Original Research Article

Impacts of the Value Chain Development Programme (VCDP) on poverty reduction among rice- and cassava-based farming households in rural Nigeria

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Abstract

Poverty has constituted a significant threat to life and economic development in most developing nations of the world. The rural dwellers in Nigeria have suffered welfare deficits and depletion in general living standards. Developmental programmes and interventions implemented to address rural poverty and inequality in Nigeria have targeted improving crop value chains to increase productivity and income and therefore eliminate poverty in the country. Hence, this study examined the impacts of the Value Chain Development Programme (VCDP) on poverty reduction among cassava and rice-based farming households in rural Nigeria. The 2022 version of the panel data set obtained from the VCDP management office within the Nigeria's Federal Ministry of Agriculture and Rural Development (FMARD) spanning the period between 2019 and 2022 was used. The data were analysed by descriptive statistics, the Foster-Greer-Thorbecke (FGT) poverty measure, and Propensity Score Matching (PSM) approach. The poverty gap estimates show that poverty headcount was lower among the cassava-based and rice-based beneficiary households (24.02% and 26.75%, respectively) compared to their non-beneficiary counterpart (66.67% and 53.42%, respectively). While annual per capita income significantly increased by ₦ 59,205.570 (131.36 USD) among beneficiaries in cassava-based households at 1%, poverty gap was reduced by 0.021% among the beneficiaries in rice-based farming households at 10%. It could be revealed that the intervention was effective in reducing poverty, more especially among the rice-based farming households. Therefore, the study recommends that the implementation of the VCDP should be sustained and scaled up for wider coverage and effective poverty reduction, especially among cassava-based farming households in rural Nigeria.

Keywords: Pro-poor; poverty status; per capita income; rural developmental programme; cassava; rice; rural farming households

INTRODUCTION

Poverty has constituted a significant threat to life and economic development in most developing nations of the world. It is more of a rural than an urban phenomenon (Bigwa et al., 2020). The rural dwellers in Nigeria have suffered deficits in social and physical infrastructure, and general living standards (World Bank, 2021). Thus, to improve welfare, there have been continued efforts to address rural poverty and inequality by governments at all levels, national and international, through several policies and programmes (Bigwa et al., 2020). Welfare enhancement strategies have constantly been reviewed to make them more pro-poor through investment in inclusive rural transformation with a keen focus on attaining the Sustainable

Development Goals (SDGs) in developing countries and the world at large (Singh and Chudasama, 2020; Habiyaremye et al., 2020).

The deliverables of many pro-poor rural developmental programmes in Africa often include access to market, economic opportunities, increase in productivity, employment and income generation (Asiamah, 2021). According to Matte (2020), the joint efforts of African governments and international donors in improving infrastructure such as paved roads, electricity grids, and piped-water system have yielded gains in living standards and lower the levels of poverty especially in the rural areas of the continent. Similarly, the waves of productivity-enhancing programmes such as the Input Subsidy Programmes (ISP) have promoted the productivity of farming households in Sub-Saharan Africa (Adenegan et al., 2017; Nhlengethwa et al., 2022). Such productivity-enhancing initiatives have been found to enhance farm output, and expand livelihood opportunities and income while also promoting welfare uplift among farmers in lower-middle-income countries (Hemming et al. 2018).

Due to changing realities, successive governments in Nigeria have pursued policies to ensure rural transformation, improve market access, enhance rural livelihood, expand farmers' output, and alleviate poverty in the country (Emetumah, 2019). Literature such as Umeh and Adejo (2019), Etuk and Ayuk (2021), and Shaibu (2023) have chronicled the previous policies and programmes. According to them, even though some progress towards poverty reduction among farming households had been made, these previous policies have not been able to achieve their full objectives. In some cases, analysts have described the impacts of these programmes as contentious (Emetumah, 2019; Etuk and Ayuk, 2021). Also, Jibrin and Lawan (2020) noted that poor or outright lack of proper implementation framework, shortage of funds, poor implementation oversight, and poor targeting of vulnerable and marginalized groups affected a host of past poverty alleviation programmes implemented in the country.

The Value-Chain Development Programme (VCDP) initiated in partnership between the Federal Government of Nigeria and the International Fund for Agricultural Development (IFAD) in 2013 aimed at improving the collective efficacy of farmer organizations, farmers' incomes and alleviating poverty through the integration of rice and cassava value chains (Eissler and Heckert, 2024). The programme promoted functional farmers' organizations, provided production inputs through matching grants, improved access to advisory extension services, financial literacy, and adoption of climate-resilient agricultural practices among rural farmers (IFAD, 2022). Hence, studies by Madubueze et al. (2018), Ndanitsa et al. (2020), Ityokumbul et al. (2020), Alabi et al. (2023a and 2023b), have assessed the impacts of VCDP on productivity and welfare outcomes such as food security and income among farming households in Nigeria. However, this study examined the impacts of the intervention in reducing poverty among farming households in the country. Contrary to previous studies that have only focused on rice-based farming households in the country, this study evaluated the impacts of the Value-Chain Development Programme (VCDP) on poverty reduction among both rice and cassava-based farming households in Nigeria.

Of specific relevance to the study was the profiling of the farming households using per capita income and the poverty gap and poverty severity they experienced. Given that the implementation of an intervention may yield unintended effects that are not related to the goals of the intervention (Belcher and Palenberg, 2018), an assessment of an intervention programme must thus examine whether the change in target outcome is attributable to the intervention and not any other possible confoundment (Scholz et al., 2017). Hence, the study examined the change in per capita income and reduction in poverty gap attributable to the implementation of the VCDP intervention among the farming households.

