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VALUE CHAIN DEVELOPMENT PROGRAMS AND SMALL SCALE RICE PRODUCERS IN NIGERIA

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ABSTRACT

This study aims to evaluate the extent to which value chain development [programs improve the livelihood outcomes of small-scale rice producers in Nigeria. Using a quasi-experimental cross-sectional research design, data was collected from 509 IFAD value chain development program participants and 608 non-participants through a structured questionnaire. Binary logistic regression, and propensity score matching (PSM) were used to analyze the data. The results of logistic regression showed that cooperative membership had a positive and significant ($p < 0.05$) influence on decision to participate in the [program while farm size and vulnerability context had a negative and significant ($p < 0.01$) impact on decision to participate. The PSM results indicated a positive and significant increase in income of rice producers for the treatment group relative to the comparison group. The average treatment effects (ATT) were found to be significant at 1% level. Also, the consumption expenditure of participants was on average higher than the non-participants, an indication of improved well-being. The study concluded that the [program had contributed significantly to the livelihood outcomes of [program participants. Among others, the study recommends that policy makers should further prioritize value chain development as a key management strategy for enhancing the livelihood of rural dwellers.

Keywords: *Rice Value chain, Value chain development program, Value chain actors, Livelihood outcomes, IFAD*

INTRODUCTION

Value chain development programs (VCDP) are an essential instrument for improving the standard of living for small-scale farmers in developing countries. In collaboration with the Federal

Government of Nigeria (FGN), the International Fund for Agricultural Development (IFAD) has been in the forefront of implementing a 6-year (2016 till end of 2021) value chain development strategy in Nigeria. The initiative attempts to include small-scale primary producers in the value chain in order to boost their productivity, profitability, and subsistence outputs. Among the six Nigerian states, Niger, Ogun, Taraba, Benue, Ebonyi, and Anambra were those that the intervention first aided in terms of value chain development. In 2019, the program's coverage expanded to include Nasarawa, Kogi, and Enugu (IFAD, 2019).

The rural households involved in the rice and cassava value chains have been the main target of the program. They include small-scale primary producers who work up to five hectares of land. Through the platform of organized association of producers, processors, and marketers, value chain actors can take part in this intervention program that has aimed to improve farmers' knowledge of production as well as markets by connecting them with sustainable market outlets where they can sell their produce (IFAD, 2020).

Despite the prominent role played by the value chain development approach in the current development agenda and its considerable potential to uplift the lives of the most vulnerable, there is, surprisingly, scanty evidence demonstrating that the intervention has effectively improved the living standards of the rural poor. Impact studies on value chain interventions are relatively uncommon, presumably as a result of the projects' high level of specificity, which makes them difficult to replicate, and the inherent complexity due to large numbers of actors that are involved (Garbero et al., 2018).

In numerous rural initiatives, the emphasis has been placed on enhancing the supply capacity of smallholders, often overlooking the consideration of market dynamics. Recognizing that inadequate links between producers and their existing or potential markets constitute a significant factor contributing to poverty traps, it is a vital aspect of interventions in value chains (Visser et al., 2012).

Many scholars (Carney, 1998.; Chambers, 1987; Davies, 1996; Ludi & Slater, 2007) have underlined the significance of utilizing a livelihood approach while working with smallholders in order to develop pro-poor value chains. They also support an approach that places an emphasis on assets. In addition, they claim that most value chain initiatives program involving the poor are founded on conceptual models that are relatively simple and concentrate on a small number of variables (production practices, output, income, employment, and infrastructure), while undervaluing or omitting other extremely important yet complex factors (such as vulnerability and the development of social and human capital) (Horton et al., 2016; Stoian et al., 2012)

Furthermore, most methodologies used to assess the livelihood effect of value chain development and growth are rather simplistic and provide only partial information on the benefits and drawbacks of the approach. Evaluation often places a greater emphasis on job creation and income generation while the reports produced as a result of value chain development give an incomplete and sometimes skewed picture of how it would influence the livelihood of the rural poor. This is because they focus on specific changes rather than more significant ones on important livelihood and business assets (Stoian et al., 2012). Based on the foregoing, this research aimed to address the existing gap by examining how the IFAD value chain development program has influenced the livelihood outcomes (specifically, income and consumption expenditure) of small-scale rice producers in Nigeria

