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Effect of Adoption of Cocoa Technologies among Participants and Non-Participants of Farmers Field School in Abia State, Nigeria

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ABSTRACT
This study analyzed effect of adoption of technologies on the output of cocoa farmers in Abia State, Nigeria. Purposive and multi-stage random sampling procedures were used to select three hundred and sixty (360) respondents (180 FFS cocoa farmers and 180 non-FFS cocoa farmers). Data were collected with a structured questionnaire and analyzed using descriptive statistics, simple regression and Z-test analyses. The result indicates that FFS farmers had high adoption ($\bar{X}$=3.8) of cocoa production technologies. The estimates of the allocative efficiency of resource used by participants and non-participant cocoa farmers showed that the participant's farmers were more resource efficient in the utilization of planting materials, fertilizer, agrochemicals and labour usage more than their non-participant counterparts and high cocoa output (23706kg) as against non-FFS cocoa farmers (15199kg). Simple regression result revealed that adoption of Farmers Field School cocoa production technologies influenced the output of cocoa at 1.0% level of probability in the study area. Z-test results showed a significant difference in cocoa output among FFS cocoa farmers and non-cocoa farmers at 5.0% levels of probability. The study therefore recommends increased extension contact by the programme facilitators and timely supply of farm inputs for higher cocoa output.

Keywords: Effect, adoption, Farmer Field School, output, cocoa farmers

INTRODUCTION

African countries accounted for about 68 percent of world cocoa production sold and consumed in the global market. The decline in cocoa production in recent years is attributed to many factors such as problem of pests and diseases attacks, improper primary processing which include fermentation and drying (Chocolate Tasting Guide, 2013). These problems become more worrisome to meet the demand of the commodity because of low production capacity of 250, 000 metric tonnes annually from cocoa beans in Nigeria. Furthermore, it was projected, that the demand for dried cocoa from Nigeria will continue to rise to 4.5 million metric tonnes by 2020 (David *et al*., 2008). In Nigeria the constraining factor to poor quality of cocoa beans are as a result of pest and disease infestations and improper fermentation practices which accounted to about 25-30% losses in yield due to mirids (*Sahlbergella singularis*) infestation, 17% because of borer (*Charalomastrictigrapha*) and black pod disease caused by *Phytophthora megakarya* (30-90%) (Herbwisdom, 2015). However, with an increase in efficiency, Nigeria can boost its comparative advantage in cocoa production and

export marketing. Improved efficiency may lead to increase the productivity in order for cocoa farmers to meet domestic and international demands from other West African countries (Effendy *et al.,* 2019; Shahandeh, 2020). The measurement of farm efficiency in performance of factors as they interplay in agricultural production is very important to researchers as well as farmers. This is because resources are scarce and in some cases, very expensive for farmers to purchase. Factors of production are said to be productive, if such factor is efficient both in physical and technical terms (Nkang, 2009; Ofuoku and Ebewore, 2012). Agrochemicals and labour as factors of production in cocoa business are very scarce. Therefore, it is expedient for both the cocoa farmers and the researchers to know whether the cocoa output justify the resources expended on it. Studies have shown that the main problem identified by cocoa farmers was low yield, which was attributed to several factors (Oguntande, 2017; Chirwa, 2007).

Due to the reduction in quality of Nigeria's cocoa beans in the world market, in 2001, Sustainable Tree Crop Programme (STCP) of International Institute of Tropical Agriculture (IITA) commenced the implementation of a Farmer Field School (FFS) in selected cocoa producing communities on a pilot basis. The purpose is the transfer of the required good agricultural practices needed for improved cocoa production to farmers through the farmer field schools. A FFS consists of a group of farmers (usually 30) with a common interest who get together regularly to study the "how and why" of a particular aspect of agricultural production. Many of these extension approaches failed to meet their goals effectively which led to continuous modification and experimentation (STCP, 2006). However, cocoa farmers' output in Abia State has suffered serious setback over the years, due to poor operational activities as nursery establishment, rational pesticide use, lack of best agricultural practices, cocoa tree pruning, harvesting, fermentation, drying process, access to credit and cocoa farm input, among others. However, the Farmer Field School was the step taken to ameliorate these setbacks in cocoa production in Abia State and other cocoa producing States of the nation (Abia State Cocoa National Day Bulletin 2009; Abia State Ministry of Agriculture, 2013; Nwaobiala, 2013).