Conceptual framework

Poverty eradication strategies in developing countries are often designed as a mix of complementary components that could together promote productivity, income generation, economic opportunities, and overall living standards among the economically and socially vulnerable (Singh and Chudasama, 2020). According to Vos and Cattaneo (2021), progressively developing rural areas is central to achieving SDG-1 of eradicating poverty through enhanced market access, and increased productivity and income. The pathway by which these may happen follows the logical framework (log frame) as described in Fig. 1.

The VCDP targeted enhancement in market access for smallholder rice and cassava farmers and agro-processors and improved productivity and volume of rice and cassava marketed by the farmers (Tenabe et al., 2018). Similar to other productivity-enhancing interventions like the Commercial Agricultural Development Project (CADP), the Growth Enhancement Support Scheme GESS, and the Agro Processing, Productivity Enhancement and Livelihood Improvement Support

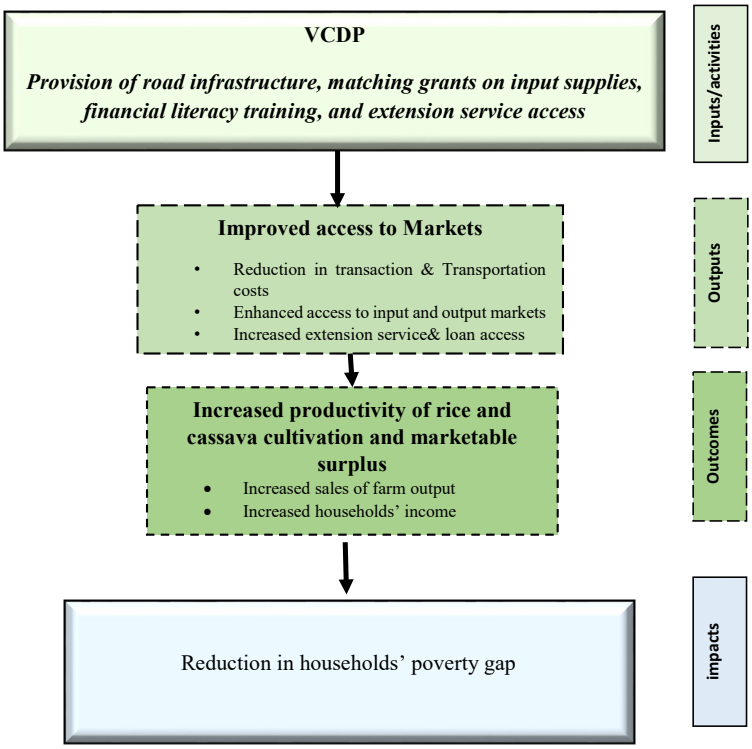


Figure 1. Impact of the VCDP as described by the theory of change
Source: Adapted from Rengarajan and Sivasubramaniyan (2020).

(APPEALS), such a rural development programme targeted the promotion of a productive rural economy which may give rise to more marketable surplus, more economic opportunities and increased profitability and more income (Abdallah et al., 2021; Geffersa and Tabe-Ojong, 2024). With more income, rural households can acquire both food and non-food items for consumption, leading to improved food and nutrition security and improved living standard of farming households (Eyuk and Ayuk, 2021).

Although income measurement of poverty is considered prone to under-reporting (Francis-Devine, 2024) income and household per capita income are commonly used to measure poverty (Brown et al., 2022). An income-based poverty measure is considered appropriate and easy to quantify for welfare analysis (Aldridge, 2017). Also, the income poverty measures correlate well (even though not perfectly) with other poverty outcomes such as food insecurity and material deprivation. The notion of income poverty measurement also aligns much with the absolute definition of poverty as the minimum resources to satisfy basic needs (Kharas and Dooley, 2022). Moreover, sustained accumulation of income may promote asset accumulation by individuals to serve as a buffer during economic and financial shocks (Bufe et al. 2021). According to Costa (2020), if the poor set defined by various measures is particularly comparable, the same or the least, similar, the simplest approach may be informative enough to describe the welfare situation of individuals, households, or society. Hence, income poverty, measured as per capita income, was used in the current study. Based on this, a reduction in the gap between estimated the poverty line and households' per capita income, due to participation in the VCDP, was assessed. While both the outputs and outcomes (especially the increase in sales of farm outputs) depicted in Figure 1 were not explicitly measured in this study, the programme's objective highlighted, among other things, the promotion of functional farmers' organisations, provision production inputs, improved access to advisory extension services, financial literacy, and adoption of climate-resilient agricultural practices among rural farmers (IFAD, 2022). Thus, it is assumed that the programme worked its way through improved market access, increased productivity, and marketable surplus to affect poverty reduction among farming households. Therefore, the outputs and outcomes stated were represented in dash-line boxes.

