IMPACT OF VALUE CHAIN DEVELOPMENT PROGRAMME ON CASSAVA PRODUCTIVITY IN OGUN STATE IN 2017

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Abstract

Ogun is one of the 6 states participating in the Value Chain Development Programmed (VCDP) implemented by the International Fund for Agricultural Development (IFAD) and the Federal Government of Nigeria (FGN) for 6 years in 6 participating states of Anambra, Benue, Ebonyi, Niger, Ogun and Taraba. In spite of the efforts taken by the governments (Ogun state and Federal) to improve the productivity of cassava in the state, there was no empirical study carried out to assess the impact of the intervention in 2017. The main objective of this study was to determine the Average Treatment Effect (ATE) due to the IFAD-VCDP intervention on the mean cassava yield of participating and non-participating farmers in Ogun state. The study collected primary data from a cross section of farms under the VCDP intervention in 2017 in Ogun state using a stratified sampling design hinged on quasi experimental design of the programmer. The sample size was 47 farm households. Field work was achieved using multi-visit interview techniques with the farmers and actual measurements on the farmers' plots. The study applied (i) independent samples T-Test with equal variances (ii) the dummy variable regression technique and (iii) Propensity Score Matching (PSM) to estimate the Average Treatment Effect (ATE) as a measure of the impact of VCDP intervention on the yield of cassava in the state. The t-test and dummy variable technique yielded the same results. The t-test and dummy variable technique independently indicated that the VCDP had positive impact on the beneficiaries and estimated the ATE at 16.9 Mt/Ha. The PSM also indicated that the VCDP had positive impact on the beneficiaries and estimated the ATE at 15.1 Mt/Ha. This ATE value is about 90 % of the 16.9 Mt/ha which was obtained from t-test and dummy variable regression analysis. On the assumption that the PSM estimate is more reliable, then the t-test and dummy variable regression analysis overestimated the true ATE by 10 percent. It was recommended that efforts should be geared at stimulating youths to take up cassava production as a means of livelihood and the VCDP should disseminate production strategies that would attract youths into cassava production in Ogun state. Under the conditions of quasi experimental design, the independent samples t-test with equal variances and the dummy variable regression technique could be used to determine the average treatment effect (impact) of cassava productivity improvement intervention.

Key words: Impact Cassava Productivity Average Treatment Effect

Background to the Study

The Federal Government of Nigeria (FGN) assisted by the International Fund for Agricultural Development (IFAD) has been implementing the Value Chain Development Programmed (VCDP) for a period of 6 years in 6 states of the Federation, namely: Anambra, Benue, Ebonyi, Niger, Ogun and Taraba with a focus on market development and productivity enhancement along rice and cassava commodity value chains for smallholder farmers. The programmer is a commercially oriented, market-led, demand-driven project designed to help farmers and processors respond to market needs of end-users of rice and cassava commodities. It is addressing issues of low productivity, poor quality produce and processed products, limited market range of processed products, lack of standardization and packaging in order to improve competitiveness along the entire value chains. In order to meet the productivity targets, and in line with the business model of the programmer for the first two years, VCDP provided farmers with 50% of the input requirement, comprising 3 bags of fertilizer and 50% of the agrochemicals for 1ha per farmer. To ensure transparency in the input supply and distribution process, VCDP engaged IFDC to facilitate distribution using the concept of Growth Enhancement Support (GES) scheme of the

Federal Ministry of Agriculture and Rural Development (FMARD). In order to ensure effective and efficient input use by farmers, VCDP engaged private extension providers to complement and strengthen the work programmer of the engaged public extension. The public-private extension delivery system facilitated the establishment of farmer-managed and farmer-owned demonstration plots.

Statement of the Research Problem

Ogun is a leading state in the production of cassava in Nigeria. IFAD-VCDP supported the cultivation of 2,686 Ha of cassava in Ogun state in 2017. This is about 30 percent of the total land area supported by IFAD-VCDP for planting of cassava in the 6 states implementing IFAD-VCDP programmer. In spite of the efforts taken by the governments (Ogun state and Federal) to improve the productivity of cassava in Ogun state, there was no empirical study carried out to assess the impact of the IFAD-VCDP intervention on the productivity of cassava in Ogun state in 2017. The question that needs to be answered is: to what extent has IFAD-VCDP intervention increased cassava productivity of the participating cassava farmers against that of non-participating farmers?