Since the inception of the programme, it is not yet certain whether the inputs used and cocoa output among participating farmers have increased. Based on these assertions, the study was undertaken to determine the effect of adoption of cocoa technologies among participants and non-participants of Farmers Field School in Abia State, Nigeria.

The specific objectives were to:

i. ascertain levels of adoption of cocoa production technologies among Farmer Field School (FFS) farmers
ii. estimate cocoa output of Farmer Field School (FFS) cocoa farmers and non-farmers; and
iii. estimate the allocative efficiency of Farmer Field School (FFS) cocoa Farmers and non-farmers

Hypotheses of the study

Adoption of Farmer Field School (FFS) cocoa production technologies do not have significant effect on farmers' output

There is no significant difference between n cocoa output of Farmer Field School (FFS) farmers and non-farmers

METHODOLOGY

Study Area

The study was conducted in Abia State. Abia State is located in the South-East agro-ecological zone of Nigeria. Abia State is made up of 17 Local Government Areas and three agricultural zones namely, Aba zone, Ohafia zone and Umuahia zone. The six major cocoa belts in Abia State are Ikwuano, Bende, Ohafia, Arochukwu and Umuahia North and Umuahia South Local Government Area respectively (Abia State National Cocoa Day Bulletin, 2009).

Purposive and multi-Stage random procedure was adopted in the study. First, six (6) Local Government Areas (LGAs) were purposively chosen (Ikwuano, Bende, Umuahia North, Umuahia South, Ohafia, and Arochukwu) because they were the major cocoa producing area of the State that paryicipated in the programme. Second, 2 (two) participating autonomous communities were selected using simple random method, from each of the selected LGAs that gave a total of twelve 12 autonomous communities. From the selected communities, 15 (fifteen) cocoa farmers were randomly selected which gave a sample size of 180 participants. Also, 180 non-participants of the programme were randomly selected from the cocoa producing areas were the participating cocoa farmers to give a grand sample size 360 cocoa farmers. The objectives were realized with descriptive statistics such as frequency counts mean scores and percentages, while the hypothesis was tested using Z-test analyses.

Measurement of Variables

i. In estimating the efficiency of farmers, marginal value product (MVP), allocative efficiency (E = MVP/PX), % deviation from optimality (1 – E) 100 were realized using the farmers unit cost of input in cocoa farming activities. The FFS participating cocoa and non-farmers gave profile of their input use, and cost. The marginal value product < or > I indicates inefficiency, while MVP = 1 indicates efficiency of resource allocative use.
ii. To ascertain the levels of adoption, seven (7) cocoa production technologies were listed out and each respondent was asked to indicate the stage he/she was on, in the adoption scale. The 5 – steps; (aware (1), interest (2), evaluation (3), trial (4) and adoption (5) adoption model were used. A midpoint was obtained by adding up the adoption stages to derive the total adoption score and dividing it by number of adoption stages. Mean score of 3.0 and above is adoption and otherwise non-adoption.

Model Specifications

i. The effect of Farmer Field School cocoa production technologies beneficiary farmers' output was tested using simple regression analysis. The model is expressed thus:

$$Y = bo + b_iX_iei \quad (1)$$

Where,
Y = cocoa output (kg/ha)
X = adoption of FFS cocoa production technologies (mean score)
b_o= regression constant
ei = error term

ii. The mean difference in the cocoa output of Farmer Field School (FFS) cocoa farmers and non-farmers was tested using Z-test analysis

The model for Z-test analysis of comparison is specified thus:

$$Z = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$n_1 + n_2 - 2$ degrees of freedom (2)

Where,
Z = Z Statistic
$\overline{X}_1$ = sample mean of cocoa output of Farmer Field School (FFS) cocoa farmers
$\overline{X}_2$ = sample mean of cocoa output of Farmer Field School (FFS) cocoa farmers and non-farmers
σ^2_1 = standard deviation of Farmer Field School (FFS) cocoa farmers and non-farmers
σ^2_2 = standard deviation of non- Farmer Field School (FFS) cocoa farmers
n_1 = sample size for Farmer Field School (FFS) cocoa farmers and non-farmers
n_2= sample size for non- Farmer Field School (FFS) cocoa farmers