MATERIAL AND METHODS

Data type and source

The study employed a secondary dataset obtained from the VCDP management office located within

under the Federal Ministry of Agriculture and Rural Development (FMARD) spanning the period between 2019 and 2022. Both beneficiaries and non-beneficiaries were interviewed. The data were collected in the 9 states, namely: Ogun, Ebonyi, Anambra, Benue, Kogi, Niger, Enugu, Nassarawa, and Taraba States, Nigeria, where the VCDP programme was implemented. Communities were sampled in each state visited to obtain a total of 647 farming households in each data period. The 647 households comprised 422 beneficiary and 225 non-beneficiary households. The 2022 version of the panel data set was used. The dataset consisted of information from 647 farming household heads made up of farmers cultivating rice and cassava as their major crops. A total of 640 households were available for use after data cleaning. The data consist of both intervention and control groups defined as the households that benefitted from the VCDP intervention (beneficiary households) and those that did not benefit from any intervention (non-beneficiary households). Both socioeconomic information and information-related production activities of the farming households were contained in the data set (FGN/IFAD, 2020).

Analytical techniques

In this study, the socioeconomic characteristics of the households, based on their participation in VCDP were profiled using descriptive statistics. The poverty line, poverty headcount, depth, and severity of poverty were estimated using the Foster-Greer-Thorbecke (FGT) (1984) measures of poverty. Following Osabohien et al. (2021) and Etuk and Ayuk (2021), the FGT is expressed as:

$$P_{\alpha}=\frac{1}{N}\sum_{j=1}^{N}\left(\frac{z-y_j}{z}\right)^{\alpha} I\left(y_j \le z\right) \quad (1)$$

N is the total number of households, α = the FGT poverty index (also referred to as the poverty sensitivity index or poverty aversion parameter), α takes on values 0, 1, 2, for P_0 = poverty headcount; P_1 = poverty gap or depth and P_2 = poverty severity respectively and z is the poverty threshold/line. Following Eyuk and Ayuk (2021) this was taken as 2/3 of the mean annual per capita income for the households. A higher poverty headcount means that poverty is more prevalent. While poor households have lower per capita income, households having equal to or greater than the poverty line are considered non-poor. To move a poor household up to, at least, the poverty line, the naira per capita income required is captured by the poverty gap. The severity of poverty distinguishes between the poor and the poorest households. It is estimated as the addition of the squared value of poverty depth expressed as a ratio of the number of poor households sampled from the study population (Dia, et al. 2023). $I(y_j \le z)$ defines households into binary categories such that:

$$I\left(y_j \le z\right)=\begin{cases}1 \, if \, y \le z \\ 0 \, if \, y > z\end{cases} \quad (2)$$

z = the 2/3 of Mean Per Capita Income (MPCI), while y is the per capita income of a particular household i. Households with a mean per capita income below the poverty line (₦ 68,896.53) are categorised as poor.

The Propensity Score Matching approach

The Propensity Score Matching (PSM) approach was employed to estimate the impacts of VCDP among farmers in rural Nigeria. It establishes an appropriate match between the treated group and an identical control group in the sample based on observed covariates representing individual and farm characteristics. After controlling for confounding in individual and farm characteristics which may bias the estimates, it generates an impact measure of the average difference in outcome (annual per capita income and poverty gap in the current study) between the two groups (Osabohien et al. 2021). Per capita income and poverty gap of the beneficiary households are compared to those of the non-beneficiary households with similar observable characteristics. Hence, the counterfactual per capita income and poverty gap, an unobserved income or poverty gap that would have been estimated had the non-beneficiary households benefitted, was estimated.

According to Rosenbaum and Rubin (1983), Michalek (2012), and Hando (2023), the propensity score used for matching a treated (VCDP beneficiary) with an untreated (VCDP non-beneficiary) represents the conditional probability (Pr), which is also equal to the expected value of the treatment status D of being a beneficiary or non-beneficiary of the VCDP intervention support based on the pre-intervention characteristics X and it is given as:

$$p(X) \equiv \Pr\left(D=1|X\right)=E(D|X) \quad (3)$$

D is the vector of the characteristics of individuals before intervention. Following Etuk and Ayuk (2021) the Average Treatment effects on the Treated (ATT) is computed from the matched sample as an estimate of the impact of VCDP intervention on the poverty gap and poverty severity among the beneficiaries. The Average

Treatment Effects on the treated (ATT) following Rosenbaum and Rubin (1983) are as follows:

$$E(Y^1 - Y^0 | D=1) = E\left(Y^1 | D=1\right) - E(Y^0 | D=1) \quad (4)$$

where $E(Y^1 | D=1)$ represents the outcome observed from the treated/beneficiaries of the intervention and $E(Y^0 | D=1)$ represents the counterfactual outcome had the untreated/non-beneficiaries benefitted from the intervention.

Although the literature provides explanations of the pros and cons of the existing matching methods, there is no clear-cut submission on which of them is the best (Roth et al., 2014). The choice often depends on how much tradeoffs can be permitted between bias reduction and consistency of estimates obtained (Caliendo and Kopeinig, 2008). However, it is appropriate to use more than one method to allow for a robustness check (Osabohien et al., 2021). Hence, both the Nearest Neighbour (NN) with replacement and Kernel-based (KB) matching algorithms were used in this study. The NN matching simply matches the treated and control group with the closest propensity scores while KB uses a weighted sum of outcomes for the matched controls; greater weight is usually assigned to the matched control units with the closest propensity score. With both algorithms, bias in estimates can be reduced. Moreover, the consistency of the estimates from both algorithms can be validated by comparing them (Caliendo and Kopeinig, 2008; Roth et al., 2014; Diro and Erko, 20119).

