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EFFECTS OF IMPROVED COCOA TECHNOLOGIES ON INCOME AND POVERTY LEVELS OF FARMERS IN ONDO STATE

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ABSTRACT

The study assessed the effects of the improved cocoa technologies on income and poverty levels of farmers adopting improved technology in the study area. A multi-stage sampling technique was used to select a total of 200 cocoa farmers from 4 Local Government Areas of Ondo State. Primary data were collected using a well-structured questionnaire. Data collected were analyzed using descriptive statistics, the instrumental variable method and Foster-Greer-Thorbecke (FGT) model. Results showed that the improved technologies adopters were more exposed to formal education and cultivated larger hectares of farm-land as compared to non-adopters. The non-adopters were older and more experienced in farming than the improved technologies adopters. Education, membership of farmers' association, farm size, influenced adoption decisions of improved technologies significantly and positively. The parameter estimates of the regression model for the determinants of farm income showed that household size, farm size and yield were positive and statistically significant at 1% level. The parameter estimates of the regression model for the determinants of poverty showed that household size was positive and statistically significant at 1%; while education and years of experience were negative and statistically significant. The proportion of adopters whose per capita income fell below the poverty line was 11.5% while that of non-adopters was 35.4%. The poverty gap index for adopter and non-adopters were 2.3% and 6.7% respectively. In addition, the severity of poverty among adopters was 0.69% and 1.89% for non-adopters. It was recommended that cocoa farmers in the study area should be provided with timely subsidized inputs to boost their production activities and hence minimize discontinuation of adoption. There is need for more awareness and sensitization programmes on use of improved technologies and effective monitoring and evaluation team for the cocoa farmers in order to guide them on the use of these technologies which has been introduced to them and also get feedback from the farmers.

INTRODUCTION

Cocoa (*Theobroma cacao* L.) is a major economic tree crop in Nigeria. Between 1950 and 1960, the crop was the largest source of foreign exchange in the country (Oyedele, 2007). Cocoa cultivation gained prominence rapidly in Nigeria such that by 1965, Nigeria became the second-largest producer in the world. However, in recent times, Nigeria has slipped from being the world's second-largest producer to the fourth position. Ranking on the top of the 10 countries with significant global production of cocoa is Côte d'Ivoire, followed by Ghana and Indonesia, and Nigeria ranked fourth (UNECA, 2013) contributing 12% of total world production (ICCO, 2014). Reasons elicited for the reduction in production included; less emphasis on agriculture, inadequate government program on agricultural input subsidies such as chemicals and planting materials, small farm sizes, inadequate capital, inadequate labour availability and change in global climate (Oduwole, 2004).

Cocoa is an important generator of income for most rural farmers in Nigeria especially in the Southwestern states and serves as a backbone for their livelihood. The production of cocoa is largely dominated by smallholders who operate at very low levels of productivity. Diseases and pests attacks, declining soil fertility, poor agronomic practices, use of low yielding varieties, limited access to credit as well as inadequate infrastructure constitute major constraints to productivity (Appiah, 2000)

Fourteen States grow cocoa in Nigeria. They are Abia, Adamawa, Akwa Ibom, Cross River, Delta, Edo, Ekiti, Kogi, Kwara, Ogun, Ondo, Osun, Oyo and Taraba. The South West is regarded as the cocoa belt of the country, it accounts for 70% of Nigeria's annual cocoa production (Michael and Nzeka, 2011). Over 200,000 households in the fourteen cocoa producing states in Nigeria depend on the crop as a source of livelihood (NCDC, 2008). Currently land area under cultivation in Nigeria is estimated at 650,000ha, with cocoa production of 250,000metric tonnes per annum. Though Nigeria contributed 11% of the world's 3.5 million tonnes cocoa supply in 2005 (Nzeka, 2005), its benefits and contributions to the country's economy and people's health cannot be overemphasized. In 2002, it contributed 2% to the national export earnings (NCDC, 2008).