RESULTS AND DISCUSSION

Levels of adoption of cocoa production technologies

Result in Figure 1 shows level of adoption of cocoa production technologies in the study area. The result reveals that the farmers adopted all the cocoa production technologies disseminated by the programme facilitators with mean score of 3.8. The result suggests that cocoa farmers in the study area were keen to improve their cocoa production as it the major cash crop in Nigeria with a lot of economic benefits. Yunana *et al.,* (2013) reported that training of farmers on the improved production technologies helps to address constraints to production among farmers. The result corroborates with the findings of Nwaobiala (2014) as he found that participation of cocoa farmers in Farmer Field School programme enhances their adoption of available production technologies practiced.

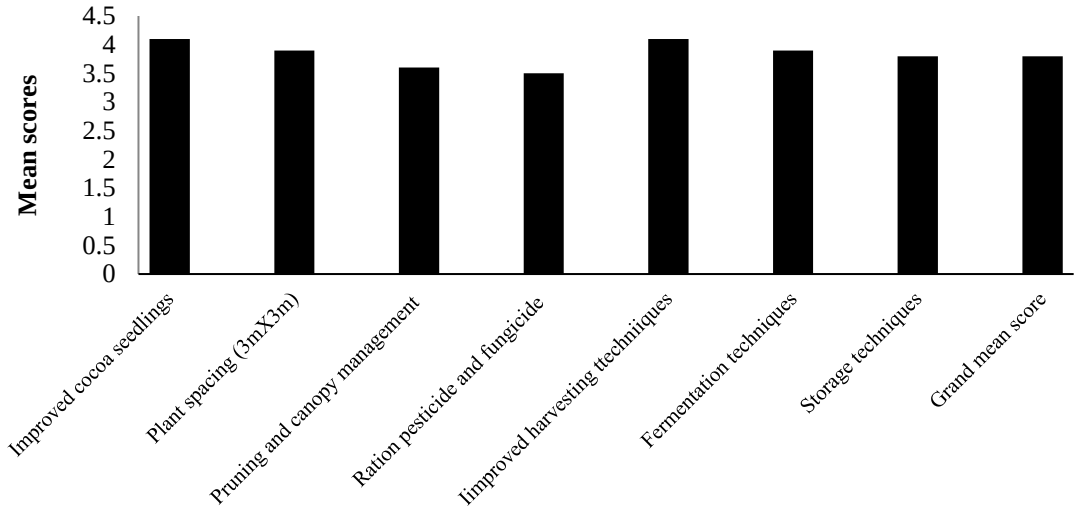


Figure 1: Level of adoption of cocoa production technologies

Estimates of cocoa output of Farmer Field School (FFS) cocoa Farmers and non-farmers

The result in Figure 2 showed the estimates of the cocoa output of Farmer Field School (FFS) cocoa Farmers and non-farmers. The result showed that the mean output of FFS cocoa farmers was 23706kg, while non-participant farmers were 15199kg. This result implied that FFS farmers recorded high cocoa output than the non-FFS counterparts in the study area. This can be attributed to effect of FFS training on the participant farmers as they seem to be more technically and managerially competent compared to the non-FFS farmers because of the adoption of these technologies in the programme. Ajayi and Okafor (2006) observed that FFS takes the lead among all participatory extension approaches in that it incorporates all the features of participatory extension approach that promotes increased output and poverty reduction. This result is in tandem with Ebowore (2013), Orimogunje *et al*., (2019 as they found that participation in FFFS by cocoa farmers has enhanced their output through adoption of the cocoa production technologies.

