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Economic Impact of IFAD-Value Chain Development Programme on Rice Farmers in North Central Zone, Nigeria

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ABSTRACT: Raising agricultural productivity, reducing food insecurity and poverty levels of poor- resource farmers is an important policy goal for any concerned nation, particularly, in developing countries, Nigeria inclusive. The study assessed the economic impact of International Fund for Agricultural Development-Value Chain Development Programme (IFAD-VCDP) on rice farmers in North Central Zone, Nigeria using appropriate standard techniques with a well structured questionnaire. Data obtained show a positive trend in net farm income per hectare, increasing from ₦390, 897.90 to ₦686, 652.91 before and after IFAD-VCDP intervention respectively. Before IFAD-VCDP intervention, 41.95% of the respondents were food-secured, improving to 61.43% after intervention. Poverty status of the respondents decreased from 50.5% before IFAD-VCDP to 43.8% after the programme intervention, with a reduced poverty depth and severity of 0.21 and 0.082 respectively. The study findings conclusively demonstrate that the IFAD-VCDP had a substantial and positive impact on livelihoods of the farmers as it led to significant improvements in the farmers' income, resulting in notable rise in net farm income per hectare, accompanied by economic uplift in food security and a reduction in poverty level among the rural farmers in the study area. Hence, the findings of the study provide valuable insights for tailoring interventions to maximize the economic benefits for the rural farmers.

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Over the last decade, considerable efforts have been made throughout the world to provide efficient, effective and appropriate technology, training and information towards improving agricultural productivity, production efficiency and alleviating poverty among the rural farmers. In Nigeria, part of efforts made at improving the status of farmers resulted in the institutionalization and implementation of several agricultural productivity enhancement programmes/projects by the Federal Government, some of which are defunct or abandoned, and some restructured while others are still in place (World Bank, 2017, NBS, 2005, Ajibefun and Aderinola, 2006). One of such programmes is the International Fund for Agricultural Development -Value Chain Development Programme (IFAD-VCDP), a global initiative that has been implemented with localized strategies in Nigeria, funded by the International Fund for Agricultural Development (IFAD) and

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domiciled in the Federal Ministry of Agricultural and Food Security, formally known as Federal Ministry of Agricultural and Rural Development (FMARD). Generally, IFAD-VCDP aims to enhance the agricultural value chains, especially rice and cassava, addressing issues such as productivity, market access and sustainability (Okoye *et al.*, 2020). Specifically, the programme aimed at reducing rural poverty, increasing food security and accelerating economic growth on a sustainable basis by applying different types of innovations in the agricultural sector depending on the root cause of the problem in the specific location of concern (FMARD, 2013). According to Okoye *et al*. (2020), IFAD-VCDP is well anchored in Nigerian government's vision for Agricultural Transformation Agenda (ATA) through commodity value chain approach, with emphasis on enhancing productivity and access to markets for rice and cassava smallholder farmers. It takes a holistic and demand-driven approach to addressing constraints along the rice and cassava value chains, through an inclusive strategy, strengthening the capacity of actors along the chain including producers and processors as well as public and private institutions, service providers, policy-makers and regulators. The IFAD-VCDP is being implemented in nine States of Nigeria including; Anambra, Benue, Ebonyi, Enugu, Kogi, Nasarawa, Niger, Ogun and Taraba State. Following the implementation strategic plan of the programme in the country, it is obvious that the programme is the brain child of Nigeria. It is therefore, expected to benefit primary producers especially the rural farmers who produce over 70 percent of the agricultural commodities. Hence, it is expected that the programme will boost rice production, the income of rice farmers as well as the value accorded to locally produced rice (Ndanitsa *et al*., 2020). Rice, a staple food crop is critical for food security throughout Africa, and most especially in Nigeria. For many years, rice had the fastest growing consumption rate among all staple crops, determined in large part by huge growth in demand in urban centers (Africa Rice, 2019). Consumers are exhibiting a shift in preference from traditional staples (such as cassava, maize and yams) to rice (Nigerian National Food Reserve Agency, Federal Ministry of Agriculture and Water Resources, Japan International Cooperation Agency, 2009).

