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Self-selection Process of Farmers' Field School Participation on Cocoa Productivity in Osun State, Nigeria, Endogenous Switching Regression Approach

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ABSTRACT:
Farmers' Field School (FFS) is an approach to teach farmers in an informal setting within their own surroundings. FFS are "schools without walls" which create a platform for groups of farmers and facilitators to meet weekly and are method of learning, technology development, and dissemination that are participatory, based on principles of adult learning like experiential learning. This kind of method make the trainer to be more of a facilitator than instructor, results into a paradigm shift in extension work and through interactions of group, participants sharpen their decision making abilities and their leadership, communication, and management skills. This study therefore examined self-selection process of Farmers' Field School (FFS) participation on cocoa productivity in Osun State, Nigeria using Endogenous Switching Regression Approach. Data were collected from 90 randomly sampled cocoa farmers from five Local Government Areas using a structured questionnaire. Data collected were analysed using descriptive statistics, and endogenous switching regression method. The result showed that in FFS category 44.44% of the cocoa farmers were between the age ranges of 56 - 65 years while in Non FFS category 42.22 % of cocoa farmers fall to the same age range of 56 – 65 years implying that the most of the cocoa farmers were very old. The study showed that participation in FFS increases farmers' productivity significantly by 29.29% when compared to the causal effects of Non-FFS participant in the study area. The study recommended that cocoa farmers should be encourage starting cultivating new cocoa plantation in order to increase their productivity. Cocoa farmers should be encouraged to participate in FFS in order to ameliorate the effect of low level education as training and retraining of cocoa farmers with innovation, knowledge and modern day techniques are made available.

Key words: Cocoa farming, Endogenous Switching Regression, Farmers' Field School, Productivity

I. INTRODUCTION

The key to poverty reduction and malnutrition in rural areas is agricultural production improvement together with the natural resource based protection, especially in Africa, where majority of the people living in rural areas were found, and which were characterized with agricultural production declining. Agricultural extension has been long noted to be a key element for most farmers to derive information and technologies that can improve their well-being (Purcell and Anderson, 2017). Agricultural Extension is the discipline which seeks to develop professional competencies essential to the operation of a system of services which assist rural people through educational programmes of improved farming methods and techniques, increased production efficiency and income, level of living and achievement of a more fulfilling rural life (Ekpere, 2019).

However, extension has been a subject of criticism for not been able to deliver such results in a satisfactory manner. Governments at the same

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time have drastically reduced budgets in the agricultural sector, therefore making it a herculean task for the public sector to deliver extension services. Another extension critique is that marginalized farmers including women minorities, and people in very remote areas, does not effectively reach (Alawy, 2018). Farmers' field school was initially developed by FAO in 1989 as a method to promote practices of integrated pest management across rice farmers in Indonesia. Central to the approach was a shift from pure information delivery as in traditional extension models toward participatory experiential learning with a strong focus on developing analytical skills and solving of problem capacities among farmers by using highly trained facilitators, (Anderson and Feder, 2017).

Farmers' Field School (FFS) method remains highly successful extension and educational approach now in nothing less than 78 countries (Braun et al., 2016). The method empowers farmers to be versatile on major aspects of localized farming systems, and is method of training which is interactive and practical. Farmers are encouraged to come up with solutions, and assess their own research, determine and test problems (Davis and Place, 2013). The FFS is an approach to teach farmers in an informal setting within their own surroundings. FFS are "schools without walls" which create a platform for groups of farmers and facilitators to meet weekly (Davis and Place, 2013). FFS are method of learning, technology development, and dissemination that are participatory (Food and Agriculture Organization of the United Nations, FAO, 2010).They are based on principles of adult learning like experiential learning (Davis and Place, 2013). The characteristics of defining FFS include group action, discovery learning, and farmer experimentation. Training programs of FFS, "help farmers improve their analytical skills, critical thinking, and creativity, and ensure that they make better decisions" (Feder et al., 2013). This kind of method, that make the trainer to be more of a facilitator than instructor, results into a paradigm shift in extension work (Feder et al., 2014; Van de Fliert et al., 1995). "Through interactions of group, participants sharpen their decision making abilities and their leadership, communication, and management skills." (Anderson and Feder, 2014).

