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IMPACT OF A GROWTH ENHANCEMENT SUPPORT SCHEME ON COCOA YIELD AND INCOME OF COCOA FARMERS IN OSUN STATE, NIGERIA

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ABSTRACT

Background. In an attempt to improve the yield of cocoa and farmers income, the Federal government of Nigeria in 2012 introduced the Cocoa Growth Enhancement Support (GES) scheme that subsidized farm inputs to farmers. This article examines the effects of the scheme on cocoa yield and the income of cocoa farmers in Osun State.

Material and methods. A multistage sampling procedure was used to obtain data from 208 cocoa farmers of whom there were 100 participants and 108 non-participants of the scheme. Data collected were analyzed using descriptive statistics, the binary logit regression model and the Propensity Score Matching (PSM) model.

Results. Descriptive statistics revealed no mean difference between some socioeconomic characteristics among the categories of farmers in the study area such as household size, farming experience, age and education. The results further revealed that participation in previous government intervention programs, access to extension services and access to credit were significant determinants of participation in the GES scheme. Participation in the GES scheme increased cocoa yield and income of cocoa farmers by 42.30 kg·ha^{-1} and 24553.99 ₦·ha^{-1} (59.71 €·ha^{-1}), respectively.

Conclusion. This suggests that a subsidy on farm inputs could increase cocoa yield and the income of cocoa farmers.

Key words: cocoa yield, income, participation, PSM

INTRODUCTION

Cocoa has consistently earned more foreign exchange than any other Nigerian agricultural export commodity (Akinbola, 2001; Dongo *et al*., 2009). In 2015 cocoa accounted for 21% of Nigeria's agricultural exports and generated US$ 711 million (CBN, 2015). Cocoa also supplies raw materials for local industries (Folayan *et al*., 2006) and offers a ready market for industrial products (Ayanwale, 2002). Additionally, it is of significant socioeconomic importance in Nigeria as over 200,000 rural households depend on cocoa as the main source of their income (NCDC, 2008; Agbongiarhuoyi *et al*., 2013). However, cocoa yield in Nigeria has diminished in recent years and this has similarly reduced the income of farmers (*Nkang et al*., 2009). The reduced yield has been partly attributed to suboptimal use of fertilizers and other inputs for cocoa production (Idowu *et al*., 2007). The Federal Ministry of Agriculture and Rural Development noted that fertilizer application among cocoa farmers is estimated at 10–15 kg·ha^{-1}, which is far less than the 200 kg·ha^{-1} endorsed by the Food and Agriculture Organization (FAO).

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The Federal Government of Nigeria, with a view to addressing this situation, implemented a number of strategies. Among the strategies was the introduction of the Agricultural Transformation Agenda (ATA) in 2012. ATA was aimed at increasing productivity through improving farmers access to subsidized farm inputs (FMARD, 2011). The ATA plan included some selected agricultural commodities such as rice, cassava, sorghum, cocoa, cotton, maize, dairy, beef, leather, poultry, oil palm and fisheries (FMARD, 2011). The GES scheme is one of four important components of the Agricultural Transformation Agenda (ATA) and is focused on the reduction of government involvement in the procurement and distribution of fertilizers and other farm inputs. It required farmers to register to participate and possess a mobile phone through which the voucher to redeem their subsidized farm inputs at a designated redemption centre is sent (Adesina, 2013). The first phase of the GES scheme was implemented in six States (Osun, Ekiti, Oyo, Ondo, Ogun and Rivers). In 2012, 65,272 farmers out of the estimated total of 250,000 cocoa farmers registered for the GES scheme. About 20% of those 65,272 registered farmers were from Osun State.