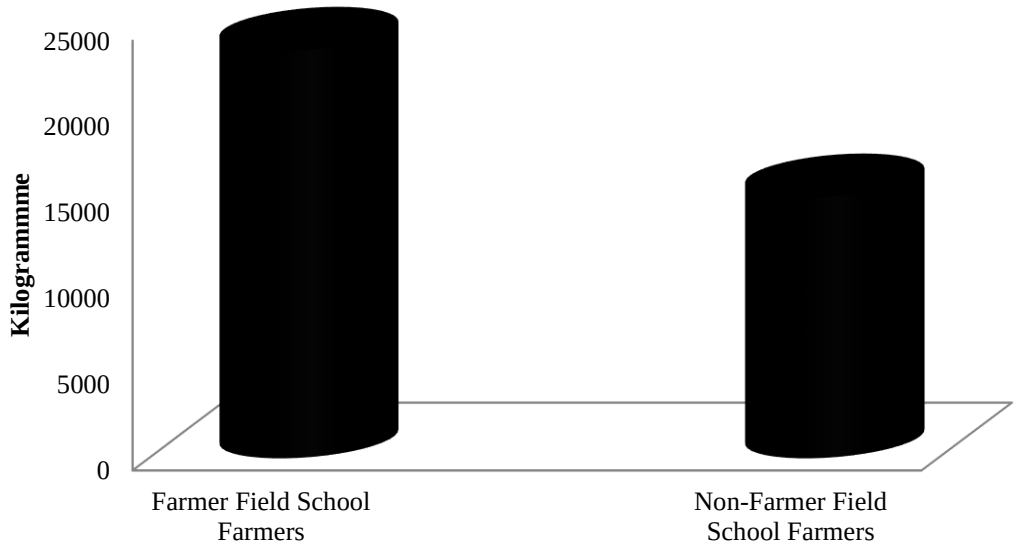


Figure 2: Estimates of mean cocoa output of farmers

Estimates of the allocative efficiency of Farmer Field School (FFS) cocoa Farmers and non-farmers

The result in Tables 1 shows the estimates of the allocative efficiency of resource used by FFS faarmerrs and non-FFS cocoa farmers in the study area. The ratio of the marginal value product were all less than one (<1) in all cases indicating that resources such as planting materials, fertilizer, agrochemicals and labour use were excessively utilized by participants and non-participant cocoa farmers in the study area.

For participant FFS farmers, planting materials, fertilizer, agrochemicals and labour were over utilized and inefficient with percentage deviation from optimality of 91.2%, 82.0%, 94.2% and 92.9% respectively. This implies that use of planting material has to be reduced by 91.2%, fertilizer by 82.0%, agrochemical by 94.2% and labour by 92.9% to achieve optimality.

For non-participants, planting material and labour were underutilized and inefficient with percentage deviation from optimality of 199.1% and 307.9% respectively. Hence the use of planting material and labour should be increased by 199.1% and 307.9% respectively to ensure efficiency of resource used. From Table 1 also, fertilizer and agrochemical resources were over utilized and inefficient with percentage deviation from optimality of 76.1% and 94.9% respectively. Hence the use of fertilizer and agrochemical by non-participant farmers has to be reduced by 76.1% and 94.9% respectively to ensure resource use and technical efficiency.

Comparatively, the FFS participating farmers were more resource efficient in the utilization of these resources more than their non-participant counterparts. This can be attributed to participation in Farmer Field School training of the participants. However, one way of increasing production by the small-scale farmers is to efficiently use all the resources available in the production process. Buran *et al*., (2008) indicated that the most productive and efficiently used inputs are labour, seeds and farm equipment due to participation in Farmer Field School training programme. Farmer Field Schools had shared knowledge of effective utilization of farm inputs, to achieve efficiency in cocoa production among cocoa farms participants in the extension programme in cocoa belts of Nigeria.

Table1: Estimates of Allocative Efficiency of FFS cocoa farmers in the study area

Inputs	$\bar{x}$	$\bar{Y}$	Unit cost of input	MVP	Standardized coefficients	Allocative efficiency $E = MVP/P_X$	% Deviation from optimality (1-E)100
FFS cocoa farmers							
Cocoa seedlings	16045.7	23753.9	1.06	0.083	0.085	0.0880	91.2%
Fertilizer cost	423501.6	23753.9	1.06	0.191	0.204	0.1801	81.99%
Agrochemical	13094.4	23753.9	1.06	0.062	0.071	0.0585	94.2%
Labour	15.7	23753.9	1.06	0.075	0.078	0.0708	92.9%
Non-FFS cocoa farmers							
Planting materials	13128.1	15168	1.06	-0.202	-0.066	-0.19057	199.1%
Fertilizer cost	20346.4	15168	1.06	0.253	0.100	0.2387	76.1%
Agrochemical	9421.4	15168	1.06	0.054	0.022	0.0509	94.9%
Labour	13.6	15168	1.06	-2.204	-0.294	-2.0792	307.9%