The objective of this study was to determine the Average Treatment Effect (ATE) due to IFAD-VCDP intervention on mean cassava yield of participating and non-participating farmers in Ogun state. The null hypothesis tested in the study was that there was no difference in the mean yields of cassava (in Mt/ha) realized by the IFAD-VCDP participants and that of the non-participants.

Ho: Mean yield of cassava of the participants was equal to the mean yield of cassava of the non-participants.

Hi: Mean yield of cassava of the participants was greater than mean yield of cassava of the non-participants.

The scope of the study was limited to cassava cultivation in Ogun state under rain fed agriculture in 2017. Irrigated cassava cultivation was not included and no other year apart from 2017 was considered.

The study is significant and relevant in many respects: firstly, it would assist the administrators of IFAD-VCDP in Ogun state to understand how they have fared with the intervention in Ogun state: whether to gear up the technologies of intervention or stay at the same level when replicating the technologies in other states not yet covered in the country. Secondly it is an opportunity for scholars to have alternative approaches to impact assessment. Thirdly, it bridges the gap in knowledge about IFAD-VCDP intervention on cassava productivity in Ogun state.

Literature Review

The relevant literatures reviewed in the study were: cassava crop in Nigeria; yield estimation methodologies and methodologies for conducting impact evaluation of agricultural interventions.

The Cassava Crop in Nigeria

According to the International Institute of Tropical Agriculture (IITA), cassava is a perennial woody shrub with an edible root, which grows in tropical and subtropical areas of the world. Cassava originated from tropical America and was first introduced into Africa in the Congo basin by the Portuguese around 1558. Today, it is a dietary staple in much of tropical Africa.

It is rich in carbohydrates, calcium, vitamins B and C, and essential minerals. However, nutrient composition differs according to variety and age of the harvested crop, and soil conditions, climate, and other environmental factors during cultivation. Cassava is a hardy plant which can grow in poor soils where other crops will not thrive. In Nigeria it is the major staple crop which is intercropped with other crops such as yam, sweet potato, melon, maize, groundnut, or other legumes. The application of fertilizer to cassava crop remains limited among small-scale farmers due to the high cost and lack of availability. Cassava roots can be harvested between 6 months and 3 years after planting. Apart from food, cassava is very versatile and its derivatives and starch are applicable in many types of products such as foods, confectionery, sweeteners, glues, plywood, textiles, paper, biodegradable products, monosodium glutamate, and drugs. Cassava chips and pellets are used in animal feed and alcohol production. In 2007, Nigeria produced 46 million tons of cassava making it the world's largest producer. According to FAO estimates in 2002, Africa exports only one ton of cassava annually. Cassava production depends on a supply of quality stem cuttings. The multiplication rate of planting materials is very low compared to grain crops, which are propagated by true seeds. In addition, cassava stem cuttings are bulky and highly perishable as they dry up within a few days. Many varieties contain a substance called cyanide that can make the crop toxic if inadequately processed. Various processing methods, such as grating, sun drying, and fermenting, are used to reduce the cyanide content. Except for the Democratic Republic of Congo, Nigeria is the largest consumer of cassava in Sub Saharan Africa (SSA). The main diseases affecting cassava are cassava mosaic disease (CMD), cassava bacterial blight, cassava anthracnose disease, and root rot. IITA scientists have played a leading role in developing improved cassava varieties which are disease- and pest-resistant, low in cyanide content, drought-resistant, early maturing, and high yielding. Disease-resistant varieties give sustainable yields of about 50% more than local varieties. From the foregoing it is apparent that the economic importance of cassava in Nigeria is very enormous and research directed at the improvement of the crop is obviously geared at improving the welfare of many Nigerians.