LITERATURE REVIEW

Garbero et al. (2018) investigated the impact of agricultural value chains support in improving the livelihoods of smallholder farmers in Senegal's Groundnut Basin. The study obtained both qualitative and quantitative data on household characteristics, agricultural yields, supplementary income sources, social capital, vulnerability to shocks, and characteristics at the producer organization (PO) level. Data analysis and an estimation of the support program's impact were done using propensity score matching. The findings indicated that the support provided through the value chain positively influenced recipients' overall gross income, as well as income derived from crops, livestock, and other sources. Nevertheless, the results suggested no discernible impact on income from wage employment, and there was even a decrease in self-employment income. This implies that while value chain support may have stimulated the diversification of crops and increased revenue from agricultural activities, it did not similarly affect income from wage employment and led to a reduction in self-employment earnings

Tenabe (2018) explored the impact of the value chain development program (VCDP) on the well-being of smallholder producers in Anambra state, Nigeria, encompassing aspects such as income and access to various services. The study utilized both descriptive statistics (means and frequencies) and inferential statistics (analysis of variance) to analyze the collected data. The results indicated a significant enhancement in the financial prosperity of smallholder rice and cassava farmers in Anambra state due to the implementation of the VCDP. The survey concluded that participants in the VCDP experienced improvements in several dimensions of well-being, including increased productivity, income, accumulation of material and financial assets, access to markets, and social services

Bamidele et al. (2019) evaluated the effects of the IFAD Value Chain Development Program on the productivity and income of smallholder cassava and rice farmers in the Obafemi-Owode and Yewa North Local Government Areas of Ogun State, Nigeria. The research employed structured surveys and targeted focus groups for data collection, with a sample size of 329 participants. The data analysis process involved the use of both descriptive and inferential statistics. The results indicated a significant impact on the income and productivity of the small-scale farmers in the study area. Furthermore, the program contributed to the expansion of businesses, value addition, and the generation of marketable surpluses

In the study conducted by Adi et al, (2020), the focus was on analyzing the effects of the Value Chain Development [program on farmers residing in the Ardo-kola LGA of Taraba State, Nigeria. Data were collected from 90 randomly selected respondents through the use of a standardized questionnaire, and the results were assessed using frequency, percentage, and t-test analyses. The findings revealed a significant influence of the VCDP on farmers' capacity to sustain themselves in the surveyed area. This conclusion was drawn based on the observation that the calculated t-value (3.18) surpassed the tabulated t-value (2.048).

METHODOLOGY

The Study Area

The field survey took place in Ogun and Niger, selected randomly from the pool of six participating states. Ogun state, which is in the southwest of Nigeria, is renowned for having fertile soil and an ideal climate for farming. The state has vast arable farmland that are ideal for growing rice (Olufayo et al., 2019). Niger state is located in the north central part of Nigeria and stands out for its large landmass and extensive irrigation systems. The state has favorable conditions for rice

farming (Yahaya et al., 2016). About 90% of the population in Niger State depends on agriculture for their livelihood, which is the foundation of the state's economy (Omoare, & Oyediran, 2017). For many years, these two states have played a crucial role in Nigeria's rice sector.

Research Design

A cross-sectional, quasi-experimental research design was used for the study. The use of quasi-experimental designs (QEDs) was necessary to select a comparison group or time period that closely matched the treatment group or time period in baseline (pre-intervention) characteristics, as advocated by Handley et al. (2018). Due to limitations in time and data, this design was considered more practical, as noted by Hawkins et al. (2007).

Data Collection Method

Primary sources were used to gather the study's data. An interview-based, structured questionnaire was used to gather the data.

To ensure a representative sample, the research employed a multi-stage sampling technique. The initial phase involved randomly selecting two states, namely Ogun and Niger, from the pool of six participating states—Benue, Anambra, Ogun, Ebonyi, Taraba and Niger. In the second stage, three out of the eight LGAs participating in the [program were chosen due to the volume of rice produced in each region within the two states. In Niger State, Bida, Katcha, and Wushishi were chosen, whereas in Ogun State, Egbado-North, Ifo, and Obafemi-Owode were chosen. In the third stage, recipients and non-recipients were randomly chosen from each of the three LGAs in the two states. The total sample size consisted of 1,117 farmers, including 509 participants in the program (the treatment group) and 608 non-participants (the comparison group), all chosen randomly. Binary logistic regression model and propensity score matching were used to analyze the data.