In rice producing countries, Nigeria inclusive, the enterprise provides employment for more than 70 percent of the inhabitants in various activities along the production/distribution chain from cultivation to consumption (Ajoma et al., 2016). However, the production of rice in Nigeria has been growing in arithmetic progression while its consumption has been growing geometrically (Shehu *et al*., 2010). AfricaRice (2019) reports that in 2018 Nigeria had a decrease in rice production of 2.70 percent compare to 2017 figures (5.70%). Consequently, the domestic supply of rice has continued to fall short of demand and importation is undertaken to make up the shortfall as about 1.5 metric tons of rice is imported annually by Nigerian government. This constitutes a huge drain on the nation's income with its untold negative effect on the balance of trade (Ogundele *et al*., 2006). IFAD-VCDP as a 'brain child of Nigeria', is therefore, targeted to boost rice production by providing affordable agricultural inputs like fertilizer and hybrid seeds to farmers in order to increase their yield per hectare and make it comparable to world standard (FMARD, 2019). It is therefore, becomes important for this study to assess the economic benefits of the programmme to beneficiary farmers. Hence, the objective of this study is to evaluate the economic impact of International Fund for Agricultural Development-Value Chain Development Programme (IFAD-VCDP) on rice farmers in North Central Zone, Nigeria.

MATERIALS AND METHODS

The Study Area: The study area was North Central Zone, Nigeria. The Zone comprises six States, viz: Benue, Kogi, Kwara, Nassarawa, Niger, and Plateau States, as well as the Federal Capital Territory (FCT), Abuja. It is situated between Latitudes 6^0 30' - 11^0 20' N and Longitudes 7^0 30' - 10^0 43'E with a land area of 296,898 km^2 representing nearly 32 percent of the country's total land area (NBS, 2008). The Zone has a population of 20.36 million people with rural population constituting 77 percent (NPC, 2006). The Major ethnic groups of Zone are the Tiv, Gwari, Baruba, Basa, Bagana, Nupe, Yoruba, Igbira, Igala, Idoma, Jukun, Angas and Biron (Ibrahim, 2019; Seibert. 2007).

On the average, the North central Zone of Nigeria receives between 1000mm to 1500mm of rainfall annually. The wet season usually starts from April to October or November while the dry season is November to March with the mean annual minimum and maximum temperature of 22.4^0C and 33.4^0C respectively. The mean annual relative humidity stands at 40.7 percent, it is usually lowest (13.2 %) in January and highest (74.4 %) in July (NBS, 2005).
Agriculture is the mainstays of the Zone's economy with majority (70%) of rural population directly engage in farming activities to earn their living. The major food crops of the Zone are; maize, rice, millet, sorghum, cowpea, groundnut, yam, cassava, melon and soybeans, major fruits and nuts in the Zone

includes; citrus, mango, cashew and kola nuts while the major livestock found in the Zone are; goat, sheep, cattle, pig and poultry (Ibrahim, 2019).

Sampling Procedure: This study adopted a multi-stage sampling procedure to select respondents in the study area. In the first stage, three States participating in IFAD-VCDP were purposively selected for the study. They include; Benue, Niger and Nasarawa States. In the second stage, three Local Government Areas (LGAs) each from the selected States known for intense rice production and have participated and benefited from the programme were purposively selected, giving a total of nine LGAs, which include: Kwande, Gwer-west and Agatu from Benue State, Bida, Katcha and Wushishi from Niger, and Lafia, Doma and Wamba from Nasarawa State. In the third stage, list of registered rice farmers under IFAD-VCDP from each of the sampled States were obtained from their respective State Programme Coordinators. Eventually, sample frame was developed for each of the LGAs sampled and by using a proportional allocation of 7% (0.07) across board, a total sample size of 210 beneficiaries was randomly selected for the study.

Method of Data collection and Data Analytical Techniques: Data for this study were collected from primary source, gathered via the use of a well-structured questionnaire. The data collected were analyzed using statistical tools such as frequency, percentage, mean score, net farm income analysis, multiple regression models, food security index and Foster-Greer -Thorbecke (FGT) poverty model. Paired sampled t- test was used to test the null hypothesis.

Model Specification

Net Farm Income Analysis: The Net Farm Income (NFI) analysis was used to evaluate the income level of beneficiary rice farmers before and after intervention of IFAD-VCDP in the study area. NFI is represented as follows:

$$NFI = GI - TVC - TFC \quad (1)$$

where; NFI = Net Farm Income (₦/ha) (Before or After VCDP participation); GI = Gross Income (N); TVC = Total Variable Cost (N); TFC = Total Fixed Cost (N)

The straight line method of depreciation was also used to calculate the rate of depreciation. Thus;

$$\text{Depreciation} = \frac{Principal\ cost - Salvage\ value}{Expected\ Asset\ life\ span} \quad (2)$$

Food security index (FSI): The food security index estimation was done using the food consumption recall approach for the selected household in the study area. The food security index is expressed as follows:

$$Xi = \frac{Yi}{R} \quad (3)$$

Where, i = Food security status of the ith household; Y_i = Daily per capita calorie intake of ith household; R = Recommended per capita daily calorie intake (2260kcal).