The GES scheme was to provide each registered cocoa farmer with 200 sachets of approved fungicides, 5 bags of NPK 20:10:10 fortified with 5 kg of Agrolyzer micronutrients fertilizer, and 50 sachets of insecticides all at a subsidy of 50% (₦ 44,000) as well as hybrid seeds at no cost. This was in order to try to increase the yield of cocoa per hectare from the current 350 kg·ha^{-1} to world standards of 600–650 kg·ha^{-1}, which if achieved would eventually translate into a rise in the family income of the beneficiaries. This was expected to have a catalytic effect on increasing the overall production from 250,000 Metric-tonnes in 2012 to 500,000 Metric-tonnes in 2015 and 1.0 million Metric-tonnes in 2018 (FMARD, 2011). Evidence is mounting in Nigeria that GES has a positive impact on the yield of different crops (Nwaobiala and Ubor, 2015; Ibrahim *et al.*, 2018; Adenegan *et al.*, 2018), but few studies have addressed this issue within the context of cocoa. Therefore, there is a need to assess the effect of the scheme on cocoa's yield and the income of cocoa farmers since cocoa is one of the targeted crops.

MATERIAL AND METHODS

Study Area

The study was carried out in Osun State. The State is geographically located in the Southwestern part of Nigeria and lies between Longitude 2.8^{o} E and 6.8^{o} E of the Greenwich Meridian and Latitude 7^{o} N and 9^{o} N of the equator (Sofoluwe *et al.*, 2011). It is bounded by Ogun State to the South, Kwara State to the North, Oyo State to the West and Ondo State to the East. The total population of the State is 3,416,959 people and it has a land mass of 9251 km^{2} (National Population Commission NPC, 2006). There are thirty (30) Local Government Areas (LGAs) in Osun State (NPC, 2006). The State has two distinct seasons, the rainy and the dry seasons. The rainy season occurs between April and October, while the dry season begins in November and last till March (Agboola, 1979). The mean annual rainfall ranges from 1125 mm in the derived savanna to 1475 mm in the rain forest belt. The mean annual temperature ranges from 27.2°C in the month of June to 39.0°C in December (Sofoluwe *et al.*, 2011). These conditions favor the growth of a variety of food and cash crops. Food crops grown in the area include maize (*Zea mays*), yam (*Dioscorea* spp.), cassava (*Manihot esculenta*), cocoyam (*Colocasia* spp.), rice (*Oryza sativa*) and leaf vegetable (*Amaranthus* spp.). The permanent crops include cocoa (*Theobroma cacao*), kolanut (*Cola nitida*) and oil palm (*Elaeis guinensis*). These crops are usually mixed or intercropped. From these crops, cocoa is the main export crop grown in Osun State and accounts for 22% of Nigeria cocoa production, thus occupying second position after Ondo State (NBS, 2010/2011).

Sampling procedure and sample size

Multistage sampling procedure was used to select respondents for the study. The first stage involved the purposive selection of Ife-ijesa zone from the three zones in the State based on the predominance of cocoa farmers in this zone. The second stage involved the purposive selection of four Local Government Areas (LGAs) out of the ten LGAs in the zone. The selected LGAs include Ife East, Ife North, Ife South, and Atakumosa West. This selection was based on the high number of cocoa farmers that participated in

GES in these LGAs. The third stage involved the stratification of cocoa farmers into two strata. The first stratum was composed of registered cocoa farmers that participated in the scheme and the second was composed of non-participants in the scheme. The communities selected from these LGAs included Ifetedo, Olode, Mefoworade, Oke owena and Amula (Ife South LGA); Famia, Akinlalu, Asipa, Oyere I and Oyere II (Ife North LGA); Yekemi, Okerewe, Oke-Ere, Erefe and Keredolu (Ife East LGA) and Agunja, Osu, Ifewara, Ilowo and Ayetoro (Atakumosa West LGA). In the fourth stage, 5 participants and 6 non-participants were randomly selected from each of the selected communities in these LGAs. This was due to the fact that the matching methods requires a greater number of non-participants than participants. A total of two hundred and twenty (220) questionnaires were administered. Two hundred and eight questionnaires (208) were found to be useful for the study.

