In the case of sex, the results showed that only 20% and 16% of cocoa farmers were female for participants and non-participants respectively. It implies that cocoa farming is been dominated by male farmers. The study also revealed the mean age of the cocoa trees for the participants and non-participants was 21 and 26 years respectively. This implies that the cocoa trees are still in their productive age. 86% of non-participants claimed they were not aware of the FBS programme.The result of ESR was based on the average treatment effects of participants in FBS on income, and this shows that the participation in FBS increases income significantly, and farmers that did not participate, would have benefited significantly had they participated in FBS. PSM analysis indicated that participants in Farmers Business School and The PSM (NNM, RM, SM) results implies that FBS training has increased income of participants by 343,950.84 point.

The combination of PSM and ESR analysis was used in this study to check the robustness of estimated treatment effect and to perform some diagnostic tests to examine the quality of the matching process after predicting the propensity for both participating and non-participating cocoa farmers, and the results showed that participating in Farmers Business School leads to significant gain and impact on income of cocoa farmers. The study also indicated that participants are more efficient compared with their non-participants counterparts. Also, variables like: level of education, farm size, amount of credit obtained, household size, and number of visit by extension agents have significant impact on the level of participation.Based on the findings of the study, the following policy implications and recommendations were made based on the findings of this study:

1. Since non-farm income has been reported to be one of the important factor that influenced participation in FBS, cocoa farmers should be encouraged to be involve in income diversification.
2. Monetary policies should be made to encourage lending institutions to administer loans to cocoa farmers in FBS at a lower interest rate as well as the timely release of funds, so as to reduce cost on major agricultural inputs.
3. State Cocoa Revolution need to do well in terms of assisting farmers in making provision for incentives and subsidies on the cocoa inputs so as to boost income and encourage more farmers to participate in FSB in the area.
4. Awareness creation should be made through other means like: Television, Newspapers, Radio and Research Institutes.
5. Research institutes and other agencies of government should improve upon their services of creating awareness for cocoa farmers so as to encourage participation of more farmers in the training programme.

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