The beneficiary rice farmers were classified into; food secured household and food insecure household based on the calculated value of the ith household. If Xi ≥ 1 = food secure ith household while, Xi ≤1= food insecure ith household.

Poverty indices: The Foster-Greer -Thorbecke (FGT) weighted poverty measure, otherwise called the Pα measure, was used to obtain the incidence, depth and severity of poverty of the respondents. The FGT measure for the ith sub-group ($P_{\alpha i}$) is given in equation 4.

$$P_{ai} = \frac{1}{n}\sum_{i-1}^{q}[(z-y)/z]^{a} \quad (4)$$

Where; a = 0, $P_0 = \frac{1}{n}\sum_{i-1}^{q}[(z-y)/z]^0 = \frac{q}{n}$ = poverty incidence; a = 1, $P_1 = \frac{1}{n}\sum_{i-1}^{q}[(z-y)/z]^1$ = poverty depth ; a = 2, $P_2 = \frac{1}{n}\sum_{i-1}^{q}[(z-y)/z]^2$ = poverty severity and a = degree of poverty aversion; n = number of households in a group; q = the number of poor households; z = poverty line and y = the per capita expenditure (PCE) of the ith household.

Paired sample t-test: To determine if there is a significant difference in the income levels of beneficiary rice farmers before and after intervention of IFAD- VCDP in the study area, Paired sample t-test was used. The *t*- statistic test is calculated as shown in equation 5.

$$\mathbf{t} = \frac{\boldsymbol{X_1 - X_2}}{\sqrt{\frac{s_1^2}{n_1}} + \sqrt{\frac{s_2^2}{n_2}}} \quad (5)$$

Where, t = t-statistic; x_1 = Mean parameters of beneficiary rice farmers before intervention of the IFAD- VCDP; x_2 = Mean parameters of beneficiary rice farmers after intervention of the IFAD-VCDP; s_1 = Standard deviation of beneficiary rice farmers

before intervention of IFAD- VCDP; s_2 = Standard deviation of beneficiary rice farmers after intervention of IFAD-VCDP; n_1 = Total number of beneficiary rice farmers before intervention of IFAD-VCDP; n_2 = Total number of beneficiary rice farmers after intervention of IFAD- VCDP.

RESULTS AND DISCUSSION

*Estimation of the Respondent's Income level before and after IFAD-VCDP intervention in North Central Zone, Nigeria:*The results of the net farm income analysis of the beneficiary rice farmers before and after IFAD-VCDP intervention in the study area is presented in Table 1.

The purpose of net farm income (NFI) in this study is to measure the difference between revenue and expenses of the respondents, before and after intervention of IFAD-VCDP in the study area. A Positive difference indicates a positive net farm income and vice versa.

Results in Table 1 showed that before IFAD-VCDP's intervention in the study area, the farmers' gross farm income per hectare was ₦551, 007.20. While after the intervention of the programme, their gross farm income stood at ₦1, 046,217.72.

This shows a significant increased (difference) of ₦495, 210.52 after the intervention, implying that the rice farmers in the study area earned more income as they participated in the programme.

It is evident from the results in Table 1 that the operational costs; including land, fertilizers, seeds, herbicides, and labor, before and after the programme intervention were ₦157, 482.08 and ₦356, 336.10 respectively. The observed increased in the farmers' operational costs after IFAD-VCDP could be as a result of increment in farm size cultivated.

Depreciated costs rose slightly from ₦2, 627.22 to ₦ 3,128.71 before and after IFAD-VCDP respectively, contributing to the overall total cost (Operational costs + Depreciated costs) which increased from ₦160, 109.30 to ₦359, 564.81 before and after the programme respectively.

Despite the rise in costs, the farmers' net farm income per hectare showed a positive trend, escalating from ₦390, 897.90 to ₦686, 652.91 before and after intervention respectively. The results suggest a considerable improvement in rice farmers' net farm income, highlighting the potential positive impacts of the IFAD-VCDP intervention in the study area.