Based on the propensity score, matching occurs in the region j which minimises the closeness between a non-participant having a propensity score P_j and its nearest participant P_i (Michalek, 2012). This is as stated:

$$C(P_i) = \min_j \left\| P_i - P_j \right\| \quad (5)$$

Meanwhile, the kernel matching is defined as:

$$W(i,j) = G\left(\frac{P_j - P_i}{a_n}\right) / \sum_{k \in I_o} G\left(\frac{P_k - P_i}{a_n}\right) \quad (6)$$

W represents the weight for a non-participant having propensity score i and participant j; G is the kernel function; a_n is the kernel bandwidth while P_k is the probability of a point within the bandwidth (Michalek, 2012).

RESULTS AND DISCUSSION

Description of households by other crops cultivated

The various crops cultivated by the households were as graphically described in Figure 2. Crops grown, apart from cassava and rice which were the focus of this study, include maize, soybean, groundnut, yam, pepper, tomato, cocoyam, amaranthus, oil palm,

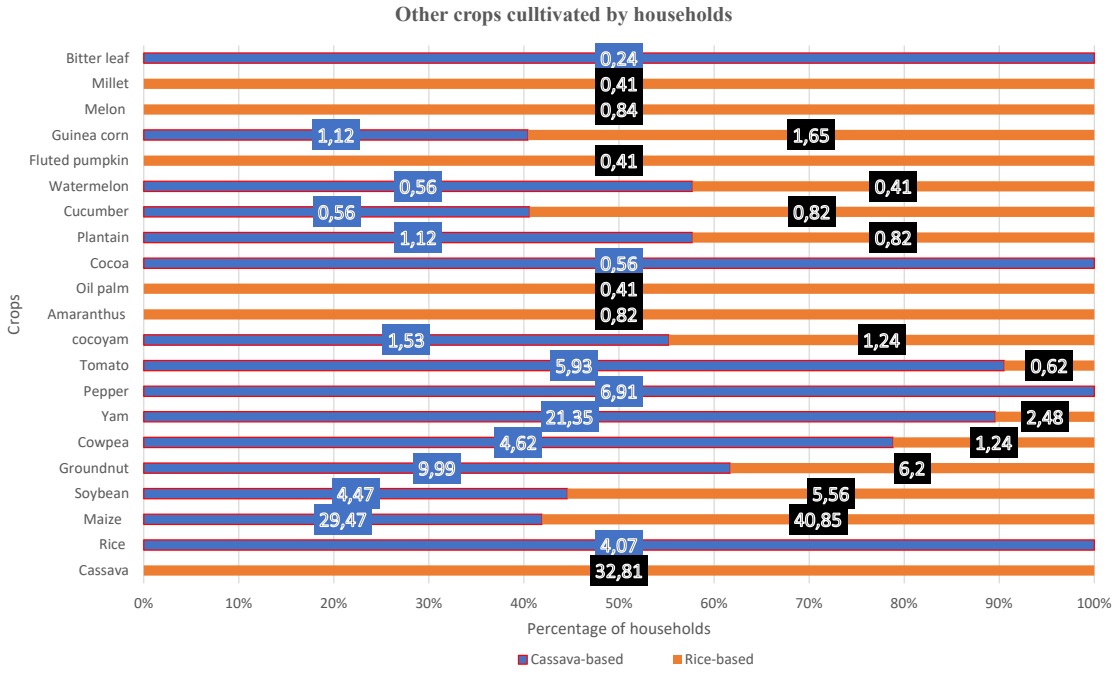


Figure 2. Distribution of cassava and rice-based farming households by other crops cultivated
Source: Author's computation from VCDP data, 2022

cocoa, cucumber, watermelon, fluted pumpkin, guinea corn, melon, millet, and bitter leaf. This is in line with Anderson et al. (2017) and Chiaka et al. (2022) that smallholder farmers in Nigeria grow a diverse variety of crops. While 29.87% of the cassava-based cultivated maize, 40.85%), of the rice-based cultivated the crop. This also aligns with Anderson et al. (2017) which found that 72% of farming households in Nigeria grow maize.

Socioeconomic characteristics of household

The socioeconomic characteristics of households in this study are as described in Table 1 based on crops cultivated and their status as either beneficiaries or non-beneficiaries of the VCDP intervention. Over half (63.59%) of the households were headed by individuals between 41–60 years of age. While 67.04% of the beneficiary cassava-based farming households were within this age bracket, 62.96% of their counterpart rice-based farming households were represented in the age bracket. Furthermore, the mean age of beneficiary cassava-based farming households differs significantly from those of the non-beneficiary by 2.40 years at 5% while that of the beneficiary rice-based farming household heads differ significantly from their non-beneficiary counterpart by 1.39 years at 1%. These show slight differences in the ages of the household heads and align with Ityokumbul et al. (2020) who found a mean age of 44.3 years among rice farmers under the VCDP in both Yewa North and Ijebu-East local government of Ogun State Nigeria. Similar to Jatto et al. (2021) which found 51.11% of farming households heads within this age bracket in Akinyele, Oyo State, Nigeria, this implies that a sizeable proportion of the farmers were in their productive and active age.

Concerning gender, the majority, about 61% of the beneficiary cassava-based and rice-based farming households were headed by males. While 64.91% of the non-beneficiary cassava-based farming households were headed by males, 40.99% of the non-beneficiary rice-based farming households were headed by males. This is similar to Mukaila et al. (2021) who found that 80.8% of farming households in Nigeria were headed by males, and Dia et al. (2023) who found 90.98% of rural households in Adamawa State, Nigeria headed by males. While about 91% of all household heads were married, 92.18% and 89.71% of the cassava- and rice-based beneficiary households respectively were married. On the other hand, 89.47% and 90.68% of the non-beneficiary cassava and rice-based farming households, respectively, were married. In agreement with Bamidele et al. (2019) who found 95.74% of married farmers among VCDP beneficiaries in Obafemi-Owode and Yewa North Local Government Areas of Ogun State, Nigeria, this implies that the majority of the households were married and this may have further implications for availability of more family labour for farm work.