The discovery of oil in the 1970s, coupled with other socio-economic factors led to the relegation of cocoa to the second position in terms of foreign exchange earnings for the country. Since then, oil sector has been the pivot of Nigerian economy with poverty, unemployment and weak industrial base. Economic diversification is a panacea to the socio-economic problems in Nigeria. In order to diversify the Nigerian economy, the Federal Government of Nigeria (FGN) decided to rejuvenate cocoa industry with an emphasis on increased production among other things. As a result, some interventions were introduced into cocoa industry with the aim of meeting the needs of the expanding industrial sector, increasing foreign exchange, enhancing job creation and farmers' income (Pervez et al. 2018; FGN, 2006).

In the past, several solutions or alternative paths to revitalize the whole agricultural sector and the cocoa economy, in particular, were suggested. Some of the solutions proffered included:

- Replanting of old cocoa farms with new varieties or 'coppicing'.
- Educated youths should be attracted through improved pricing
- The institutional support through a monitoring board, strengthening of cooperatives and funding of research institutes.

- Increasing the area under cocoa production
- Education on international agreements and standards
- Reduction in taxes and levies
- Infrastructural facilities to support local marketing system
- Increased local consumption
- Policy support for the cocoa sector.

However, the government has taken a more comprehensive and proactive approach by developing an Agricultural Transformation Agenda from which the Cocoa Transformation Agenda (CTA) was designed. The Ministry of Agriculture and Rural Development is the primary institution in Nigeria responsible for the development of the cocoa sector. The ministry has introduced a set of policies that are expected to ensure increased productivity, improved cocoa quality and improved livelihoods of small scale cocoa farmers. The policy thrust is summarized in the Cocoa Transformation Agenda (CTA). The major thrust is to support actors along the value chain through public-private partnership platforms such as the rehabilitation of about 200 000 hectares of the cocoa plantation through private sector support. The long term vision of the CTA is to grow Nigeria's share of the world cocoa market while eliminating challenges such as poor production practices, low productivity, environment, labour, youth engagement; poverty issue; access to credits; market exposures; price volatility; land tenure; environmental issue; social issues such as labour and migration. The Cocoa Transformation Agenda also aims at doubling the production of cocoa in the next few years

One of the government interventions into cocoa industry was the supply of improved seedlings at a subsidized rate to the farmers. This aims at increasing the accessibility of the cocoa farmers to large quantity of cocoa seedlings to enhance their production capacity. The subsidy on improved seedlings was based on the fact that supply of adequate quantity of improved seedlings constitutes a catalyst for agricultural development, foundation for crop production and productivity and realization of agricultural transformation agenda in the country. For sustainable food production and balance of payment surplus, the Federal Republic of Nigeria has revisited issues of the improvement of agricultural sector instead of depending solely on petroleum for national development by embarking on institutional efforts, such as cocoa rehabilitation programmes, cocoa trade liberalization, distribution of improved cocoa varieties among others. These efforts have made the agricultural sector to grow at an average rate of 7.5% per annum between 2002 and 2003 (Daramola,2004)

The role of agricultural technologies and innovations in alleviating and reducing poverty and contributing to economic development has been well documented (Just and Zilbermann, 1988, Binswanger and von Braun, 1991). The benefits of adopting new technologies and innovations are viewed directly through productivity increases that can translate into higher farm incomes and food security. Indirect benefits can accrue to other farmers and consumers through lower food prices, increase in food availability, accessibility and consumption and potentially non-farm employment (de Janvry and Sadoulet, 2001).

The adoption of new agricultural technology such as the high yielding varieties (HYV), fertilizers etc could lead to significant increases in agricultural productivity in Africa and stimulate the transition from low productivity subsistence agriculture to a high productivity agro-industrial economy (World Bank, 2008). Studies that show a positive impact of the adoption of agricultural technologies include;

Winters *et al*. (1998) and Dejanvry and Sadoulet (1992), Mendola (2006), Kijima *et al* (2008), Adekambi *et al* (2009). Agricultural research and technological improvements are therefore crucial to increase agricultural productivity and thereby reduce poverty and meet demands for food without irreversible degradation of the natural resource base. Agricultural research and technological improvements are also crucial in reducing poverty (Solomon (2010); Solomon *et al*, 2011).