The relevance of cocoa to most developing economies cannot be overstated. The crop is produced by more than fifty developing countries across tropical and semi tropical regions of Asia, Africa and Latin America (Akinbola, 2010). The cocoa economy is characterized by a heavy concentration of production in sub region West Africa (Abbott, 2002). As at 2018, worldatlas.com emphasized that Nigeria is cocoa fourth largest producer in the world, ranking after Ivory Coast, Ghana and Indonesia. However, it is appraised that 90% of cocoa production in the world come from smallholdings in which 2.5 million are cocoa smallholders with yield averaging 350 kg ha per smallholder (Ogunleye and Oladeji, 2017). Today, the new order of the day is the Cocoa Transformation Agenda of Federal Government. The transformation of cocoa production in the country to become a leading exporter of the product in the world is what Nigerian government is committed to. Cocoa Transformation Agenda include tripling of current cocoa production, from 250,000 metric tonnes in the next three years, to one million metric tonnes, in order to increase Nigeria's market share in the global market. It was as a result of this, that National Cocoa Development Committee (NCDC) was instituted in 1999. The committee, domiciled in the Federal Ministry of Agriculture and Natural Resources, was given the authority to promote cocoa production through the implementation and design of Sustainable Tree Crops Programme (STCP) which involves rehabilitation (rebirth) of old plantations and new plantings. In order to ensure its mandate, NCDC synergized with International Institute of Tropical Agriculture (IITA) and Cocoa Research Institute of Nigeria (CRIN) in 2003 to find a detailed plan for reviving the cocoa economy in Nigeria by making use of Farmers' Field School (FFS) as a new extension approach. Therefore this study is aimed at assessing the self-selection process of Farmers' Field School Participation on cocoa productivity in Osun State, Nigeria.

II. METHODOLOGY

The study was carried out in Osun State, Nigeria. Osun State is one of the 36 States of Nigeria located in the South-West part of Nigeria. The State has 30 Local Government Areas, and one area office and state Headquarters is Osogbo. The rainfall pattern is bimodal with summit in the late June/early July and September, while November to February is characterized by dry season. The temperature ranges between 28^0 C and 30^0 C (Adedipe et al., 2014). The zone covers areas ranging from rain forest to savannah. The rainforest cover the southern parts South West, while the savannah interspersed with trees cover the south west northern parts. The vegetation cover is a rainfall pattern and edaphic factors reflection. In areas where the rainfall is less than 1100mm in the

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Volume 4, Issue 12 Dec. 2022, pp: 296-304 www.ijaem.net ISSN: 2395-5252

region, there are grasslands and other shrubs. (Adedipe et al., 2014).

The favourable climate accounts for 80% of the inhabitants are farmers. Farming is the main occupation of people while the "engine of growth" in the agricultural sector is cocoa and palm produce which have historically been the major source of government revenue and foreign exchange earnings. Cash and food crops are both grown. The grown cash crops comprises of kola nut, cocoa and coffee. They also grow food crops such as yams, maize, cocoyam etc.

Sampling Technique

Osun State is divided into three agricultural zones namely; Zone A, Zone B and Zone C. Using a combination of purposive and random sampling techniques, a total of five Local Government Areas were selected for the study. Purposive sampling technique was employed to select the areas with high concentration of cocoa production in Osun State. From each of the five selected Local Government Areas in Osun State, the farmers whose names were in the list obtained from Sustainable Tree Crops Program, Nigeria (STCP) and Agriculture Ministry offices were randomly selected. In all, farmers up to Ninety were selected (45 FFS farmers, and 45 non FFS farmers from Osun State) were selected for the study. 45 farmers were selected each from 150 Osun FFS participants constituting 30% of Osun State FFS participants.

Data were collected from both primary and secondary sources. Primary data for the study were generated through the use of a structured questionnaire, copies of which were administered to the 90 cassava farmers selected for the study in the study area. This sample was randomly drawn from the five Local Government Areas (Aiyedaade, Irewole, Ede South, Ife South and Ife East local government) that were selected for the study.

Analytical Techniques

Basically to analyze self-selection process of Farmers field school participation on productivity of cocoa in the area of study, endogenous switching regression model method was used.