Binary Logistic Regression Model

Using a binary logistic regression model, the variables influencing the participation of rice producers in the program were examined. Based on a set of independent parameters and a binary dependent outcome, the model may calculate the probability that an event will occur.

The basic logit model for rice producers is given by:

$$Y = \beta_0 + \beta_1 D_i + \beta_2 N_i + \beta_3 H_i + \beta_4 S_i + \beta_5 F_i + \beta_6 P_i + \beta_7 V_i + E_t \qquad (1)$$

Where Y equal 1 if the respondent participated in the IFAD program and 0 otherwise. β_0 = Intercept (i.e. the value of Y when all of the independent variables are equal to zero) and β_1- β_7 represents the regression coefficients. The demographic characteristics, denoted as Di, encompass the following: D_1 represents gender (1 if male, 0 otherwise), D_2 denotes age in years, D_3 signifies marital status (1 if married, 0 otherwise), D_4 represents the number of households, and D_5 corresponds to educational level. The natural capital variables, Ni, include N_1 for land access (1 if the respondent has access to land, 0 otherwise) and N_2 for the size of the paddy rice farm in hectares. Human capital variables, Hi, consist of H_1 for farm experience in years and H_2 for access to extension services (1 for yes, 0 otherwise). Social capital is represented by Si, where S_1 equals cooperative membership (1 if yes, 0 otherwise). Financial capital variables, Fi, encompass F_1 for access to credit (1 if yes, 0 otherwise). Physical capital variables, Pi, include P_1 for access to a

good road (1 for yes, 0 otherwise), P_2 for access to electricity (1 for yes, 0 otherwise), P_3 for access to potable water (1 for yes, 0 otherwise), P_4 for access to markets and market information (1 if yes, 0 otherwise), and P_5 for the distance to the nearest market in kilometers. The vulnerability context, V_I, is captured by V_1 for involuntarily being without food (1 if yes, 0 otherwise). The error term is represented by ε_t

Propensity Score Matching (PSM) Model

The PSM method was employed to estimate the impact of IFAD value chain development programs on the livelihood outcomes of small-scale rice producers.

Following Vishwanatha & Eularie (2017), Caliendo & Kopeinig (2005), Smith & Todd (2005), and Rosenbaum & Rubin (1983), the propensity score probability function is formulated as:

$$P(X) \equiv Pr\{D = 1 \mid X\} = E\{D \mid X\} \quad . \quad (2)$$

where,

X is the multidimensional vector of pre-treatment attributes and,

D = (0, 1) is the binary variable on whether an actor participated in the IFAD value chain development project (1) or not (0).

The operationalization of the propensity score involved estimating the predicted probability of participation using a logistic regression model (Fasakin *et al.,* 2022). Matching was conducted by utilizing the individual propensity score. The propensity score matching enables the estimation of the Average Treatment Effects on the Treated (ATT), as described by Imbens (2004) The ATT was determined using kernel based matching (KBM) approach.

The Average Effect of Treatment on the Treated (ATT) was estimated given a propensity score p (Xi) as follows (Becker & Ichino, 2002).

$$\begin{aligned} ATT &\equiv E\{Y_1i - Y_0i \mid Di = 1\} \quad (3) \\ &= E\{E\{Y_1i - Y_0i \mid Di = 1, p(Xi)\}\} \\ &= E\{E\{Y_{1i} \mid Di = 1, p(Xi)\} - E\{Y_0i \mid Di = 0, p(Xi)\} \mid Di = 1\} \end{aligned}$$

Where.

Y_{1i} and Y_{0i} represent the potential outcomes in the treatment and non-treatment counterfactual scenarios respectively. The outer expectation spans the distribution of (p(Xi) | Di = 1).

FINDINGS & DISCUSSION

4.1 Socio-economic attributes of rice producers

Demographic characteristics of rice producers is presented below in Table 1 (next page).