Furthermore, the majority (about 70%) of the households had between 6–10 members. The beneficiary cassava and rice-based farming households in this category were 64.80% and 73.25%, respectively, while the non-beneficiary cassava and rice-based farming households composed of 6–10 household members were 71.93% and 68.94%, respectively. The mean sizes of the beneficiary households were 7.62 and 8.02 for both cassava and rice-based farming households, respectively, compared to the 7.45 and 7.84 members in non-beneficiary cassava and rice-based farming households, respectively. While the beneficiary households were slightly larger than the non-beneficiary households., these mean values were similar to the findings of Ogunniyi et al. (2021) who found an average of 7.69 members among maize farmers in Ogun State, Nigeria. Following the same reasoning as adduced to the marital status of the households, this fairly large family size may imply the availability of family labour.

Regaeding the size of the farm cultivated, the majority of the households (55.94%) cultivated less than 2.5 ha, with a mean of 2.53 ha. The beneficiary cassava and rice-based farming households who cultivated less than 2.5 ha were 51.84% and 56.14%, respectively, whereas 56.14% and 59.63% of the non-beneficiary households among cassava and rice-based farming households, respectively cultivated less than 2.5 ha. While this connotes small farm holding, the beneficiaries cultivated significantly larger farm sizes than non-beneficiaries by 0.46 ha and 0.14 ha among the cassava and rice-based farming households, respectively, at 5% and 1%. These findings are similar to the 2.54 ha average farm size found by Umaru and Maurice (2019) among smallholder farmers in Taraba and Gombe State, Nigeria, and the 2.73 ha mean farm size found by Ityokumbu et al. (2020) among the VCDP beneficiaries in Yewa-North and Ijebu-East local government areas of Ogun State, Nigeria.

While the average total income among all households was ₦ 690,003.60, the majority (52.81%) of the households earned annual income between ₦ 500,001 and ₦ 1,000, 000. Beneficiary cassava and rice-based farming households in this income-earning bracket were 67.04% and 62.14%, respectively, while the non-beneficiary counterparts were 22.81% and 33.54%, respectively. Meanwhile, the mean annual income among the beneficiary cassava and rice-based farming households were ₦ 739,

Table 1. Socioeconomic characteristics of farm household heads by beneficiary status

Variable	All (N = 640)	Cassava-based farming households			Rice-based farming households		
		Beneficiary (N = 179)	Non-beneficiary (N = 57)	Differences	Beneficiary (N = 243)	Non-beneficiary (N = 161)	Differences
Age							
≤20	1(0.16)	–			1 (0.41)	–	
21–40	192(30.00)	50 (27.93)	23 (40.35)		68 (27.98)	51 (31.68)	
41–60	407(63.59)	120 (67.04)	32 (56.14)		153 (62.96)	102 (63.35)	
≥61	40(6.25)	9(5.03)	2 (3.51)		21 (8.64)	8 (4.97)	
Mean ±*SD*	46.27 ± 9.38	46.63 ± 8.35	44.22 ± 10.25	2.40**	46.95 ± 9.87	45.55 ± 9.34	1.39*
Gender							
Male	389(60.78)	109 (60.89)	37 (64.91)		148 (60.91)	95 (40.99)	
Female	251(39.22)	70 (39.11)	20 (35.09)		95 (39.09)	95 (59.010)	
Marital status							
Married	580(90.63)	165 (92.18)	51 (89.47)		218 (89.71)	146 (90.68)	
Otherwise	60 (9.38)	14 (7.82)	6 (10.53)		25 (10.29)	15 (9.32)	
Household size							
≤5	132(20.63)	46 (25.70)	12 (21.05)		44 (18.11)	30 (18.63)	
6–10	446(69.69)	116 (64.80)	41(71.93)		178 (73.25)	111 (68.94)	
11–15	55(8.59)	15 (8.38)	4(7.02)		16 (6.58)	20 (12.42)	
≥16	7(1.09)	2 (1.12)			5 (2.06)		
Mean ± *SD*	7.81 ± 2.83	7.62 ± 2.95	7.45 ± 2.56	0.17	8.02 ± 2.89	7.84 ± 2.65	0.18
Farm size cultivated (ha)							
≤2.5	358(55.94)	91 (51.84)	32 (56.14)		139 (57.20)	96 (59.63)	
2.6–5.0	265(41.41)	81 (45.25)	25 (43.86)		96 (39.51)	65 (40.37)	
5.1–7.5	7(1.09)	4 (2.23)			3 (1.23)	–	
≥7.6	10(1.56)	3 (1.68)			5 (2.06)	–	
Mean ±*SD*	2.53 ± 1.38	2.75 ± 1.43	2.29 ± 1.78	0.46**	2.64 ± 1.58	2.23 ± 1.38	0.14***
Total household income (N)							
≤500,000	195 (30.47)	35 (19.55)	40 (70.18)		43 (17.70)	77 (47.83)	
500,001–1,000,000	338 (52.81)	120 (67.04)	13 (22.81)		151 (62.14)	54 (33.54)	
≥1,000,001	107 (16.72)	24 (13.41)	4 (7.02)		49 (20.16)	30 (18.63)	
Mean ±*SD*	690,003.60 ± 297,114.7	739,699.80 ± 243,848.00	472473.80 ± 269,389.60	267,226***	763,706.80 ± 254,905.60	600,523.60 ± 356,091.40	1631,83.10***
Access to extension services							
Yes	448 (70.00)	143 (79.89)	29 (50.88)		200 (82.30)	76 (47.20)	
No	192 (30.00)	36 (20.11)	28 (49.12)		43 (17.70)	85 (52.80)	

Source: Author's computation from VCDP data, 2022. Figures in parentheses represent the percentage distribution.
***Significant at 1% level, ** Significant at 5% level, *Significant at 10% level.