Poverty is a phenomenon and a state which has generated a lot of interests in recent times and various views have been raised about the conceptualization of poverty (Okumadewa, 1997). Poverty is recognized as one of the greatest challenges facing human survival. It is described as income level below some minimum level resulting into deprivation of basic necessities of life. Poverty is the main development problem confronting the world and since poverty is widespread and is largely rural, increase in agricultural productivity has therefore been suggested as the main strategy for poverty reduction. (Alene *et al*.2005). Indeed, agriculture is central to the livelihood of most people that live in rural areas whose population accounts for more than half of the world's population. Productivity increases in agriculture can reduce poverty by increasing farmers' income, reducing food prices and thereby, enhancing increments in consumption. In DFID (2003) it is estimated that a 1 percent increase in agricultural productivity reduces the percentage of poor people living on less than 1 dollar a day by between 0.6 and 2 percent and no other economic activity generates the same benefit for the poor. Much of the poor live in rural areas and many of these poor are farmers. This suggests that growth in agriculture is the best way to poverty reduction. The mechanisms for both technology development and provision of rural price incentives are no longer as clear as they were in the 1960s. In many circumstances the poor do not have access to productivity-enhancing technologies. Where they do have access, higher agricultural productivity can lead to lower food prices – to the benefit of poor consumers who spend a large share of their budget on food (Olowa, 2014). Enterprises that promote income growth and distribution and enhance the revenue of the poor households are most likely into lead into poverty reduction among the poor households. For instance, improvement in farmers' productivity and output would lead to income growth and consequently poverty reduction (Asogwa, 2012). This agricultural productivity growth can also be driven by improved farm technologies, including improved seeds, fertilizer, pesticides and other agronomic practices.

Cocoa used to be the highest source of foreign exchange earning in Nigeria before the oil boom of the 1970s. Since then, crude oil has remained the highest source of foreign exchange earnings while cocoa, a versatile, renewable and sustainable source of revenue is yet to reclaim its lost glory. The production in Nigeria is retarded by declining productivity of the existing old cocoa trees while its production is undertaken mostly by poor, small scale and low technical capability farmers. These farmers, therefore, face difficulties in setting up of new cocoa farms and rehabilitation of old ones. These old trees coupled with their susceptibility to pest attack are responsible for decline in the quality and quantity of cocoa production in the country (CRIN, 2003). Diseases and pests attacks, declining soil fertility, poor agronomic practices, use of low yielding varieties, limited access to credit as well as inadequate infrastructure constitute major constraints to productivity (Appiah, 2000)

Consequently, cocoa has not proved to be lucrative as it should be for most of the cocoa farmers in Ondo State as most cocoa farmers typically live in poverty (CRIN, 2003). The projections that over 60% of the rural populace including cocoa farmers will continue to remain poor (Mendola, 2007) suggest a need to focus on poverty reduction strategies for the Nigerian cocoa farmers and hence economic development. Since poverty is widespread and is largely rural, increase in agricultural productivity has therefore been suggested as the main pathway to poverty reduction. Studies like

(Johnston and Kilby, 1975, Thirtle *et al* 2001, Diagne *et al.*, 2009, Asogwa, 2012) have shown that increase in agricultural productivity can be driven by improved farm technologies, including improved seeds, fertilizer, pesticides and other agronomic practices. However, there is limited information on the effects of improved cocoa technologies on yield, income and poverty status of cocoa farmers, hence this study.

This study seeks to describe the socio-economic characteristics of the respondents; identify and describe the improved technologies adopted by cocoa farmers and the levels of adoption and assess the effects of the improved cocoa technologies on the income and poverty levels of farmers adopting improved technology in the study area.

METHODOLOGY

The Study Area

The study area is Ondo State in South-Western Nigeria. It was one of the seven states created on 3rd February, 1976. The state consists of eighteen Local Government Areas. Ondo State is bounded on the East by Edo and Delta States, on the West by Ogun and Osun States and to the South by Bright of Benin and Atlantic Ocean. The ethnic composition of Ondo State is largely from the Yoruba sub-groups of Akoko, Akure, Ikare, Ilaje, Ondo and Owo. The Ijaws (minority populations) inhabit the coastal areas. The choice of the study area was born out of its prominence in cocoa production. About 60% of the nation's cocoa output is produced in Ondo State (IITA, 2007).