Analytical technique

The data collected were analyzed using descriptive statistics, binary logit regression and the propensity score matching technique.

Descriptive statistics

Descriptive statistics such as mean and percentages were used to elucidate the socioeconomic characteristics of the respondents. The T-test was used to compare the mean difference of socio-economic and farm characteristics of participants and non-participants.

Binary Logit regression

The binary logit regression model was used to determine the factors that influenced farmers' participation in the GES scheme as well as an estimation of propensity scores.

The model is explicitly expressed as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \beta_{13}X_{13} + e \quad (1)$$

Where:
Y_i = probability of participating in the scheme,
X_1 = Age (years); X_2 = Sex (male = 1, female = 0); X_3 = Household size (number); X_4 = Marital status (married = 1, otherwise = 0); X_5 = Years of education; X_6 = Access to credit (yes = 1, no = 0); X_7 = Access to extension service (yes = 1, no = 0); X_8 = membership of association (yes = 1, no = 0); X_9 = primary occupation (farming = 1, otherwise = 0); X_{10} = farm size (Ha), X_{11} = participation in government intervention programs in the past (yes = 1, no = 0); X_{12} = land ownership (yes = 1, otherwise = 0); X_{13} = cocoa farming experience(years); ε_i = error term.

Propensity score matching technique

The propensity scores of participants and non--participants were matched using Nearest neighbour matching and Kernel matching based on common support. The average treatment effects on the treated population (ATT) were estimated:

$$ATT = E(\Delta Y \mid D = 1, X) \quad (2)$$

$$= E(Y_1 - Y_0 \mid D = 1, X) \quad (3)$$

$$= E(Y_1 \mid D = 1, X) - E(Y_0 \mid D = 1, X) \quad (4)$$

Where:
Y_0 = value of outcome when the respondents did not participate in the GES scheme; Y_1 = value of outcome when the respondents participated in the GES scheme; The outcome variables (Y) in this study are yield and income.
Therefore,
$E(Y_1 \mid d = 1, X)$ = mean outcome from participating in the program; $E(Y_1 - Y_0 \mid D = 1, X)$ is the mean of the counterfactual and denotes what the outcome would have been among cocoa farmers that participated had they not participated in the program.
Estimating the mean effect of the treatment through the mean difference in the outcome of the matched pairs is given as follows:

$$ATT = E[Y_1 \mid D = 1, P(X)] = E[Y_0 \mid D = 0, P(X)] \quad (5)$$

$$ATE = E[Y_1 \mid D = 1, P(X)] - E[Y_0 \mid D = 0, P(X)] \quad (6)$$

RESULTS AND DISCUSSION

Socioeconomic characteristics of sampled cocoa farmers

Table 1 presents the socioeconomic characteristics of the respondents. The majority of the participants (87%) and non-participants (83.33%) were males.

The average age for participants and non-participants were 55.65 years and 53.85 years, respectively. The T-test value showed no significant mean difference between the categories of farmers for age. The average household size for participants and non-participants were 6.01 members and 6.34 members, respectively. The T-test value showed no significant mean difference between the categories of farmers for household size. The average years of education for participants and non-participants were 8.11 and 7.54, respectively. The T-test value showed no significant mean difference between the categories of farmers for years of education. The average years of farming experience for participants and non-participants were 29.02 and 28.04 years, respectively. The T-test value showed no significant mean difference between the categories of farmers for years of farming experience. The average farm size for participants and non-participants were 2.39 and 2.88 hectares. The T-test value showed significant mean difference between the categories of farmers for farm size. The majority of the participants (94%) and non-participants (53.70%) had been visited by extension agents in the previous production season. About 81% of the participants and 50% of the non-participants were member of an association. Only a few (22.00%) of the participants and non-participants (19.44%) had access to credit. The primary occupation of the majority of the participants (81%) and non-participants (73.15%) was farming. The study further revealed that 63% of the participant and 6.48% of the non-participants had participated in past government intervention programs.