Yield Estimation Methodologies

Estimating crop yields was never easy and is even more of a challenge in the context of African farming systems that are characterized by smallholder farms that produce a wide range of diverse crops (Anneke F. & Todd B., 2011). There are several methods of estimating crop yields and notable ones are the subplot crop cut which has been adopted as the standard method recommended by the Food and Agriculture Organization of the United Nations (FAO) to measure crop production (FAO 1982; Murphy, Causley, and Curry 1991). There are several variants of the subplot crop cut namely: one random subplot (Spencer 1989)); two large quadrants (Fielding and Riley 1997)); Multiple Small Quadrants (Norman et al 1995) and Sub-sampling Using Row Segments (Verma et al. 1988). Another popular approach to estimating yield is the farmers recall in which postharvest estimations are commonly made at the farmer's house or at the site where the harvest is stored in order for the enumerator to cross-check the estimates with the available storage capacity (Causley and Kumar 1988). Yet another approach to yield estimation is farmer's prediction whereby farmers will base their predictions of expected yield on previous experiences, by comparing the current crop performance to previous crop performances (David 1978). From the review of literature on crop yield estimation it was evident that yield estimation using the subplot crop cut was the most commonly adopted estimation technique all over the world. With the inception of the agricultural development projects in Nigeria in 1975, it has been the most popular approach adopted by the ADPs to estimate the national yield of various crops. It is the standard method recommended by the Food and Agriculture Organization of the United Nations (FAO) to measure crop production (FAO 1982; Murphy, Causley, and Curry 1991). Crop cutting methodology involves randomly locating prior to the harvest of one or more small subplots of known area, usually in form of squares or triangles, within the farmer's plot. At the time of harvest, the subplot is harvested by the survey enumerator, the crop is dried and processed, and then it is weighed. Crop yield is calculated as total production divided by total harvested area in the crop cut plot or sub-plots. A strong advantage of the crop-cut method is that the area of the cut is known and thus does not introduce an error into the final yield computation (Poate 1988).

Methodologies for Conducting Impact Evaluation of Agricultural Interventions

Several authors have elaborate discussion on impact evaluation of agricultural interventions. Notable ones included: Khandker et al (2010); Lechner (1999); and Rosenbaum and Rubin (1983). The general notion is that the main problem associated with impact evaluation is the determination of the counterfactual. They agreed that there are two broad approaches that are used to mimic the counterfactual of a treated group. The first one is to create a comparator group through a statistical design and the second is to modify the targeting strategy of the programmer itself to wipe out differences that would have existed between the treated and non-treated groups before comparing outcomes across the two groups. They concluded that depending on the assumptions made about the nature of potential selection bias in project targeting and participation, the following methods are employed in impact evaluation studies namely; (i) Randomized evaluations; (ii) Matching methods, specifically propensity score matching (PSM); (iii) Double-difference (DD) methods; (iv) Instrumental variable (iv) methods; (v) Regression discontinuity (RD) design and pipeline methods; (vi) Distributional impacts; and (vii) Structural and other modeling approaches. The VCDP intervention design in Ogun State followed the quasi experimental design. Although it closely imitated randomization, it was not strictly randomly distributed across candidate participants rather some levels of selection and targeting of small scale and poor rural households were applied to determine participants and non-participants in the programmer.

Analytical Framework

There were three analytical procedures applied in the study. **The first procedure** was the two sample t-test with equal variance. This procedure tests whether the mean yield of VCDP participants in Ogun state was equal to that of the non-participants at 95 percent level of confidence. The test may be alternatively stated as testing whether the difference between the yield of the participant and that of the non-participants (ATE) was equal to zero. In this case the subtrahend was the yield of the non-participants. This test is one-tailed test because the alternative hypothesis stated that the difference in the mean yields (ATE) was greater than zero. It was assumed that the control group is a true counterfactual and applies t-test of equality of two means from homogenous population.

The null hypothesis was: ATE or $(\bar{X}_1 - \bar{X}_0) = 0$

where $\bar{X}_1$ was the mean cassava yield of the VCDP participants and $\bar{X}_0$ was the mean cassava yield of the VCDP non-participants.

The alternative hypothesis was ATE or $(\bar{X}_1 - \bar{X}_0) > 0.$

The Statistical test was the two sample t-test with equal variance.

The level of significance $(\alpha) = 0.05$

The sample sizes were: $N_1 = 39;\ N_0 = 8; N = 47;$ where $N_1$was the sample size of the participants and N_0 was the sample size of the non participants and N is the total sample size.