Sampling Technique

The study employed a multistage sampling technique for the selection of its respondents. The first stage involved a purposive selection of four notable cocoa-producing Local Government Areas (LGAs) out of a total of fifteen coco- producing LGAs in the state (Ile oluji, Akure South, Ondo East and Idanre. The second stage involved the random selection of five villages/communities from each of the selected LGAs while the third stage involved the random selection of ten respondents from the selected communities to make a total sample of 200 respondents.

Method of Data Analysis

The data collected for the study were subjected to descriptive and inferential analysis.

Descriptive statistics such as frequencies, percentages were used to examine the socio-economic characteristics and strategies for coping with poverty among the respondents. They were also used to identify the improved technologies adopted and their levels of adoption.

Instrumental Variable Method

The instrumental variable (IV) method identifies variables which correlate with the treatment decision but do not correlate with unobserved characteristics of outcomes. These variables can be used as instruments for the endogenous treatment variable. The IV based methods assume the existence of at least one variable *z* called *instrument* that explains treatment status but is redundant in explaining the outcomes. When used with panel data it can control for time-varying selection bias (Hien, 2013). The instrumental variable approach relies on econometric methods to separate the effects of belonging to a group (through targeting or choice) from those of other factors that influence impact. Identifying valid instrumental variables is the major challenge associated with this method. In this case, valid instrumental variables are those that determine whether or not a farmer uses improved technologies in cocoa production, but only influence outcome variables through use.

An important factor in impact measurement is the problem of endogenous explanatory variables. Variables that are endogenous to adoption may influence welfare status, but be unobserved by the econometrician, and thus be correlated with the error term in the regression and cause bias. One of the common approaches to address these problems is the use of instrumental variables (IV) regression or two stage least squares (2SLS) estimation. In order to investigate the effects of improved cocoa technology adoption on welfare status of farmers, an instrumental variable in a two-stage least squares regression was done. This is to isolate the impact of technology adoption from other intervening factors. The establishment of a counterfactual outcome is required, as is the ability to overcome selection bias. (Adeniyi, 2014; Asfaw,*et al.*, 2013)

It is estimated as:

$$Y_{ij} = \alpha + \gamma G_{ij} + \lambda V_{ij} + \varepsilon_{ij} \quad (1)$$

$$G_{ij} = \lambda V_{ij} + u_{ij} \quad (2)$$

Where;

Where $j = 1, \ldots e$ denotes the technology choices available, Y_{ij} represent outcome variables (income and poverty), V_{ij} is a vector of exogenous variables thought to influence adoption of improved technologies, ε_{ij} is random disturbances associated with the impact model. The effect of adoption on the outcome variable is measured by the estimates of the parameter γ in a two-stage simultaneous procedure.

$Y_{ij} =$ outcome variables(Farm Income and poverty)

V_{ij} is the vector of explanatory variables expected to influence Y_{i}

$\gamma =$ a vector representing the marginal effects of each component

G_{ij}= is the predicted values of G_j from Logit Regression Model in the second stage OLS regression.

V_{ij} is the vector of explanatory variables $(X_1, X_2, \ldots X_{\text{i}})$

The Logit regression model is stated below:

$$G_j = \beta_0 + \beta_1 AGE + \beta_2 FSIZE + \beta_3 FEXP + \beta_4 HHSIZE + \beta_5 YIELD + \beta_6 EDU + \beta_7 MBERASS + \beta_8 ASCRED + \beta_9 LAND + u_{ij}$$

X_1 is farmer's age (years)
X_2 is Cultivated land area/ Farm size (hectares)
X_3 IS years of farming experience (years)
X_4 is household size (numbers)
X_5 is yield (ha)
X_6 is level of education (years)
X_7 is membership of association (dummy variable 0= non –member, 1=member)
X_8 is access to credit
X_9 is the land tenure system (Dummy variable 1= own land, 0= otherwise)