Table 1. Descriptive statistics of respondents' socioeconomic characteristics

Variables	Non-Participants	Participants	t-stat
Male, %	83.33	87.00	
Age, years	53.85	55.65	1.13
Household size	6.34	6.01	1.30
Education, years	7.54	8.11	0.89
Farming experience, years	28.04	29.02	0.58
Farm size, ha	2.88	2.39	1.79*
Access to extension services, %	53.70	94.00	
Membership of association, %	50.00	81.00	
Access to credit, %	19.44	22.00	
Primary occupation (Farming), %	73.15	81.00	
Previous Participation, %	6.48	63.00	

* significant at 10%

Factors influencing Respondent's Participation in the GES Scheme

The factors influencing farmers participation in the GES scheme in the study area were Pre-GES participation, access to extension visits and access to credit (Table 2). Participation in past Government intervention Programs positively influenced the participation of respondents in the GES scheme. It implies that farmers that had participated in past government intervention programs were more likely to participate in the GES scheme. A unit increase in participation in past government intervention programs increased the likelihood of farmers' participation in the GES scheme by 0.821 units. This result agrees with the findings of Adenegan *et al*. (2018). Farmers access to credit had a negative influence on participation in the GES scheme. This

implies that respondents with no access to credit facilities are more likely to participate in the GES scheme than those with access to credit. A unit increase in farmers' access to credit reduced participation in the GES scheme by 0.320 units. This suggests that having access to credit facilities encouraged cocoa farmers to purchase their inputs directly on the open market or from other sources rather than waiting on the government to supply the subsidized inputs. This result corroborates the findings of Adenegan *et al*. (2018). Access to extension services had a positive influence on respondents' participation in the GES scheme. This implies that the farmers with access to extension services were more likely to participate in the GES scheme than those without such access. A unit increase in farmers' access to extension services increased the likelihood of respondents' participation in the GES scheme by 0.473 units. This is in line with the findings of Kamdem (2016) and Ibrahim *et al.* (2018).

Table 2. Factors Influencing Respondent's Participation in the GES Scheme

Variables	Coefficient	Standard Error	P value	Marginal effect
Sex	0.780	0.152	0.200	0.195
Age	-0.001	0.022	0.995	-3.6e-5
Marital status	-1.015	0.633	0.109	-0.254
Household size	-0.108	0.107	0.310	-0.027
Education years	-0.019	0.047	0.687	-0.005
Farm size, ha	-0.102	0.112	0.361	-0.026
Cocoa farming experience	-0.003	0.020	0.857	-9.16e-4
Membership of association	-0.148	0.441	0.736	-0.037
Pre-GES participation	3.283***	0.617	0.000	0.821
Access to credit	-1.281**	0.599	0.032	-0.320
Extension visit	1.892***	0.528	0.000	0.473
Farming primary occupation	0.816	0.503	0.105	0.204
Land ownership	0.554	0.484	0.252	0.139
Constant	1.833**	1.611	0.045	
LR chi2 (13)	114.67			
Prob >chi2	0.0000			
Pseudo R^2	0.3981			
Log likelihood	-86.6839			

** significant at 5%, *** significant at 1%

Impact of participation in the GES scheme on yield and income

Matching Indicators Before and After Matching

The balancing test was done to ascertain whether the differences in the covariates of the participants and non-participants in the matched sample have been eliminated, so that the matched comparison group can be considered a reasonable counterfactual (Ali and Abdulai, 2010). Table 3 shows the result of the

covariate balancing test before and after matching. The mean bias of 60.08 was reduced to 12.4 and 10.3 in NNM and KBM, respectively. The Pseudo R^2 dropped significantly from 0.377 to 0.020 and 0.024 in NNM and KBM, respectively. The low Pseudo R^2, low-mean bias, and insignificant p-value of likelihood after matching suggested that the proposed specification of propensity score is fairly successful in terms of balancing the distribution of covariate between the two groups.