Table 1: estimation of net farm income of the respondents before and after IFAD-VCDP intervention in north central zone, Nigeria

Description	Before IFAD-VCDP (₦/ Ha.)	After IFAD-VCDP (₦/Ha.)
A: Gross farm Income/Ha.	**551,007.20**	**1,046,217.72**
B: Operational Costs		
Cost of Land	32,142.90	50,490.48
Cost of Fertilizers	51,261.10	143,890.48
Cost of Seeds	16,188.10	26,035.71
Cost of Herbicides	13,196.70	25,942.38
Cost of Labour	44,693.28	109,979.05
Total Operational Cost/ Ha.	**157,482.08**	**356,336.10**
C: Depreciated cost	2,627.22	3,128.71
D. Total Cost (B + C)	**160,109.30**	**359,564.81**
E: Net Farm Income/Ha. (A- D)	**390,897.90**	**686,652.91**

Source: Field Survey, 2023

Food Security Status of the Respondents, before and after IFAD-VCDP intervention in North Central Zone, Nigeria: The food security status of the respondents before and after the intervention of IFAD-VCDP in North Central Zone of Nigeria is presented in Table 2. To provide a more nuanced interpretation, the study adapted a food security benchmark of 2260 kilocalories (kcal), which is the recommended per capita daily caloric intake. This implies that households whose daily per capita calorie intake stood up to 2260 kcal were regarded as food secured; otherwise they were regarded as food insecure. Sequel to this benchmark, the results revealed that, prior to IFAD-VCDP intervention in the study area, 41.95 percent of respondents (86 households) were food-secured, with a headcount ratio of 0.586, whereas most (59.05%) respondents were food insecure, with a headcount ratio of 0.431. On the other hand, the results showed a notable improvement in food security of the respondents in the study area after the programme, as the percentage of food-secured respondents increased to 61.43 percent (129 households) with an enhanced headcount ratio of 0.643.

Conversely, the percentage of food-insecure respondents decreased to 38.57 percent (81 households), accompanied by a lower headcount ratio of 0.404, indicating a positive changes in food security of the respondents and highlighting a significant shift towards a more secure status. This result implies that the IFAD-VCDP programme has effectively contributed to improving the food security situation among the respondents in the study area, demonstrating positive outcomes in terms of both the percentage of food-secured households and the associated headcount ratios. This result confirms the results of Olaolu, et. al. (2013) who reported in their research on impact of national Fadama development

project phase (II) on poverty and food security among rice farming beneficiaries in Kogi State, Nigeria, that there was a significant decreased (2.8%) in food insecure households after the project.

Table 2: food security status of the respondents before and after IFAD-VCDP

Category	BEFRORE IFAD-VCDP			AFTER IFAD-VCDP		
	Freq	Percentage	**Headcount**	**Freq.**	**Percentage**	**Headcount**
Food secured	86	41.95	0.586	129	61.43	0.643
Food insecure	124	59.05	0.431	81	38.57	0.404
Total	210	100		210	100	