ε_i= is the random error term

The empirical model for farm income (FINCOME) is stated thus:
FINCOME =

$$\Psi_0 + \Psi_1 AGE + \Psi_2 FSIZE + \Psi_3 FEXP + \Psi_4 HHSIZE + \Psi_5 EDU + \Psi_6 G_{ij} + \Psi_7 IMPSEED + \Psi_8 PEST + \Psi_9 FERT + \varepsilon_{ij}$$

X_1 is farmer's age (years)
X_2 is Cultivated land area/ Farm size(hectares)
X_3 IS years of farming experience (years)
X_4 is household size (numbers)
X_5 is level of education (years)
X_7 is improved seedlings (dummy variable 0= non-adopters, 1=adopters)
X_8 is pesticides (dummy variable 0= non-adopters, 1=adopters)
X_9 is the fertilizer (dummy variable 0= non-adopters, 1=adopters)

ε_i= is the random error term

The empirical model for poverty (Pov) is stated thus:

$$\text{Pov} = \alpha_0 + \alpha_1 AGE + \alpha_2 HHSIZE + \alpha_3 EDU + \alpha_4 FEXP + \alpha_5 G_{ij} + \alpha_6 HHASSET + \varepsilon_{ij}$$

X_1 is farmer's age (years)
X_2 is household size (numbers)
X_3 is level of education (years)
X_4 IS years of farming experience (years)

G_{ij}= is the predicted values of G_j from Logit Regression Model in the second stage OLS regression.

X_6 is Total Asset (Naira)

ε_i= is the random error term

Foster-Greer-thorbecke (FGT) Model
The Foster-Greer-thorbecke (FGT) model was used in analyzing poverty status of the rural farming households. FGT poverty index was used to measure poverty status among the rural cocoa farmers. The FGT poverty index is given by:

$$P_\alpha = \frac{1}{n} \sum_{i=1}^{q} \left[\frac{Z-y}{Z}\right]^\alpha \qquad (3)$$

Where,
n = total number of households in the population
Z = the poverty line for the households defined as 2/3 of Mean annual per capita income
y = the household income
q = the number of poor households in the population of size n,
α = the degree of poverty aversion and takes on value 0,1,2

$\left[\frac{Z-y}{Z}\right]$ = proportion of shortfall in income below the poverty line.

Determining the poverty index:
When α =0; is the Headcount index (P0) measuring the incidence of
poverty (proportion of the total population of a given group that is poor, based on poverty line).

$$P_0 \left(\frac{1}{n}\right) q = \left(\frac{1}{n}\right) \quad (4)$$

When α =1; is the poverty gap index measuring the depth of poverty, that is on average how far the poor is from the poverty line;

$$P_1 = \frac{1}{n} \sum_{i=1}^{q} \left[\frac{Z-y}{Z}\right] \quad (5)$$

When α =2; is the squared poverty gap measuring the severity of poverty among households, that is the depth of poverty and inequality among the poor.

$$P_2 = \frac{1}{n} \sum_{i=1}^{q} \left[\frac{Z-y}{Z}\right]^2 \quad (6)$$

The poverty line

This is a pre-determined and well-defined standard of income or value of consumption. This was done to categorize the respondents into poor and non-poor groups. In the study, the line was based on the income of the households. Two –thirds of the mean per capita income was used as the poverty line (benchmark) which was adopted from the studies carried out by Reuben *et al* 2001, Yunez-Naude and Taylor 2001, Adewumi *et al* 2011.

The mean per capita household income (MPCI) is obtained by dividing the total of all individual household per capita income by the number of households surveyed.

$$\text{Per capita income (PCI)} = \frac{\text{Income}}{\text{Household size}} \quad (10)$$

$$\text{Mean per capita household income (MPCHI)} = \frac{\text{Total per capital income}}{\text{Total number of Households}} \quad (11)$$

$$\text{Poverty line (PL)} = \tfrac{2}{3} \times \text{MPCHI} \quad (12)$$

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

The summary statistics of the socio-economic characteristics of the farmers is presented in table 1. The major findings from the study showed that the mean difference between adopters and non-adopters was two years; most of the non-adopters were older. Male farmers dominated cocoa production in the study area. It was observed that most farmers were married (90.5%). Adopters had a mean household size of 6.08, lower as compared to that of non-adopters (6.37).