Table 3. Matching indicators before and after matching

Sample	Ps R^2	LR chi^2	$p > chi^2$	Mean Bias	% bias reduction
Unmatched	0.377	108.52	0.000	60.8	
PSM (NNM)	0.020	5.38	0.371	12.4	79.60
PSM (KBM)	0.024	6.45	0.265	10.3	83.06

Impact of GES scheme participation on cocoa yield

Table 4 reveals the results of participation in the GES scheme on cocoa yield. The result from the PSM (KBM) analysis revealed that the scheme exerts a positive impact on the yield of cocoa with an average treatment effect on treated (ATT) of 42.3 $kg \cdot ha^{-1}$. The NN match robustness result also revealed a similar result (ATT = 41.58 $kg \cdot ha^{-1}$) with that of the Kernel based matching.

Table 4. Impact of GES scheme participation on cocoa yield

Matching Algorithm	Unmatched $kg \cdot ha^{-1}$	ATT $kg \cdot ha^{-1}$	ATT t-stat	ATE $kg \cdot ha^{-1}$	Hidden bias (r)
PSM (KBM)	86.88	42.30	1.39	61.43	1.50
NN Match		41.58	1.49		

Rosenbaum sensitivity analysis for yield

Table 4 further shows the Rosenbaum sensitivity result that determined the level of critical hidden bias due to unobserved confounders. It measured the degree of departure if a study is free of hidden bias. Using the KBM Hodges-Lehmann point estimate, Γ for yield is 1.5 which implies that bias might be as high as 66.9485 or as low as 20.3577. It can be concluded that the findings were sensitive to possible hidden bias due to unobserved confounders and that the GES scheme had a positive treatment effect on cocoa yield.

Impact of GES scheme participation on income

The gross margin of cocoa farmers was used as a proxy for their income. Table 5 reveals the result of the impact of the GES scheme on the income of cocoa farmers. The result from the PSM (KBM) analysis revealed that the scheme exerted a positive impact on the income of respondents with an average treatment effect on treated (ATT) of 24553.99 ₦·ha^{-1}. An NN match was also carried out to ensure robustness of the result and it revealed an almost similar result (ATT = 20770.42 ₦·ha^{-1}) with that of the Kernel matching.

Table 5. The impact of GES scheme participation on income

Matching Algorithm	Unmatched ₦·ha^{-1}	ATT ₦·ha^{-1}	ATT t-stat	ATE ₦·ha^{-1}	Hidden bias (r)
PSM (KBM)	30774.30*	24553.99	1.45	7770.78	1.3
NN Match		20770.42	1.25		

* 1000 ₦ = 2.43 €

Rosenbaum sensitivity analysis for cocoa farmers income

Using the KBM Hodges-Lehmann point estimate, Γ for income is 1.3, which implies that bias might be as high as ₦ 29272.4 or as low as ₦ 17100.7. It can be concluded that the finding is sensitive to possible hidden bias due to unobserved confounders and the GES scheme had a positive treatment effect on the income of cocoa farmers.

Identified constraints faced by cocoa farmers in the GES scheme

The actual impact, though positive, was low compared with the expected impact on the yield of cocoa. This can be traced to the constraints identified by participants in the GES scheme (Table 6). About 65% of the participants had issues with their cellular network that made it impossible to track their inputs unless they travelled to urban centers. This led to spending additional time that could have been used to do other work on the farm. Also, 80% of the respondents complained that the package for cocoa farmers was incomplete. A cocoa farmer was supposed to have access to 200 sachets of approved fungicides (Ridomil, Champ DP or Funguran OH), 5 bags of NPK 20:10:10 fortified with 5kg of Agrolyzer micronutrients fertilizer and 50 sachets of insecticides all at a 50% subsidy, but were only able to access and redeem 1 or 2 bags of fertilizer in most cases. This was found to be true among the majority of the participating farmers. About 55% of the farmers also complained of not having enough money to redeem their voucher and of having to borrow or to go for the quantity that they could afford at the time when the input was brought to them. Many of them were of the opinion that such a scheme should be targeted at the harvesting period for cocoa, which is usually between October and January, so that they can then have enough money to redeem those inputs. If all of these constraints are taking care of then the GES scheme would result in a higher impact on cocoa yield and the income of cocoa farmers.