Endogenous Switching Regression method

Following Shively (1998) population of farmers, each of whom voluntarily chooses whether to partake in farmers' field school or not. Let the binary variable F_i represent the decision for farmer i, to partake in farmers school field, with F_i = 1denoting a farmer who partake in farmers school field, and $F_i = 0$ denoting a farmer who does not. Formally, this implies a self selection mechanism:

$$F_i^* = \gamma' \mathbf{w}_i + \varepsilon_i, \quad \varepsilon \sim N(0,1)$$

$$F_i = 1 \quad \text{if} \gamma' \mathbf{w}_i \geq \varepsilon_i$$
$$F_i = 0 \quad \text{if} \gamma' \mathbf{w}_i < \varepsilon_i \qquad (1)$$

Vector **w** contains variables related to the self-selection process and vector γ contains coefficients to be identified. By assumptions, prob [F = 1] = $\emptyset(\gamma' \mathbf{w})$ and prob[F = 0] = 1 - $\emptyset(\gamma' \mathbf{w})$, where ∅ denotes the standard normal distribution function.

To determine the self selection process impact on cocoa productivity, considered agricultural production model that relates agricultural production to agricultural inputs to productivity. The model explains the fact that expected cocoa productivity may depend on participation in farmers' field school either directly, or implicitly. If y_i represents the yield of cocoa product observed on the farm i, then the heteroskedastic production function corresponding to the farmers that partake in famers field school or that do not participated is:

$$y_i = g_1(\mathbf{x}_{1i}, F_i)\varepsilon_{1i} \text{if} F_i = 1$$
$$y_i = g_0(\mathbf{x}_{0i}, F_i)\varepsilon_{0i} \text{if} F_i = 0 \qquad (2)$$

Vectors $\mathbf{x}_1$ and $\mathbf{x}_0$ contain variables believed to influence expected cocoa productivity for those farmers that participated or did not participate respectively. These may include inputs, farm characteristics, and farmer characteristics. The functions $g_1(\mathbf{x}_1)$ and $g_0(\mathbf{x}_0)$ relate input levels and other factors to cocoa productivity for those that participated or did not participate respectively. By assumption, ε_i , ε_{1i} and ε_{0i} are trivariate normal distribution, mean zero, with covariance matrix

$$\begin{bmatrix} \sigma_1^2 & \sigma_{10} & \sigma_{1_\varepsilon} \\ . & \sigma_0^2 & \sigma_{2_\varepsilon} \\ . & . & 1 \end{bmatrix}$$

Following Maddala and Nelson (1975) and Maddala (1983) equation (1) and (2) are referred to as switching regression with endogenous switching. The system can be assessed using the two- step procedure associated with Heckman (1979). First equation (1) is determined using a probit bivariate model. Probability that is estimated measures for each observation (as a function of the switch point expressed in the sample) are computed and retained then in the form of the inverse Mills ratio (IMR). Second, production data for those that partake in farmers'

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 12 Dec. 2022, pp: 296-304 www.ijaem.net ISSN: 2395-5252

field school or those that do not participate are embarked upon to appraise the mean component of the equation (2). The IMR is brought in as a regressor in the mean equations. Controlling for the selection process through inclusion of the IMR in equation (2) is necessary for obtaining estimates of the coefficients that is unbiased in the productivity equation of cocoa. Furthermore, the stochastic component specification in equation (2) is required to obtain consistent and efficient appraisals of the deterministic component. In general, standard errors for equation (2) to gain possession from the two-step procedure outlined above must be corrected.

III. RESULTS AND DISCUSSION

Socio-economic Characteristic of Cocoa Farmers in Osun State

The result in Table 1 shows that in FFS category majority (44.44%) of the cocoa farmers were between the age ranges of 56 - 65 years. So also in the Non FFS category majority (42.22) of cocoa farmers fall to the same age range of 56 – 65 years implying that the most of the cocoa farmers are very old. Their old age may influence their productivity and decision making. This supports the findings of Ajetomobi, Oladele and Adio (2021) in their study on factors influencing Farmers Participation in Farmers' Field School in Ondo State, Nigeria. It is also evident from the Table that underage are not involved as cocoa farmers while the relatively young people are minimal which may not be disconnected with the finding that youth are much very involved in the migration of rural-urban in scour of greener pasture . Majority (38.89%) of the respondents had one form of primary education or the other, while 24.44% had no education and secondary education 11.11% had tertiary education. Just 1.1% had post graduate education. This means that cocoa farming is dominated by the educated class with primary education. This is so because cocoa farming requires a lot of technical and scientific knowledge. The information on the innovations of cocoa farming is somehow complex and this need some high level of education to practice and the more educated an individual is, the easier it will be for him or her to decode and process information. Male (75.56%) dominates in cocoa farming. The male dominancy in this source of livelihood implies the laborious nature of cocoa farming operations right from management which their female counterparts cannot easily undertake. On the marital status, 80% were married. This suggests that there may be high demand for food and additional income as the family size increases. Few percentages (20%) of the respondents were single. As for cocoa farmer's household size 41.11% of the respondents had household size of 7-8 which indicates that they are enough youth that still have strength to work on the farm without hiring labour. Majority (77.78%) of the cocoa farmers possess 0-5 hectares of land which showed that most of the farmers of cocoa in this area can be considered as small- scale farmers ofcocoa that generally dominate the production of cocoa sector in West Africa. while the majority (33.33%) of age of cocoa trees falls within age 31 – 40 years.