The mean farm size in the study area was 2.50ha and 2.12ha for the adopters and non-adopters respectively. Moreover, adopters had larger hectares of farm-land compared to non-adopters. About 63.5% of the respondents belong to cooperative societies and the majority of them were adopters.

Table 1: Socio-Economic Characteristics of Respondents

Variables	Adopters		Non Adopters		Pooled	
Age	Freq	%	Freq	%	Freq	%
< 40.00	9	7.4	9	11.5	18	9.0
41.00 - 50.00	32	26.4	14	11.5	46	23.0
51.00 - 60.00	57	47.2	28	38.5	85	42.5
61.00 - 70.00	18	14.9	21	25.0	39	19.5
71.00+	5	4.1	7	13.5	12	6.0
Gender						
Male	102	84.3	63	79.7	165	82.5
Female	19	15.7	16	20.3	35	17.5
Household size						
≤ 5	47	38.8	29	36.7	76	38.0
6 - 10	72	59.5	48	60.8	120	60.0
>10	2	1.7	2	2.5	4	2.0
Cooperative Society						
No	0	0	73	92.4	73	36.5
Yes	121	100	6	7.60	127	63.5
Years of Farming Experience						
< 10.00	11	9.0	9	11.4	20	10.0
11.00 - 20.00	74	61.2	38	48.1	112	56.0
21.00 - 30.00	23	19.0	15	19.0	38	19.0
31.00 - 40.00	10	8.3	15	19.0	25	12.5
41.00+	3	2.5	2	2.5	5	2.5
Farm Size(Hectare)						
< 2.00	79	65.3	56	70.8	135	67.5
2.01 - 4.00	32	26.4	19	24.1	51	25.5
4.01 - 6.00	6	5.0	4	5.1	10	5.0
6.01+	4	3.3	0	0	4	2.0

Source: Field Survey, 2017

Identification of Improved Cocoa Technologies and Levels of Adoption

Adoption of Improved Technologies

Table 2 shows the distribution of respondents by the technologies adopted in the study area. About 24% of the respondents adopted improved seedlings, 60.5% adopted pesticides which include insecticides and fungicides which could be as a result of an infestation of their cocoa farms with pests and diseases and 42% of them adopted fertilizers.

Table 2: Distribution of Respondents by Technologies Adopted

Technologies	Frequency	Percent
Improved seedlings	48	24.0
Pesticides	121	60.5
Fertilizers	84	42.0

Source: Field Survey, 2017

Levels of Adoption

The results of the cocoa farmers in the study area based on their levels of adoption of the improved technologies are presented in Table 3 which shows different categories of respondents into levels of adoption in the study area. The percentage of the adopters of improved technologies is about 60.5% while those categorized as non-adopters were 39.5%. The adopters are more in the study area as a result of their prominence in cocoa production.

Table 3: Distribution of Respondents by Levels of Adoption

Category	Frequency	Percent
Adopters	121	60.5
Non adopters	79	39.5
Total	**200**	**100**

Source: Field Survey, 2017

Effects of Improved Cocoa Technologies on Income

In the study area, education, membership of farmers' association, farm size, influenced adoption decisions of improved technologies significantly and positively. All the three factors mentioned above as determinants of adoption were significantly different among adopters and non-adopters. The parameter estimates of the regression model for the determinants of farm income showed that household size, farm size and yield were positive and statistically significant at 1%. The parameter estimates of the regression model for the determinants of poverty showed that household size was positive and statistically significant at 1%; while education, years of experience were negative and statistically significant. Age and total asset were negative and statistically insignificant. The predicted values generated from the first stage regression analysis result were included as an explanatory variable in the second stage regression in order to control for endogeneity. It was observed that the predicted values were statistically significant at 1%. This implies that the use of improved cocoa technologies by the farmers results in increase in their farm income.