The critical F-value to determine whether to use pooled or separate variance is $F_{\frac{8}{39}} = 2.27$

The critical t-value that divides the rejection and non-rejection region is: t = 1.68.

If the estimated test statistic (t) was greater than the critical value the null hypothesis was rejected and the alternative hypothesis was accepted.

$$t = \frac{\bar{\bar{X}}_1 - \bar{\bar{X}}_0}{\sqrt{\frac{s_p^2}{N_1} + \frac{s_p^2}{N_0}}} \text{ where } s_p^2 = \frac{(N_1 - 1)s_1^2 + (N_0 - 1)s_0^2}{N_1 + N_0 - 2}$$

$where\ s_p^2\ is\ the\ pooled\ variance\ which\ is\ the\ weighted\ average\ of\ participant's\ variance(s_1^2)\ andnon\ participant's\ variancce(s_0^2)$ (SPSS Manual, B-122)

The second procedure was the application of dummy variable technique. In Econometrics, the technique of using dummy variables to measure the impact of qualitative variables has been widely adopted in the form of straight forward inclusion of qualitative variables in regression models. The dummy variables were used as proxies for qualitative factors such as participation, sex, religion etc. Koutsoyiannis, (1979). According to Khandker (2010), the dummy variable technique is used to estimate Average Treatment Effect (ATE) between the participants and non-participants. The average treatment effect estimates the increase in the mean yield of cassava of the participants relative to that of the non-participants which was attributable to participation in the VCDP programmer. In order to avoid dummy variable trap, whenever dummy variables were included using the zero-one technique, and there was an intercept term in the equation, the number of such dummy variables should be one less than the number of different ways in which the dummy variable is expected to affect the dependent variable (Johnston, 1984). In this study, the shift in the dummy variable indicated a parallel shift in the regression line since it affected the intercept, holding the slope coefficients constant (Dutta, 1975). The following assumptions were implicit in our model namely;

(i) The attributes corresponding to the dummy variables have impact only on the level of the dependent variable represented by the intercept of the equation

(ii) There is linear additively of the constant (intercept) terms.

Model: $Y = \alpha_1 + (\alpha_2 - \alpha_1)T + u_i$

Where Y = Yield level

$\alpha_i = intercept\ term$

$(\alpha_2 - \alpha_1) = ATE$

T = Intercept Shift (Treatment) dummy

$u_i = disturbance\ term$

The third procedure for the impact evaluation of the VCDP intervention on the yield of cassava farmers in Ogun State was the Propensity Score Matching (PSM) technique. It was assumed that the control group was not a true counterfactual since there were different levels of selection which were bound to introduce bias to the ATE estimate. For this application the existence of selection bias in the sample was assumed. The core theory in the analysis was hinged on the legit and comparison models. The generalized legit model which estimated the propensity (probability) score was specified as follows:

$$\boldsymbol{p_{ij}} = \frac{\boldsymbol{exp(X_i^{/} B_j)}}{\boldsymbol{1 + \sum_{k=1}^{j-1} exp(X_i^{/} B_k)}}$$

Where:

P = the probability of response category j at subpopulation i:

This is the propensity score P(X) = PR (T=1/X).

The last category j is assumed to be the reference category

X = matrix with element (n x k) of the covariates

i=1,..., n are the observations in the covariates

j=1,...,k are the parameters of the covariates

B =vector of the coefficient for the *j*th parameter

When j = 2 this model becomes equivalent to the binary logistic regression model. Thus the model can be thought of as an extension of the binary logistic regression model from binary response to polychromous nominal response. The outcomes of participating and non-participating sample cassava farmers with similar propensity scores were compared to obtain the VCDP effect denoted by: $ATE = E[Y_i(1)|T_i = 1] - E[Y_i(0)|T_i = 0]$.