699.80 and ₦ 763,706.80, respectively. The mean annual income of beneficiaries was higher than those of the non-beneficiary cassava and rice-based farming households by 267,266 and 163,183.20 at 1%, respectively. This higher income, which may be attributed to benefitting from VCDP, was slightly higher than the ₦ 505, 712.40 annual equivalent of the ₦ 42,142.70 monthly income found by Mukaila (2022) in rural Nigeria and the ₦ 460, 842.70 annual income found by Ityokumbu et al. (2020). Furthermore, 70% of the households had access to extension services. Whereas the beneficiary cassava and rice-based farming households with access to extension services were 79.89% and 82.30%, the non-beneficiary counterparts were 50.88% and 47.20%, respectively. Since the VCDP intervention promoted financial literacy and access to advisory extension services among farming households (FGN/IFAD, 2019), benefitting from the intervention may have enhanced access to extension services among them.

Poverty status of VCDP beneficiaries and non-beneficiaries by crops cultivated

Poverty incidence, poverty gap and severity among beneficiary and non-beneficiary households and crops cultivated are shown in Table 2. Under each category namely: All households, rice-based farming households, and cassava-based farming households, beneficiaries and non-beneficiaries were profiled by their Mean Per Capita Income (MCI), poverty lines, poverty headcount (P_0), poverty gap/depth (P_1) and poverty severity (P_2). Households whose per capita income is lower than the poverty line were considered poor.

Among all the households, Mean Per Capita Income (MPCI) was ₦ 103,344.80 while the poverty line, which was taken as two-thirds of the MPCI was ₦ 68,896.53. The MCPI of ₦ 106,740.10 and poverty

Table 2. Poverty status of households disaggregated by crop cultivated and beneficiary status

Poverty status	All		Cassava-based		Rice-based	
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
	N=422	N=218	N=179	N= 57	N=243	N=161
Poverty headcount (P_0) (%)	25.59	56.88	24.02	66.67	26.75	53.42
Poverty gap (P_1)	4.40	7.90	1.80	2.20	2.60	5.70
Poverty severity index (P_2)	1.80	4.30	0.7	1.10	1.00	3.20
Mean Per Capita Income (MPCI)	103,344.80		106,740.10		101,361.30	
Poverty line (2/3 MPCI)	68,896.53		71,160.06		67,574.20	

Source: Author's computation from VCDP data, 2022.

line of ₦ 71,160.06 found among the cassava-based farming households were higher than the ₦ 101,361.30 MCPI and ₦ 67,574.20 poverty line found among the rice-based farming households. These poverty lines are similar to the ₦ 66,373.55 poverty line found by Osabohien et al. (2021) among young farmers in Nigeria. Among the beneficiary cassava-based farming households, 24.02% were poor compared to 26.75% who were poor among their counterpart rice-based farming households. On the other hand, poverty headcounts were 66.67% and 53.42%, among non-beneficiary cassava-based and rice-based farming households respectively. These show that while poverty headcount was higher among non-beneficiary cassava-based farming households compared to those of rice-based, among the beneficiary cassava-based farming households, it was lower than that among the beneficiary rice-based farming households. Hence, this implies that the impacts of VCDP on the reduction in poverty headcount may be higher in cassava-based farming households.

Similarly, the non-beneficiary households were deeper in poverty than the beneficiary farming households. While poverty gaps of 7.90%, 2.20%, and 5.70% were found among non-beneficiaries in all households, cassava-based farming households and rice-based farming households respectively, beneficiaries in all households, cassava-based farming households and rice-based farming households experienced 4.40%, 1.80%, and 2.60% poverty gaps respectively. This implies that ₦ 2,348.28 was required to lift a poor non-beneficiary cassava-based farming households out of poverty compared to the ₦ 5,777.59 required to lift a poor non-beneficiary rice-based farming households out of poverty. While ₦ 1,921.32 is needed to move poor beneficiary cassava-based farming households out of poverty, ₦ 2,635.39 was required to lift a poor beneficiary rice-based farming household out of poverty compared. The smaller amounts needed to move poor benefitting households out of poverty further confirms that the VCDP intervention may have led to reduction in poverty among them.

Following the same pattern, poverty was more severe among non-beneficiary households than the beneficiary households. Poverty severity values of 1.80, 0.7% and 1.00 % were found among beneficiaries in all, cassava-based, and rice-based farming households, respectively. This implies that there is less severe poverty among the poor benefitting households. Following Bamidele et al. (2019) who found that benefitting from VCDP improved income of farming households in Obafemi-Owode and Yewa North local government areas of Ogun State, Nigeria, it may be implied that benefiting from the VCDP led to higher income and poverty reduction, especially among the cassava-based farming households. These may be due to the fact that cassava is an important root crop of choice for cultivation across cultural and social divides in Nigeria (Otekunrin and Sawicka, 2019). Moreover, a report from the Collaborative Africa Budget Reform Initiative (CABRI) (2019) noted that there are opportunities for more commercialization and export of its processed products compared to rice which is largely imported as milled rice to complement local production in Nigeria. This could translate to more income and less poverty among the cassava-based farming households.