Source: Field Survey, 2023

Poverty Status of Beneficiary Rice Farmers, Before and After IFAD-VCDP Intervention in North Central Zone, Nigeria: The poverty status of the beneficiary rice farmers in the study area were analyzed using the three poverty indices (poverty incidence, poverty depth and poverty severity) from Foster- Greer-Thorbercke (FGT) index and the results are presented in Table 3. To determine the poverty status of the respondents, a common base line (poverty line) was established. The poverty line was determined using two third (2/3) of the mean per capita household's expenditure (MPCHHE). A monthly relative poverty line of ₦29, 029.68 before IFAD-VCDP intervention in the study area was established and another poverty line of ₦48, 420.56 per month, after the programme intervention was also established. Sequel to this, households spending an average annual expenditure below ₦43, 544.52**,** before the programme were considered poor while those with expenses higher than ₦43, 544.52 were considered non-poor. The result of the poverty incidence among the sampled households was 0.35 which imply that about 35 percent, of the selected households in the study area were poor before IFAD-VCDP intervention. Poverty depth represents the depth or poverty gap, it is the mean distance that separates the population from the poverty line. The poverty gap index of the poor households before the programme stood at 0.23, which means that about 23 percent of the total expenses are required to bring individuals within the poor households up to the poverty line of ₦43, 544.52. The implication is that farmers among the poor household need about 23 percent of ₦43, 544.52, in addition to their mean per capita monthly expenditure to come out of poverty. The results from Table 4 also showed that the poverty severity index of the households before the programme's intervention was 0.096 percent. The poverty severity takes into account not only the distance separating the poor from the poverty line, but also the inequality among the poor (Oyinbo and Kehinde, 2016).This implies that poverty is more severe among poor farmers with about 9.6 percent of the selected households that constitute the poorest among the rice farmers in the study area. This result is in agreement with the findings of Nwahia *et al*. (2021) who reported that 54% of farming households in Ebonyi State were poor, while 46% of them were not poor, in their researched on analysis of poverty status of Ebonyi State farming households. The situation is different when these farmers have participated and benefited from IFAD-VCDP in the study area. Though as shown in Table 5, there is an increase in the poverty line from ₦29,029.68 to ₦48,420.56 but the number of poor households have reduce from 50.5 percent to 43.8 percent. This has further reduced the head count ratio (poverty incidence) to 0.31, meaning that about 31 percent of the respondents after the IFAD-VCDP intervention in the study area were poor. Poverty depth also reduced from 0.23 to 0.21 and this implies that the poor households require 21 percent of the poverty line to escape from poverty group. This result is in agreement with the findings of Ojo and Adetunji (2020) who reported that 25 percent of the respondents were poor with 0.31 and 0.36 as their poverty depth and severity respectively. Poverty severity value equally reduced slightly from 0.096 to 0.082 as shown in Table 3. This implies that the severity of poverty among the poor households after the programme in the study area was 8 percent. The intervention of the IFAD- VCDP in the study area has shown that indeed, supporting the poor- resource farmers with adequate production/ marketing resources is very key and significant towards improving their standard of living and reducing their poverty level.

Hypothesis testing: The null hypothesis that there's no significant difference in the income levels of the respondents before and after the IFAD-VCDP intervention in the study area was tested using paired sample t-test analysis. The result is shown in Table 4. The results showed a significant difference in the income level of respondents before and after the IFAD-VCDP intervention as the mean income of the respondents before the intervention was to ₦ 415,039 with a standard error of ₦ 27,393.27. Whereas, after the programme, the mean income increased to ₦770, 287.5 with a standard error of ₦ 50,840.74 The

difference between the two incomes showed a significant increased of ₦ 355,248.5. The results also showed a t-value of 12.45 with 209 degrees of freedom resulted in a two-tailed p-value of 0.000, which is less than the conventional significance level of 0.05. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted.

Table 3: poverty status of beneficiary rice farmers, before and after IFAD-VCDP Intervention in north central zone, Nigeria

	BEFORE IFAD-VCDP		AFTER IFAD-VCDP	
Poverty Category	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Poor	106	50.48	92	43.81
Non poor	104	49.52	118	56.19
Total	210	100.00	210	100.00
Poverty indices:				
Poverty Incidence (FGT=0)		0.345		0.312
Poverty Depth (FGT =1)		0.230		0.210
Poverty Severity (FGT =2)		0.096		0.082
MPCHHE	**₦43,544.52**		**₦72,630.84**	
Poverty line (PL)	**₦29,029.68**		**₦48,420.56**	

Source: Field Survey, 2023; Note: MPCHHE = Mean per capita household expenditure; PL= 2/3 of MPCHHE.

Table 4: paired sample t- test result on income of respondents before and after IFAD-VCDP

Variable	**Mean**	**Std. Err**	**Std Dev.**	**95% confidence Interval**				
				Lower	**Upper**	**t- value**	**df**	**P(2-tailed)**
Income A.	770287.5	50840.74	736752.3	670061.1	870513.9			
Income B.	415039	27393.27	396966.2	63103.4	469041.6			
Difference	355248.5	28527.07	413396.6	411486.2	299010.9	12.45**	209	0,00

*Source: Field Survey, 2023; ** = p < 0.05; B. = Before IFAD-VCDP Intervention, A. = After IFAD-VCDP Intervention.*

Conclusion: It is evident from the findings of the study that the IFAD-VCDP had a substantial and positive impact on the livelihoods of beneficiary rice farmers in North Central Zone, Nigeria. The programme led to significant improvements in the farmers' income, resulting in a notable rise in net farm income per hectare. This economic uplift was accompanied by improvement in food security and a reduction in poverty level among the rural farmers in the study area. These findings provide valuable insights for tailoring interventions to maximize the economic benefits for the rural farmers.

Declaration of Conflict of Interest: The authors declared that there is no conflict of interest.

Data Availability Statement: Data are available upon request from the corresponding author.

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