The Propensity Score Matching (PSM) mimics the randomized design by adopting an observational analogue. The application of PSM involved constructing a statistical comparison group that was based on a model of the probability (propensity) of participating in the treatment (VCDP), using observed characteristics. Participants were then matched on the basis of this probability, or propensity score, to non-participants. The average treatment effect of the intervention was then calculated as the mean difference in outcomes across these two groups. Two conditions must be satisfied prior to the application of the PSM namely:

i) Conditional independence which implies that the unobserved factors (error term in econometric parlance) do not affect participation. This was denoted as: $(Y_i^T Y_i^c) \perp T_i / X_i$; and

ii) Sizable common support or overlap in propensity scores across the participant and non-participant samples which implies that the probabilities or propensity score are bounded away from zero and one: 0 < P (Ti = 1|Xi) < 1. This condition ensures that treatment observations have comparison observations "nearby" in the propensity score distribution (Heckman, La Londe, and Smith 1999).

These conditions were met in this study. The limitations of the model included that:

(i) t-statistics and the adjusted R^2 are not informative and may be misleading;

(ii) Over-specification (including too many X) leads to higher standard errors for $\hat{P}(X)$ and may result $\hat{P}(X) = 1$ thus falling outside the region of common support and consequently the case will be dropped.

Methodology

This study conducted a farm survey using a sample of farmers to track and establish the productivity level of cassava farmers under the VCDP intervention in the Ogun State. The study collected primary data from a cross section of farms and farming households under the VCDP intervention in 2017 in the State.

A stratified sampling design hinged on quasi experimental design of the programmer was applied to determine the sample size and select the sample. A pre-survey training was conducted for the enumerators and supervisors. Preparation of the survey instrument used for collecting the data was part of the pre-survey training. Enumeration was accomplished through scheduled multiple visit interviews with the farmers at home and in their farms. Firstly, the enumerators visited the farmers to estimate their farm sizes using the Geographical Positioning System (GPS) and also collect information on their agronomic details and inputs' application. Secondly the enumerators visited the farmers' farms with the farmers to lay random triangular subplot of 0.01Ha and harvest the cassava in the subplot. The weight of the cassava output from the triangular subplots was recorded in the survey instrument. The data collected with the survey instruments were keyed into the computer using the Microsoft Excel Spread Sheet software. Data cleaning and management were also achieved using the Microsoft Excel Spread Sheet. The inferential analysis of the data including the propensity score matching was carried out using the Statistical Package for the Social Sciences (SPSS version 22). Results of the analysis are presented and discussed in simple prose aided by tables that are understandable by both professionals and laymen alike.

Sample Size Selection

The frame work for determining the sample size (n) for estimating the yield per hectare of cassava in Ogun state was the stratified sample design. The sample size was determined by applying the total sample size formula for equal size subsamples selected from each stratum as detailed in Daniel and Terrell (1975) pp.388-389. The formula is as follows:

$$n = \frac{z^2 L \sum_{L=1}^{L} N_h^2 S_h^2}{N^2 d^2 + z^2 \sum_{L=1}^{L} N_h S_h^2}$$

Legend

S/No	Symbol	Descriptive meaning	Values
1	z	Reliability coefficient	1.96
2	L	Number of strata (states)	6
3	N_h	Size of h^{th} Stratum	50
4	N	Population size (VCDP Baseline data)	300
5	D	Maximum desirable sampling error	10 Kg
6	S_h^2	Variance of cassava yield	3361111 Kg

Variance of cassava yield approximated as $\left[\frac{range}{6}\right]^2$.
Range of cassava yield in Ogun state =from 13 Mt to 24 Mt. per hectare.

The formula above was applied to arrive at a sample size of 50 that is 8 per LGA including the control LGA. In data cleaning 3 respondents were lost.

Presentation of Results and Discussion

This study applied the frequency procedure of the SPSS to analyses the categorical variables in the data (ii) it applied the descriptive procedure of the SPSS to analyses the continuous variables in the data; (iii) thirdly, it applied the compare means procedure of the SPSS to conduct the independent sample t-test; (iv) fourthly, it applied the linear regression procedure of the SPSS to carry out the dummy variable analysis technique; (v) fifthly, randomized design was mimicked by adopting an observational analogue namely the propensity score matching (PSM) to determine the impact of VCDP intervention on the yield of cassava. This procedure was also carried out with SPSS.

Descriptive Analysis of the Data

This study determined the frequencies of response in the categories of the following variables: Local Government Areas (LGAs), category of respondents, gender; role in the household; marital status and educational level. It estimated the mean values and standard deviation of the following variables: the plot area; yield; number in the household and ages of respondents. Detailed analysis and description of these variables were beyond the scope of this study; suffice it to present brief summaries of their results.