Impacts of VCDP on per capita income and poverty gap among households disaggregated by crop cultivated and beneficiary status

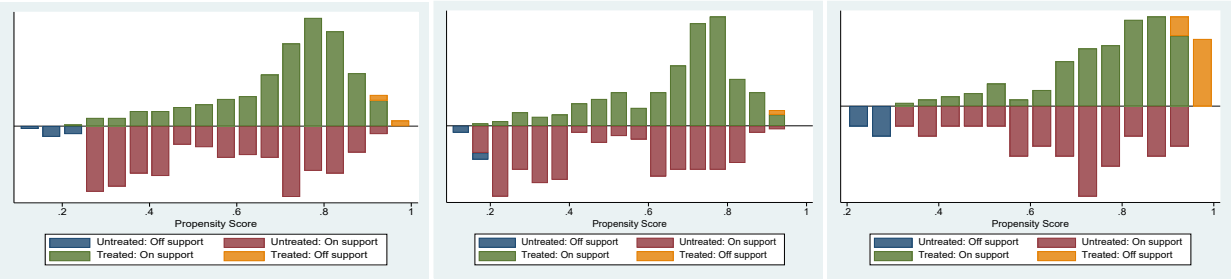
The impacts of VCDP intervention on per capita income and poverty reduction among farming households are shown in Table 3. Estimates of the treatment effects on the treated (ATT) using both NNM and KBM algorithms, given the characteristics of the households, show that the intervention had positive impacts on per capita income and poverty reduction among beneficiary households. Estimates from both algorithms were similar, showing consistencies in estimates. From the NNM estimates, annual per capita, income increased by ₦ 17,636.91, ₦ 59,205.57 and ₦ 14,260.02 for all the households, cassava-based farming households

Table 3. Impact of VCDP on per capita income and poverty severity of the households

Matching algorithm	Impact variable	Sample	Treated	Control	Difference	Standard error	T. value
	Per capita income (₦)			**All**			
NNM		Unmatched	112,338.86	85,934.18	26,404.68	6,134.67	4.30***
		ATT	112,756.88	95,119.98	17,636.91	8,413.85	2.10**
KBM		Unmatched	112,338.86	85,934,18	26,404.68	6,134.67	4.30***
		ATT	112,781.59	94,474.77	18,306.82	7,138.54	2.56**
				Cassava-based farming households			
NNM		Unmatched	117,386.09	73,307.98	44,078.11	12,452.28	3.54***
		ATT	120,357.66	61,152.09	59,205.57	119,99.70	4.93***
KBM		Unmatched	117,386.09	73,307.98	44,078.11	12,452.28	3.54***
		ATT	120,357.66	65,161.82	55,195.84	113,76.62	4.85***
				Rice-based farming households			
NNM		Unmatched	108,620.937	90,404.3198	18,216.617	6,916.85	2.63***
		ATT	108,440.553	94,180.5382	14,260.015	10,148.07	1.41
KBM		Unmatched	108,620.94	90,404.32	18,216.617	6,916.851	2.63***
		ATT	108,440.55	96,837.87	11,877.73	7,865.08	1.51
	Poverty gap (%)			**All**			
NNM		Unmatched	0.040	0.064	–0.024	0.004	–5.37***
		ATT	0.037	0.061	–0.024	0.008	–3.17**
KBM		Unmatched	0.040	0.064	–0.024	0.004	–5.37***
		ATT	0.037	0.066	–0.028	0.006	–4.14***
				Cassava-based farming households			
NNM		Unmatched	0.042	0.060	–0.018	0.007	–2.61***
		ATT	0.038	0.052	–0.014	0.010	–1.47
KBM		Unmatched	0.042	0.060	– 0.018	0.007	–2.61***
		ATT	0.039	0.053	–0.014	0.010	–1.46
				Rice-based farming households			
NNM		Unmatched	0.040	0.067	–0.026	0.006	–4.63***
		ATT	0.036	0.057	–0.021	0.011	–1.93*
KBM		Unmatched	0.040	0.066	–0.026	0.006	–4.63***
		ATT	0.041	0.063	–0.021	0.012	–1.75*

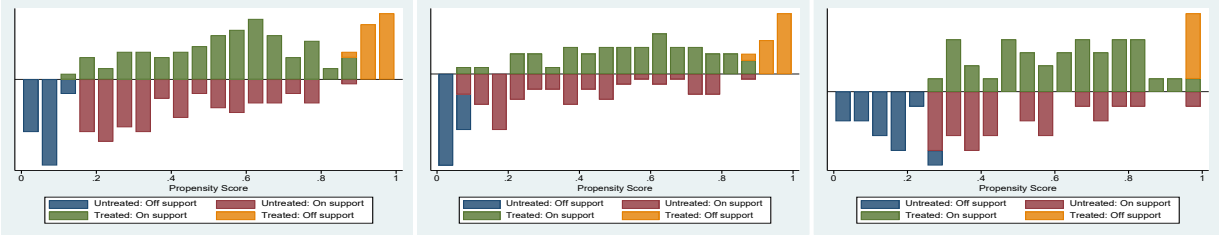
Source: Author's computation from VCDP data, 2022. ***Significant at 1% level, ** Significant at 5% level, *Significant at 10% level. NNM = Nearest neighbour matching, KBM = Kernel-based matching.