Effects of FFS Participation on Cocoa Productivity of Cocoa Farmers

Table 3 shows yield regression results for Osun state, model 1 Ordinary Least Square (OLS) regression revealed that land and labour are characterized with cocoa yields increases at statistically significant levels. In elasticity terms, anincrease of one percent in available land resulted into a 0.78% increase cocoa yield increase at the mean and an increase of one percent in available labour lead to 0.64% cocoa yield increase at the mean. In addition, the regressors are statistically significant jointly, because the overall F statistic value of 56.2. The OLS estimate for farmers field school participation in Osun at the same time, had $R^2 = 0.770$ which shows that 77 % of the variation in cocoa yield.

Model 2 selection results point out that land, labour and fungicide resulted into increase in cocoa yields at statistically significant levels. Examining the result with respect to elasticity, an increase of one percent in available land lead to a 0.38% increase cocoa yield increase at the mean, increase of one percent in available labour resulted into a 0.52% increase cocoa yield increase and an increase of one percent in available fungicide resulted into 0.55% cocoa yield increase. The inverse Mills ratio coefficient 0.369 is significantly different from zero at significance level of 1%; its inclusion in the yield equation increases the explanatory power of participation variable of farmers' field school, proposing that the measured impact of cocoa yield is not partly embodied in the characteristics associated with participation in farmers' field school. Therefore, hypothesis that farmers' field school participation effects are independent of the self-selection process is accepted with this model.

Average Treatment Effect of Farmers Field School Participation in Osun state

The change in the result due to participation in FFS can be specified as the divergences between the participants in FFS

(treatments) and Non-FFS Participants (control). The expected outcomes are employed to collect estimates of impacts of FFS participation that isunbiased. These estimates are called the Average Treatment effect on the treated (ATT) in the impact assessment literature (Lokshin and Sajaia, 2004).The estimates for the average treatment effects on the treated (ATT), which shows the causal effects of participation in FFS on productivity using Endogenous Treatment Effects, are presented in Table4. The results for the sub-samples in Osun State revealed that the participants in FFS tends to increase farmers' productivity significantly at 10% level by 29.29% when compared to the causal effects of Non-FFS participants in the area of study.

IV. CONCLUSION AND RECOMMENDATIONS

The study showed the fact that rising age would lead to a decline in the productivity of Cocoa means that government should focus on ways to attract and encourage young people who are agile and aggressive in Farming business. This group of people would be able to put in a lot of efforts at raising the current level of productivity. The fact that the age of cocoa trees in the country is over 30 years which has led to decline in productivity of Cocoa means that government should find a way of encouraging Cocoa farmers to start cultivating new cocoa plantation in order to increase Cocoa productivity. More Cocoa farmers should be encouraged to participate in FFS in order to ameliorate the effect low level education that characterized the Cocoa farmers as by training and retraining cocoa farmers with innovation, knowledge and modern day techniques will help farmers increase their productivity. The participation in FFS increases farmers' productivity significantly by 29.29 % when compared to the causal effects of Non-FFS participants in the area of study. These findings imply that promoting the participation of cocoa farmers in FFS can be beneficial to farmers' productivity in Nigeria. The FFS program established the land importance as an important factor that lead to increases in Nigeria cocoa productivity at a statistically significant level. Hence government should provide land for young Farmer entrant to cultivate new Cocoa plantation to increase Cocoa productivity.