Local Government Areas (LGAs) involved in the study

Six LGAs contributed a total of 47 respondents to the sample for study as follows: 8 respondents each were selected from Ewekoro, Ifo, Ijebu East, Ijebu-North, Obafemi Owode and 7 from Yewa North LGAs.

Category of Respondents: Of the 47 respondents in the sample, 39No or 83 % were participants of the VCDP while 17 % were not. Of the 8 non participants in the sample 5 were males and 3 were females.

Gender of the Respondents

The gender of the respondent determines to a large extent his/her access to crucial farm inputs such as land in the rural areas of Ogun State. Out of these 39 participants 30 were males and 9 were females.

Role of the Respondent in the Household

A household head in rural areas of Ogun State is responsible for taking the important decisions that will be binding to all household members; what crops should be planted to each family plot, when and how to plant the crops. The household head is also responsible for taking decision on where and how to source farm inputs and also where and how to dispose of farm produce. Out of the 47 respondents in the survey 72 percent were household heads, 28 percent were non household heads. Out of the 34 respondents that were household heads 30 were participants and 4 were non participants.

Marital Status of the Respondents

Out of the 47 respondents in the sample 44 No or 93 percent were married and only 7 percent were single. Out of the 44 respondents that were married, 37 were participants and 7 were non participants.

Highest Educational Level Attained by the Respondents

The highest educational level of the respondents determines their level of exposure and indicates the literacy level that will be applied in preparing extension manuals and disseminating extension messages to the respondents. Out of the 47 respondents in the study about 28 percent completed primary, 53 percent completed secondary and 9 percent completed tertiary school education.

Table 1: Descriptive Statistics of Key Variables

Category	Plot Size	Yield	HH size	Age
Nonparticipants	0.99	21.1	5.0	39.5
Participants	1.72	37.9	6.5	45.8
Total	1.59	35.0	6.3	44.8
Std. Deviation	0.93	11.2	2.8	9.6

Source: VCDP Cassava CAYS 2018

Farm size

The cultivated plot area is a measure of the status of the farmer and an indicator of expected total output. The estimated mean plot area from the sample survey was 1.59Ha. The participants had larger mean farm size (1.7Ha) compared to non-participants (0.9Ha). The mean plot yield was 35.0 Mt/Ha. The participants had higher mean yield (37.9 Mt/Ha) compared to non-participants (21.1 Mt/Ha).The details are in table 1.

Household Size

The household size is an estimator of the size of family labour available for farm work. It is also an estimator of the consumption burden on the farm output. The estimated mean household size from the sample survey was 6 members. The participants had larger household size (6 persons) compared to non-participants (5 persons).The details are in table 1.

Age

The age of the farmer is an indicator of potential energy for farm work. It is also an indicator of the farmer's potential to learn and take up other commitments apart from farm work. The estimated mean age of the sample farmers was 45 years. The participants were on the average older (46 years) than the non-participants (40 years). The details are in table 1. Younger people between the ages of 20 and 35 years will be more vigorous at work and has better capacity to adopt new production technologies. The VCDP should disseminate production strategies that would attract youths into cassava production.

Impact of the VCDP intervention on Cassava Productivity

In selecting individual participants some categories of individuals such as women, youths and the poor were targeted. Given the impact assessment model as:

$$Y_i = \alpha + BT_i + \varepsilon_i$$

Assumption: Covariance (T, ε) ≠ 0

Y= Outcome variable (yield),

i is bivariate = 0 or 1,

α is the intercept term,

β = Average Treatment Effect (ATE) which estimates the difference in the yields of the participants and the control group.

T = Treatment (T=1 is "Beneficiary" and T= 0 is "Control or Non-beneficiary" of the intervention)

ε = the stochastic disturbance

Some of the reasons why Ti may not be random are:

a) Endogeneity in programmer targeting or placement. Programmed were deliberately located in areas with specific/special characteristics such as earning opportunities or social norms that may or may not be observed but correlated with the outcome Y.

b) Unobserved individual heterogeneity arising from individual beneficiaries' self selection into the program which confounds the experimental set up.