Table 4: Econometric Results from Second-Stage Regression of the Determinants of Farm Income

Variable	Coefficient	Standard error	T-ratio	P-value	Mean of X
Constant	62981.07	29318.7	2.148	0.033	
AGE	295.614	657.5452	0.45	0.6535	55
HHSIZE	6420.876	2851.608	2.252	0.0255	6.195
EDU	-1906.47	980.7626	-1.944	0.0534	6.74
FARMSIZE	7658.711	3174.893	2.412	0.0168	2.35
YRSEXP	-794.798	729.0301	-1.09	0.277	21.355

PREDICTE	62169.85	13570.1	4.581	0.0000	0.645
IMPSEED	39119.75	10854.95	3.604	0.0004	0.24
PESTICID	16607.56	14375.36	1.155	0.2494	0.605
R-Squared		0.5933			
Adjusted R-Squared		0.5741			
F		30.80			
Degree of freedom		190			

Note: * = Significant at 1%, ** = Significant at 5%, * = Significant at 10%**

Source: Data Analysis, 2017

Effects of Improved Cocoa Technologies on Poverty

The parameter estimates of the regression model for the determinants of poverty through poverty gap are presented in Table 5. The estimates showed household size was positive and statistically significant; while education and years of experience were negative and statistically significant. Age and total asset were negative and statistically insignificant.

The coefficient of household size was positive and statistically significant at 1%. This implies that as household size increases, the poverty gap among the respondents also increases. However, age was negative and statistically insignificant implying that farmers that are older are poorer compared to farmers that are younger. The predicted values generated from the first stage regression analysis result were included as explanatory variable in the second stage regression in order to control for endogeneity. It was observed that the predicted values were negative and statistically significant at 10%. This implies that adoption of improved cocoa technologies by the farmers results in reduction in poverty gap among the cocoa farmers.

Table 5: Econometric Results from Second-Stage Regression of the Determinants of Poverty

Variable	Coefficient	Standard Error	T-ratio	P-value	Mean of X
Constant	0.131615	0.458986	0.287	0.7746	
AGE	-0.00345	0.0101	-0.341	0.7335	55
HHSIZE	0.118071***	0.0439	2.692	0.0077	6.195
EDU	-0.0577***	0.0152	-3.798	0.0002	6.74
YRSEXP	-0.0279**	0.0109	-2.555	0.0114	21.355
PREDICTE	-0.21369*	0.123683	-1.728	0.0856	0.645
TASSET	-0.000000702	0.000000956	-0.735	0.4634	73350.5
R-Squared		0.1501			
Adjusted R-Squared		0.1236			
F		5.68			
Degree of freedom		193			

Note: * = Significant at 1%, ** = Significant at 5%, * = Significant at 10%**

Source: Data Analysis, 2017

Incidence, Depth and Severity of Poverty

The proportion of adopters whose per capita income fell below the poverty line was 11.5% while that of non-adopters was 35.4%. The poverty gap index for adopter and non-adopters were 2.3% and 6.7%

respectively. In addition, the severity of poverty among adopters was 0.69% and 1.89% for non-adopters.

Table 6: Distribution of Sampled Respondents using Poverty indices

		Poverty indices	
	Headcount	**Depth**	**Severity**
Adopters	11.5	2.3	0.69
Non adopters	35.4	6.70	1.86
Whole sample	33.5	8.37	2.89

Source: Data Analysis, 2017

In conclusion, the use of improved technologies in cocoa production had a positive influence on the income of adopters by increasing their farm income. It also contributed to poverty reduction among adopters, increased the standard of living and well-being of the adopters. It is therefore recommended that cocoa farmers in the study area should be provided with timely subsidized inputs such as improved seedlings, fertilizers, herbicides, insecticides and farm implements so as to boost their production activities and hence minimize discontinuation of adoption. There is also need for more awareness and sensitization programmes on use of improved technologies so that more farmers will be aware and adopt these improved technologies.

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