Table 1 Socio-economic Attributes of Rice Producers

	Pooled data		Participants		Non-participants	
Variables	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Gender						
Male	911	81.6	424	83.3	487	80.1
Female	206	18.4	85	16.7	121	19.9
Age (years)						
≤20	24	2.1	15	2.9	9	1.5
21-40	524	46.9	260	51.1	264	43.4
41-60	447	40.0	177	34.8	270	44.4
≥61	122	10.9	57	11.2	65	10.7
Marital status						
Single	232	20.8	115	22.6	117	19.2
Married	885	79.2	394	77.4	491	80.8
Household size						
0 - 4	255	22.8	129	25.3	126	20.6
5 - 9	775	69.4	332	65.2	443	72.5
≥10	87	7.8	48	9.4	39	6.4
Mean	6.33		6.31		6.34	
SD	2.29		2.50		2.11	
Farm size (ha)						
0.1-2.0	729	65.3	385	75.6	344	56.6
2.1-4.0	346	30.9	99	19.4	247	40.6
4.1-6.0	42	3.8	25	4.9	17	2.8
Mean	2.21		2.02		2.38	
SD	1.18		1.15		1.17	
Total	**1.117**		**509**		**608**	

Source: Author's computation, 2022

The result shows that male participants account for 83.3 percent of the total [program participants while female participants make up the remaining 16.7 percent. The percentage distribution for non-participants indicate that male make up 80.1percent of the total while female non- participants account for 19.9 percent. This finding suggest that males are more involved rice farming and participate more in IFAD value chain development [program. Marital status revealed that married participants' constitute77.4 percent of the total [program participants while single participants make up 22.6 percent. In contrast, the result indicates that married non-participants account for 80.8percent of the total while single non-participants constitute 19.2percent. This implies that married people engaged more in farming due to the fact that more resources are needed to improve livelihood and alleviate poverty.

The age distribution results reveal that a majority (51.1%) of [program participants are between 21 and 40 years old, whereas a higher percentage of non-participants (44.4%) fall within the age range of 41-60 years.This affirmed that most rice farmers are still at their productive and youthful age with strength for agricultural production invariably leads to increase in farm productivity. The distribution of the household sizes among [program participants indicate that majority (65.2%) have a household size ranging from 5-9 person with an average of six (6)

household members. These findings indicate that respondents with larger household sizes are more inclined to participate in IFAD [program. Farm size distribution among [program participants indicates an average of 2ha. This implies that the rice producers had a moderate household size and fairly large farm size such that it might contribute to their productivity and enhance their livelihood.

Factors influencing participation of rice producers

Binary logistic regression, a statistical analysis technique, was employed to examine the relationship between a binary dependent variable and one or more independent variables. The binary dependent variable in this context is the choice made by small-scale rice producers to engage in the value chain development program.

Table 2 Logit Regression Results on Factors Influencing Rice Farmers' Participation

Rice producers				
Independent variables	**Coeff.**	**Std. Error**	**P-value**	**Marginal Effect**
Demographic variables				
Gender	-0.117	0.182	0.519	-0.026
Age of respondent	0.058	0.111	0.602	0.013
Marital status	-0.307	0.195	0.115	-0.066
Size of household	-0.051	0.036	0.157	-0.011
Educational level	-0.456	0.207	0.027	-0.096**
Natural capital variable				
Access to land	0.455	0.234	0.052	0.106*
Size of farm	-0.187	0.063	0.003	-0.042***
Human capital variable				
Farming experience in years	0.003	0.149	0.825	0.001
Access to extension services	-0.041	0.251	0.871	-0.009
Social capital variable				
Cooperative membership	1.399	0.254	0.000	0.335***
Financial capital variable				
Credit Access	0.053	0.165	0.748	0.118
Physical capital variable				
Access to road infrastructure	-0.999	0.425	0.019	-0.188***
Access to rural electricity	0.435	0.358	0.224	0.102
Potable water access	-0.234	0.395	0.554	-0.050
Market information access	-0.835	0.519	0.108	-0.158
Proximity to the nearest market	-0.082	0.147	0.000	-0.018***
Vulnerability context				
Involuntarily without food	-1.617	0.179	0.000	-0.333***
Constant	3.721	0.776		0.000***
Number of observations				1,117
Log likelihood				-564,234.88
LR Chi-square (17)				365.84
Prob > chi^2				0.000
Pseudo R^2				0.2448
Marginal effects				;0.66440545