Time varying factors that may confound T include: unobserved entrepreneurial talent of targeted subjects; ability to maintain social ties and networks all of which varies with the duration of the program.

In the first scenario, it was assumed that the reasons listed above why Ti may not be random were not serious in the data collected using the quasi experimental design, a high degree of randomness was assumed in the data. Consequently selection bias was assumed away. In this context, the independent samples t-test with equal variances assumed (justified by F= 12.2) was applied to estimate the Average Treatment Effect (ATE) as a means of assessing the impact of VCDP intervention on the yield of cassava and the result is presented in table 2. As stated earlier in the analytical frame work:

The null hypothesis was: $\bar{X}_1 = \bar{X}_0$

The alternative hypothesis was: $\bar{X}_1 > \bar{X}_0$

The Statistical test was the two sample t-test with equal variance.

The level of significance $(\alpha) = 0.05$

The sample sizes are: $N_1 = 39;\ N_0 = 8; N = 47;$

The critical F-value to determine whether to use pooled or separate variance was $F_{\frac{8}{39}} = 2.27$

The estimated F-value was 12.2 which were greater than 2.27. It was accepted that the two population variance were equal consequently the t-test with equal variances was adopted in the analysis. The critical t-value (one tailed) that divides the rejection and non-rejection region was: t = 1.68. Since the estimated test statistic (t = 4.7) was greater than the critical value the null hypothesis was rejected and the alternative hypothesis was accepted. It was evident that the VCDP had positive impact on the beneficiaries. The estimated ATE was 16.86 Mt/Ha which was the incremental yield obtained by the participant above the non-participants because they participated in the VCDP.

Table 2 : Estimates of ATE from T-Test and Dummy Variable Techniques

Independent Samples T-Test F=12.2; t =4.7				
Category	N	Mean (Mt/Ha)	Mean Diff. (Mt/Ha) (ATE)	Std. Error Difference
Participants	39	37.9	16.86	3.5
Non Participants	8	21.1		
Regression Analysis Applying Dummy Variable Technique				
	Unstandardized Coefficients			
F= 22.1; R-sq = 0.3		B	Std. Error	t-statistic
(Constant)		21	3.3	6.5
Category(ATE)		16.86	3.6	4.7

Source: VCDP-CAYS, 2018

In the second scenario according to Khandker (2010): if treatment was random (then T and ε were independent), the equation can be estimated by using ordinary least squares (OLS), applying the dummy variable technique and the treatment effect β_{OLS} estimates the difference in the outcomes of the treated and the control group. Following this, the dummy variable technique was applied using OLS to estimate the average treatment effect (ATE) as a tool for assessing the impact of VCDP intervention on the yield of cassava. The result is presented in table 2.

The F-statistics of the dummy variable regression analysis was 22.1 indicating that the yield of cassava was correlated with VCDP intervention.

The R^2 was 0.3;

The estimated ATE was 16.86 Mt/Ha with standard error of 3.6 and t-statistic of 4.7

The null hypothesis was: $ATE = 0$
The alternative hypothesis was: $ATE > 0$
The level of significance $(\alpha) = 0.05$
The critical t-value (one tailed test) was 1.68.
The sample sizes are: $N_1 = 39;\ N_0 = 8; N = 47.$
Since the estimated t-statistic (4.7) was greater than the tabulated t-statistic (1.68) the null hypothesis of $ATE = 0$ was rejected and the alternative that $ATE > 0$ was accepted
The dummy variable regression analysis also showed that the VCDP had positive impact on the beneficiaries. The estimated ATE was also 16.86 Mt/Ha which was the incremental yield obtained by the participant above the non-participants because they participated in the VCDP. The t-test and dummy variable technique yielded the same results. Each one indicated that the VCDP had positive impact on the beneficiaries and estimated the ATE at 16.86 Mt/Ha.