and, rice-based farming households. While the increase was significant for all households and cassava-based households at 5% and 1%, it was not significant for the rice-based. On the other, hand, the corresponding KBM estimates shows that annual per capita income increased by ₦ 18,306.82, ₦ 55, 195.84 and ₦ 11,877.73 at 5% and 1% for all households and cassava-based households respectively, but not significant for the rice-based households. While these findings corroborate Ityokumbul et al. (2020) who found a significant increase in average income and during VCDP intervention among rice farmers in Yewa North and Ijebu North-East, Ogun State, Nigeria, it implies that VCDP had more impact on per capita income of cassava-based farming households. The unmatched estimates show the average outcomes (per capita income and poverty gap) of the treated and control and as well as the differences between these averages before accounting for confounding due to observable characteristics of the beneficiary and non-beneficiary households. The unmatched average difference in outcomes may either be over or underestimated due to bias introduced by confounding characteristics (Kahlert et al., 2017; Varga et al., 2023). Estimates of average difference in per capita income was over estimated among all households and rice-based farming households, but underestimated among cassava-based farming households given the average per capita income estimates of ₦ 44,078.11 unmatched and ₦ 59,205.57



All Rice Cassava

Figure 3. Distribution of propensity scores and common support regions generated from impact estimates of capita income for all, rice-based, and cassava-based farming households.
Source: Figure generated using STATA 17 Software.



All Rice Cassava

Figure 4. Distribution of propensity scores and common support regions generated from per impact estimates of poverty gap for all, rice-based, and cassava-based farming households.
Source: Figure generated using STATA 17 Software.

ATT for the NNM and ₦ 44,078.11 unmatched compared to the ATT of ₦ 55,195.84 for the KBM.

About the poverty gap, NNM estimates of ATT were –0.024, –0.014 and –0.021 for all households, cassava-based farming households and, rice-based farming households, respectively. This implies that VCDP intervention reduced the poverty gap by 0.024%, 0.014% and 0.021%. Whereas, the reduction in poverty gap among all and rice-based households were significant at 1% and 10% respectively, that of cassava-based households was not significant.

The corresponding KBM estimates shows that poverty gap reduced by 0.028%, 0.014% and 0.021% Similar to the estimates of NNM, the poverty gap reduced among all households and rice-based households at 1% and 10% respectively, while it did not reduce significantly among cassava-based households. These align with Bamidele et al. (2019) which found that VCDP had a positive impact on income smallholder farmers in Obafemi-Owode and Yewa North Local Government Areas of Ogun State, Nigeria. Although the poverty gap was reduced among both cassava and rice-based farming households, unlike the case with annual per capita income, VCDP reduced the poverty gap more among rice-based farming households than cassava-based farming households. Also, Etuk and Ayuk (2021) found that poverty was reduced among beneficiaries of the Commercial Agricultural Development Project (CADP) a similar agricultural development intervention assisted by the World Bank in Nigeria. Similar to the per capita income estimates, the average difference in poverty gap reduction was overestimated among cassava-based and rice-based farming households but underestimated among all households given the average per capita income KBM estimates of –0.024 unmatched compared to the ATT of –0.028.

Figures 3 and 4 show the visual presentation showing substantial overlap in the distribution of the estimated propensity scores of the beneficiary and non-beneficiary households in terms of annual per capita income and poverty gaps. These indicate that the common support condition is satisfied as there is a substantial overlap in the distribution of the propensity scores.

CONCLUSION AND RECOMMENDATIONS

Poverty is a common social threat to life and economic development, especially in rural areas of developing countries. Efforts are thus being made to tackle the menace through pro-poor development interventions. The VCDP intervention was one of

the developmental interventions for improving the standard of living in the country. Hence, this study examined the impacts of VCDP intervention on poverty reduction among farming households in Nigeria. A sizeable proportion of the farmers were in their productive and active age. In addition, the beneficiary farmers cultivated larger farm sizes and earned more income than non-beneficiary farmers. The study found that VCDP had significant and favourable implications for increased per capita income and poverty reduction. Poverty headcounts were reduced among households who benefitted from VCDP compared to non-beneficiary households. Furthermore, poverty headcount, poverty gap, and poverty severity were lower among beneficiary cassava-based farming households than among the beneficiaries in rice-based farming households.

It was also found that VCDP increased per capita income and reduced poverty among farming households. Furthermore, the impact of the intervention on annual per capita income was significantly higher among cassava-based farming households compared to rice-based farming households. However, the intervention reduced the poverty gap more significantly among rice-based farmers than among cassava farmers. Thus, it could be concluded that the quantum of poverty reduction impact attributable to the VCDP intervention differs among beneficiary farming households in Nigeria based on crops cultivated. Therefore, the study recommends that the implementation of a crop-specific value-chain approach to agricultural development like the VCDP should be sustained and scaled up for wider coverage and for effective poverty reduction in rural Nigeria.

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CONFLICT OF INTEREST

The authors declared no conflicts of interest concerning the research, authorship, and publication of this article.

ETHICAL COMPLIANCE

The authors have followed ethical standards in conducting the research and preparing the manuscript.

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