Source: Computation by the Author, 2022

As shown in Table 2, membership in a cooperative society exerts a significant and positive impact on producers' choices to engage in the value chain development project, with statistical significance at the 1% level. The marginal effect indicates that belonging to a cooperative group

increases one's likelihood of participating in IFAD [program by 33.5%. Moreover, the proximity to the nearest market demonstrated a statistically significant adverse effect on rice producers' decisions to partake in the IFAD value chain development program at the 1% significance level. The size of the farm had a statistically significant negative effect on a rice producer's inclination to participate in an IFAD project, evident at the 1% significance level. The marginal effect reveals that with an increase in farm size, there is a 4.2% decrease in the probability of participating in the IFAD rice value chain [program. The vulnerability context of rice producers exerted a statistically significant negative impact on their capacity to engage in the IFAD value chain development program, observed at the 1% significance level. According to the marginal effect, there is a 33.3% reduction in the likelihood that vulnerable rice growers will participate in the IFAD rice value chain [program

The results suggest that, at a 5% significance level, the educational attainment had a statistically significant adverse influence on rice producers' decisions to participate in IFAD value chain development [programs. The marginal effect predicts that as education levels rise, producers' chances of participating in the IFAD are reduced by 9.6%. Land access positively influenced the participation of IFAD rice producers, with statistical significance at the 10% level. The marginal effect suggests that if land is made accessible for rice production, rice producers are 10.6% more inclined to participate in the IFAD rice value chain program. Contrary to expectations, the study revealed that access to road infrastructure had a significant and negative impact on rice producers' decisions to participate in the IFAD program at the 5% significance level. This aligns with the findings of Habte (2016), who similarly identified a negative association between access to roads and the likelihood of participation in a savings and microcredit program in rural Eritrea

Impact Estimation Using Propensity Score Matching Model

Propensity Score Matching (PSM) is a statistical technique used to estimate the average treatment effect by comparing the outcomes of participants in a treatment or program with matched non-participants. In this case, researchers have used PSM to analyze the impact of IFAD value chain development programs on the livelihoods of rice value chain actors. These results compare the outcomes of program participants with those of non-participants who were carefully selected based on shared characteristics.

Covariate balance indicators for rice producers (pre- and post-matching)

Table 3 (next page) analyses the result of the balancing test for rice producer. The results reveals that before matching, some covariates exhibit statistically significant differences, except gender, age, size of household , rice farming experience, access to extension services, access to electricity, credit access , access to potable water, access to market information, and marital status. However, after matching all covariates indicates insignificance difference as such they are balanced. It concurs with Sianesi (2004), who suggested that, following matching, there should be no systematic disparities in the distribution of covariates between the two groups.

Table 3 Propensity Score & Balancing Test for the Kernel Based Matching for Producers.

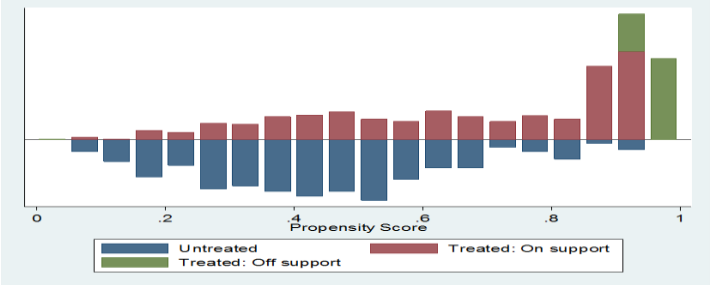
Variables	Treated	Control	%bias	T	P>t
Gender	1.169	1.201	-8.1	-1.34	0.182
Age	2.635	2.484	21.5	3.61	0.832
Marital status	0.795	0.867	-18.0	-3.16	0.254
Educational level	0.849	0.859	-2.8	-0.48	0.632
Access to land	0.894	0.879	4.5	0.74	0.461
Household size	6.592	5.607	44.0	6.97	0.182
Farm size	2.153	2.236	-7.4	-1.17	0.241
Years of experience in rice farming	16.028	16.494	-8.4	-1.46	0.144
Access to extension services	0.918	0.907	3.2	0.59	0.557
Membership of cooperative society	0.931	0.918	3.8	0.80	0.424
Access to credit	0.663	0.628	7.3	1.19	0.236
Access to road infrastructure	0.953	0.944	3.0	0.65	0.518
Access to electricity	0.927	0.930	-1.0	-0.19	0.846
Access to potable water	0.952	0.972	-10.0	-1.76	0.791
Market information access	0.966	0.963	1.6	0.25	0.805
Proximity to nearest market	10.365	10.84	-9.1	-1.56	0.118
Vulnerability context	0.525	0.486	9.1	1.28	0.201

Source: Author computation, 2022

Propensity Score Matching Graph on Treated and Non-treated for producers' Income and consumption expenditure

The propensity score distribution as presented in Figure 1 demonstrates that there is enough overlap between the two groups, supporting the robustness of the finding to the common support assumption.