Source: Field survey, 2018. MVP < or > 1 indicates inefficiency, MVP = 1, indicates efficiency of resource use

Regression estimates of the effect of adoption of Farmer Field School cocoa production technologies on participating farmers' output

The result on Table 2 showed the regression estimates of the effect of adoption of Farmer Field School cocoa production technologies on participating farmers 'output in the study area. The R-square value was 0.815 indicating that about 81.5% of the variation in the dependent (adoption in FFS cocoa production technologies) was accounted for, while the remaining was due to error. The F-test was statistical significant at 1.0% indicating that the model used was fit for the analysis. The coefficient of adoption of Farmer Field School cocoa production technologies was positive and statistically significant at 1.0% level of probability. The result implied that a unit increase in adoption of Farmers Field School cocoa production technologies will lead to a corresponding increase in the output of cocoa farmers in the study area. Abdullahi, Ikani and Ahmed, (2018) affirmed that participation of farmers in donor agencies sponsored programmes has been proven to increase farm output due to yielding enhancing technologies disseminated by facilitators.

Table 2: Simple linear regression estimates of effect adoption of Farmer Field School cocoa production technologies on farmers' output in the study area

Parameters	Coefficient	Standard error	t-value
Constant	889.821	0.540	9.953***
Participation	0.137	0.048	2.952***
R-square	0.815		
R-adjusted	0.799		
F-ratio	8.679***		

Source: Computed from Field Survey, Data 2018. ***p≤ 0.01

Differences in cocoa output among Field School (FFS) cocoa farmers and non-farmers

The Z- test comparative analysis of the difference in the cocoa output of participants and non-participant farmers in the study area is shown on Table 3. The result of the output of participant and non- participant farmers showed that the mean output of participant farmers was 23706kg, while the non-participant farmer was 15199kg. The standard deviation for the participants and non-participant farmers were 25606.1 kg and 182.0kg respectively. The result shows that the calculated 'Z' was 3.785, which is greater than the 'Z' tabulated of 1.960 and was highly significant at 1% level of probability. This result implied that participant farmers recorded more cocoa yield than their non-participant counterparts in the study area. The can be attributed to effect of FFS training on the participant farmers as they seem to be more technically and managerially competent compared to the non-participant farmers in the study area. This result is in consistent with the findings of

Nwaobiala, (2017), Nwaobiala and Mbah, (2016) as they reported that IFAD framers had relatively higher output more than the non-IFAD farmers in Abia and Cross River States Nigeria.

Table 3: Z-test analysis of the difference in the output of Field School (FFS) cocoa Farmers and non-farmers

Farmers Output (kg)	Mean	Standard Deviation	Df	Z- cal	Z-tab
FFS cocoa famers	23706	256.1			
Non-FFS cocoa famers	15199	182.0			
Differences	8507.5	74.14	358	3.78***	1.96

Source: Computed from Field Survey, Data 2018. ***p≤ 0.01

CONCLUSIONAND RECOMMENDATIONS

The study has revealed that FFS cocoa farmers had high adoption of cocoa production technologies, realized higher cocoa output and were more resource efficient in the use farm inputs than their non-participant farmers. Simple regression result revealed that a unit increase in adoption of Farmers Field School cocoa production technologies lead to a corresponding increase in the output of cocoa farmers in the study area. Z-test results showed a significant difference in cocoa output among the FFS cocoa farmers and non-farmers.

The study therefore recommends that;

i. Increased extension contacts by the programme facilitators in order for the beneficiaries to enhance cocoa output.
ii. Timely supply of farm inputs such as fertilizers, agrochemicals, improved cocoa seedlings among others to beneficiary farmers, considering the time-bound nature of farming

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