Table 6. Identified constraints faced by cocoa farmers in the GES scheme

Constraints	%
Cellular Network	65
Incomplete package	80
Wrong input delivery time	55

CONCLUSIONS

This study investigated the impact of participation in the GES scheme on the yield of cocoa and the income of cocoa farmers. The binary logit model was used to identify the determinants of participation of cocoa farmers in the GES scheme while Propensity score matching was used to determine the impact of participation in the GES scheme on cocoa yield and the income of cocoa farmers. The significant determinants of cocoa farmers participation in the GES scheme were access to extension services, access to credit and participation in previous government intervention programs. Propensity score matching revealed that cocoa yield and the income of cocoa farmers who participated in the scheme increased by 42.30 kg·ha^{-1} and 24553.99 ₦·ha^{-1}, respectively, as a result of participation in the scheme. Although the GES scheme had a positive impact on both cocoa yield and the income of cocoa farmers, the impact was not statistically significant.

This could be ascribed to constraints identified by farmers such as bad cellular networks in rural areas, incomplete packages and wrong input delivery time. Based on these findings, it is imperative that policies that are aimed at improving cocoa yield and the income of cocoa farmers in the study area are better implemented. Any policy should consider cocoa farmers access to extension services, bad cellular networks in rural areas, incomplete packages and wrong input delivery time to cocoa farmers. In particular, the GES program would improve cocoa yield and income of cocoa farmers if information about the program was made available through extension agents. Therefore, extension services should be made available and affordable to farmers.

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WPŁYW PROGRAMU WSPARCIA UPRAWY NA PLON KAKAO I DOCHODY PRODUCENTÓW KAKAO W STANIE OSUN, NIGERIA

Streszczenie

Próbując poprawić plon kakao i dochód rolników, rząd Nigerii w 2012 r. wprowadził program wspierania rozwoju uprawy kakao (Growth Enhancement Support – GES), który subsydiował nakłady rolne dla rolników. W artykule przeanalizowano wpływ programu na wydajność kakao i dochody jego producentów w stanie Osun. Zastosowano wieloetapową procedurę pobierania próbek, aby uzyskać dane od 208 producentów kakao, wśród których było 100 uczestników i 108 osób niebędących uczestnikami programu. Zebrane dane przeanalizowano przy użyciu statystyki opisowej, modelu regresji binarnej logit i modelu dopasowywania wyniku skłonności (Propensity Score Matching – PSM). Statystyka opisowa nie ujawniła żadnej średniej różnicy niektórych cech społeczno-ekonomicznych między kategoriami rolników na badanym obszarze, takich jak wielkość gospodarstwa domowego, doświadczenie w rolnictwie, wiek i wykształcenie. Wyniki wykazały ponadto, że udział w poprzednich rządowych programach interwencyjnych, dostęp do usług dodatkowych i dostęp do kredytu były istotnymi determinantami uczestnictwa w systemie GES. Udział w systemie GES zwiększył plon kakao i dochód hodowców kakao, odpowiednio o 42,30 $kg \cdot ha^{-1}$ i 24553,99 ₦$\cdot ha^{-1}$ (59,71 €$\cdot ha^{-1}$). Sugeruje to, że dotacja na środki produkcji rolnej mogłaby zwiększyć plon kakao i dochód hodowców kakao.

Słowa kluczowe: dochód, dopasowywanie wyników skłonności, plon kakao, uczestnictwo