Figure 1 Propensity Score Matching Graph on Treated and Non-treated



.Source: Author's computation, 2022

Effect of the IFAD value chain development program on both income and consumption expenditure

The result of the average treatment effect on the treated (ATT) for rice producers is presented in Table 4.

Table 4 Average Treatment Effects of IFAD value chain development [program on Producers

Sample	treated	controls	difference	S. E.	T-stat
KBM (Income)					
Unmatched	654,963.38	113,715.37	541,248.01	550350.909	5.40
ATT	774,481.69	107,985.03	666,496.66	558343.223	3.58***
ATU	113,715.37	241,814.35	128,098.98		
ATE			425,241.38		
Kernel (Expenditure)	Based	Matching	(KBM)		
Unmatched	136,666.80	83,810.28	52,856.53	7083.11306	7.46
ATT	141,899.61	82,144.22	59,755.39	8586.27653	6.96***
ATU	83,810.28	135,080.23	51,269.95		
ATE			55,953.08		

Source: Author's computation, 2022

Note: ***, significant at 1%

The result indicates a positive and significant increase in income of about ₦666,496.66 among participants. The average treatment effect was found to be significant at 1% significance level. This implied that income of rice producers' that participated in IFAD rice value chain [program is higher than that of non-IFAD rice producer participants by ₦666,496.66. This finding is consistent with the outcome of Garbero et al. (2018), who demonstrated that agricultural value chain support led to increased crop income, elevated livestock income, and higher overall gross income for beneficiaries in their study on the impact of agricultural value chain support in enhancing the livelihoods of smallholder farmers in Senegal's Groundnut Basin. Also, the KBM results show that the average treatment effect on consumption expenditure for participating rice producers was positive and significantly higher than non-participants by ₦59,755.39. It was significant at 1% level. This implied that rice producers who had participated in IFAD rice value chain development [programs had their consumption expenditure improved by about ₦59,755.39 compared to non-participants. This is consistent with findings of Habte (2016). The results confirmed that the intervention [program has a positive and significant impact on the livelihood of the participants

Rosenbaum sensitivity analysis on income and consumption expenditure

The Rosenblum sensitivity analysis result is presented in Table 5.

Table 5 Rosenbaum sensitivity analysis on income and consumption expenditure

Gamma (r)	Sig+	Sig-	t-hat	t-hat-
1	0	0	99500	99500
1.2	0	0	96475	102500
1.4	0	0	93800	105100
1.6	0	0	91700	107400
1.8	0	0	90000	109500
2	0	0	88400	111250
2.2	0	0	87000	113000
2.4	0	0	85750	114600
2.6	0	0	84750	116025
2.8	0	0	83850	117500
3	0	0	83000	118950

Source: Author's computation, 2022

Gamma – log odds of differential assignment due to unobserved factors
Sig+ - upper bound significance level
Sig- -lower bound significance level
t -hat+ -upper bound Hodges-Lehmann point estimate
t –hat- -lower bound Hodges-Lehmann point estimate

The outcomes as presented in Table 5 above indicate the extent of critical hidden bias resulting from unobserved confounders. This measurement gauges the extent of deviation if a study lacks hidden bias. A value of r=1 signifies an identical odds ratio for treatment, signifying the absence of hidden bias in the study. Conversely, an r=2 suggests hidden bias when two units with identical values experience different probabilities of receiving treatment. The results, as indicated by Sig-, demonstrate the statistical significance of p-critical values for all outcome variables, estimated across various critical values of gamma. This suggests that crucial covariates influencing both participation and outcome variables have been duly considered, aligning with the findings of (Nguyen et al., 2018). The findings underscore a holistic impact of participation in the IFAD rice value chain program on the outcomes

CONCLUSION & IMPLICATIONS

Based on the empirical evidence obtained from the study, it is concluded that value chain development program has positively impacted on the livelihood outcomes (income and consumption expenditure) of program participants compared to non-participants, evidence that the intervention is helping to improve the living conditions of small-scale rice producers in the research region. To maximize the program's impact, it is recommended that policy makers should further prioritize value chain development as a key strategy for agricultural development. There is also the need to scale up the program to cover more states of the federation so as to reach more small scale rice producers.

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