Application of the PSM to Assess the Impact of VCDP on the Yield of Cassava

In the third scenario, it was observed that since VCDP applied selection at the various levels of stratification and in targeting some social groups for participation; also there were perversions as political and elitist pressures may have resulted in some self-inclusion of non-selected members into participation and some selected individuals may have dropped out from the sample; then certain levels of selection bias would have violated the validity of the assumed randomness in the quasi experimental design of VCDP sampling strategy. To mitigate the effects of selection biases arising from these sources mentioned, propensity score matching procedure was applied to overcome observed differences between treatment and comparison groups and filter out reliable ATE as the impact of VCDP intervention on the yield of cassava. The result of this analysis is presented in table 3. From the table it was apparent that the ATE was estimated at 15.09 Mt/Ha. This ATE value is about 90 % of the 16.86 Mt/ha which was obtained from t-test and dummy variable regression analysis. On the assumption that the PSM estimate was more reliable, then the t-test and dummy variable regression analysis overestimated the true ATE by 10 percent.

Table 3: Result of PSM on Cassava Yield

Number of observations = 216			
The Estimator = Propensity-Score Matching			
Matches: requested = 5			
Outcome model = Matching			
Minimum matching = 5			
Maximum Matching = 5			
Treatment model = logit			
Treatment dependent variable = participant in VCDP (1); Non participant in VCDP (0).			
Treatment independent variables or covariates (7) namely: gender of the respondent; head of household; household size; age of respondent; education level attained and farm size as surrogate for class of farmer.			
Outcome Variable	**Coefficient**	**SE**	**95 % Conf. Int.**
Yield (Mt/Ha)	15.09	3.6	7.2 to 23.0

Source: VCDP-CAYS, 2018

Summary and Conclusions

Ogun is one of the 6 states participating in the Value Chain Development Programmed implemented by IFAD and FGN for 6 years in 6 participating states of Anambra, Benue, Ebonyi, Niger, Ogun and Taraba. In spite of the efforts taken by the governments (Ogun state and Federal) to improve the productivity of cassava in the State, there was no empirical study carried out to assess the impact of the intervention in 2017. The main objective of this study was to determine the Average Treatment Effect (ATE) due to the IFAD-VCDP intervention on mean yield of cassava on participating and non-participating farmers in Ogun state.
The study collected primary data from a cross section of farms under the VCDP intervention in 2017 in Ogun state using a stratified sampling design hinged on quasi experimental design of the programmer. The sample size was 47 farm households. Field work was achieved using multi-visit interview techniques with the farmers and

actual measurements on the farmers' plots. From descriptive analysis, the participants were on the average older (46 years) than the non-participants (40 years). The VCDP should disseminate production strategies that would attract youths into cassava production in Ogun state. The estimated mean plot area from the sample survey was 1.59Ha. The participants had larger mean farm size (1.7Ha) compared to non-participants (0.9Ha). The mean plot yield was 35.0 Mt/Ha. The participants had higher mean yield (37.9 Mt/Ha) compared to non-participants (21.1 Mt/Ha). On inferential analysis, the study applied (i) independent samples t-test with equal variances (ii) the dummy variable regression technique and (iii) Propensity Score Matching (PSM) to estimate the Average Treatment Effect (ATE) as a measure of the impact of VCDP intervention on the yield of cassava in the state. The t-test and dummy variable techniques yielded the same results. The t-test and dummy variable techniques independently indicated that the VCDP had positive impact on the beneficiaries and estimated the ATE at 16.86 Mt/Ha. The PSM also indicated that the VCDP had positive impact on the beneficiaries and estimated the ATE at 15.09 Mt/Ha. This ATE value is about 90 % of the 16.86 Mt/ha which was obtained from t-test and dummy variable regression analysis. On the assumption that the PSM estimate was more reliable, then the t-test and dummy variable regression analysis overestimated the true ATE by 10 percent.

Recommendations

This study recommended that:

(i) Efforts should be geared at stimulating youths to take up cassava production as a means of livelihood and the VCDP should disseminate production strategies that would attract youths into cassava production in Ogun state.

(ii) Under the conditions of quasi experimental design, the independent samples t-test with equal variances and the dummy variable regression technique could be used to determine the average treatment effect (impact) of an intervention.

(iii) If selection bias is suspected to exist in the selected sample for impact assessment study, the propensity score matching should be used for estimating the average treatment effect (impact) of the intervention.

(iv) The propensity score matching should be used for assessing the impact of VCDP intervention on the productivity of cassava in Ogun State and elsewhere in Nigeria.

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