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Appendix:

Table 1: Socio-economic Characteristics of the Respondents

Age						
	FFS	**%**	**Non-FFS**	**%**	**POOLED**	**%**
[25 - 35)	2	4.44	1	2.22	3	3.33
[36 - 45)	4	8.89	3	6.67	7	7.78
[46 - 55)	8	17.78	16	35.56	24	26.67
[56 - 65)	20	44.44	19	42.22	39	43.33
[66 - 75)	11	24.44	6	13.33	17	18.89
TOTAL	45	100.0	45	100.0	90	100.0
Level of Education						
[0 - 5)	20	44.44	2	4.44	22	24.44
[6 - 10)	17	37.78	18	40.0	35	38.89
[11 - 15)	6	13.33	16	35.56	22	24.44
[16 - 20)	1	2.22	9	20.0	10	11.11
[20 - 25)	1	2.22	0	0	1	1.11
TOTAL	45	100.0	45	100.0	90	100.0

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 12 Dec. 2022, pp: 296-304 www.ijaem.net ISSN: 2395-5252

Gender						
Female	10	22.22	12	26.67	22	24.44
Male	35	77.78	33	73.33	68	75.56
TOTAL	45	100.0	45	100.0	90	100.0
Marital Status						
Single	8	17.78	10	22.22	18	20
Married	37	82.22	35	77.78	72	80
Divorce	-	-	-	-	-	-
TOTAL	45	100.0	45	100.0	90	100.0
Household sizes						
[2 - 4)	6	13.33	3	6.67	9	10
[5 - 6)	17	37.78	18	40	35	38.89
[7 - 8)	18	40	19	42.22	37	41.11
[9 - 10)	4	8.89	5	11.11	9	10.0
TOTAL	45	100.0	45	100.0	90	100.0
Size of Cocoa Plantation						
[0 - 5)	35	77.78	35	77.78	70	77.78
[6 - 10)	4	8.89	10	22.22	14	15.56
[11 -15)	5	11.11	-	-	5	5.56
[16-20)	1	2.22	-	-	1	1.11
TOTAL	45	100.0	45	100.0	90	100.0
Age of Cocoa Trees						
[0 - 10)	2	4.44	2	4.44	4	4.44
[11 -20)	11	24.44	8	17.78	19	21.11
[21-30)	18	40.00	12	26.67	30	33.33
[31-40)	13	28.89	16	s35.56	29	32.22
[41-50)	1	2.22	7	15.56	8	8.89
TOTAL	45	100.0	45	100.0	90	100.0

Table 2
Selection Regression Result for FFS Participants in Osun state

	Dependent variable:
	FFS
	(Osun)
Age	0.056**
	(0.024)
Edu	0.204***
	(0.052)
Gender	-0.376

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 12 Dec. 2022, pp: 296-304 www.ijaem.net ISSN: 2395-5252

	(0.450)
Extension	-6.241
	(302.075)
Constant	1.439
	(302.078)
Observations	90
Log Likelihood	-34.632
Akaike Inf. Crit.	79.265

***, ** and * represents 1%, 5% and 10% significant levels respectively

Table 3
Yield Regression Result for Osun State of Nigeria.

	Dependent variable:			
	log(yield)			
	OLS		Selection	
	(1)	t	(2)	t
log(land)	0.783	5.757***	0.384	1.770*
	(0.136)		(0.217)	
log(labour)	0.636	3.741***	0.519	2.257**
	(0.170)		(0.230)	
log(tree)	-0.110	-1.358	-0.150	-1.852*
	(0.081)		(0.081)	
log(herbicide)	0.125	0.984	-0.229	-1.324
	(0.127)		(0.173)	
log(fungicide)	0.024	0.171	0.549	2.614***
	(0.140)		(0.210)	
Constant	3.082	3.810***	4.414	3.744***
	(0.810)		(1.179)	
Observations	90		90	
R^2	0.770			
Adjusted R^2	0.756			
Rho			1.171	
Inverse Mills Ratio			0.369 (0.072) 5.125***	
Residual Std. Error	0.312 (df = 84)			
F Statistic	56.170*** (df = 5; 84)			

***, ** and * represents 1%, 5% and 10% significant levels respectively

International Journal of Advances in Engineering and Management (IJAEM)
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Table 4
Average Treatment effect of Farmers' Field School Participation

	FFS Participants	Non-FFS Participants	ATT	P- value	Change/ difference (%)
Productivity	2.581(2.248)	3.337(1.968)	0.756	0.090*	29.29

*****, ** and * represents 1%, 5% and 10% significant levels respectively**
Figures in parentheses are the standard error