

## IMPACT OF FADAMA III ADDITIONAL FINANCING (AF) DEVELOPMENT PROJECT ON RICE YIELD, INCOME AND CHALLENGES TO PARTICIPATION IN PLATEAU STATE, NIGERIA

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### ABSTRACT

The study assessed the impact of the Fadama III Additional Financing (AF) Development project on rice farmers' yield, income, and challenges to participation. A total of 259 respondents (participants and non-participants) were selected through a multistage sampling technique from rice-producing communities. Using Propensity Score Matching (PSM) methods, results showed that participants recorded an average rice yield of approximately 2,600 kg/ha, significantly higher than the 1,500 kg/ha of non-participants reflecting a yield increase of over 1,090 kg/ha across different matching algorithms. Similarly, income among participants averaged between ₦1,020,000 and ₦1,423,000, significantly exceeding the non-participants' income range of ₦661,557 to ₦941,557, with income gains of up to ₦481,442. Despite these benefits, several constraints hindered participation, with security challenges reported by 86.9% of respondents as the most critical barrier, followed by inadequate land access (68.7%) and poor transportation (64.5%). Other notable challenges included high technology costs, inadequate startup funds, and climate change effects. The study recommends targeted interventions such as improving rural security, land reforms, infrastructural development, affordable technology dissemination, and expanded farmer training and credit access to enhance the effectiveness and inclusiveness of the Fadama III AF project.

**Keywords:** Yield, Income, Fadama III Additional Financing, Propensity Score Matching, Rice Farmers

### INTRODUCTION

Nigeria has long tried to tackle rural poverty and boost food security through initiatives like Operation Feed the Nation and the National Accelerated Food Production Project (Akarowhe, 2018). Yet, poverty levels in rural areas remain stubbornly high, undermining household well-being (Awojobi, 2019). In response, the Fadama projects were introduced. Fadama I and II focused on water management and community-driven agricultural support, while Fadama III expanded to address broader development goals. Recognizing that poverty persisted, stakeholders launched the Fadama III Additional Financing (AF) project, a decisive step to extend impact and reach more farmers (Ifeanyi, 2019). Fadama III AF focused on four key components: i. Capacity building for farmers' groups, ii. Development of small-scale rural infrastructure, iii. Support for production and marketing of priority value chains rice, sorghum, tomatoes, and cassava, iv. Effective project coordination and management (Ifeanyi, 2019).

Rice, as a staple crop, received special attention under Fadama III AF, with initiatives designed to boost yields, improve market access, and enhance incomes key steps toward tackling poverty and improving food security. Rice is a critical staple and cash crop in Nigeria, cultivated across multiple ecologies such as rainfed upland, rainfed lowland, irrigated, and flood-prone areas (Adewale *et al.*, 2023). It remains one of the fastest-growing food staples, especially in urban centers, contributing significantly to national food security and dietary energy intake (Ojo and Musa, 2023). Despite its importance, smallholder rice farmers face numerous challenges, including climate variability, limited access to quality inputs, poor infrastructure, and market inefficiencies (Okoro *et al.*, 2023). The

Fadama III Additional Financing (AF) project strategically prioritized rice within its value chains, focusing on capacity building, infrastructure improvements, and enhanced market access to boost productivity and incomes (World Bank, 2023). Early evaluations indicate that the Fadama project has helped increase yields and improve livelihoods among participating farmers, underlining the value of targeted interventions in transforming rural agriculture (Adewale *et al.*, 2023; Ojo and Musa, 2023).

Since the Fadama project has shown only small changes so far, this study takes a closer look at how the Fadama III AF project has influenced rice farming and poverty reduction in Plateau State, Nigeria. It aims to reveal both the wins and the struggles, helping to guide smarter decisions for the future.

The specific objectives were to;

- i. Evaluate the impact of the Fadama III AF Project on the yield of rice farmers.
- ii. Assess the effect of the Fadama III AF Project on the income of rice farmers.
- iii. Identify the constraints to participation in the Fadama III AF Project in the study area

### METHODOLOGY

Plateau State, nestled in Nigeria's North-Central region, stands out for its breathtaking highlands, cool climate, and vibrant cultural mosaic. Covering around 30,913 km<sup>2</sup>, the state's name is drawn from the Jos Plateau a spectacular tableland rising between 1,200 and 1,800 meters above sea level (NIMET, 2020; Plateau State Government, 2023). Its capital, Jos, is a bustling hub for administration and trade, known for its dynamic markets and lively atmosphere.

The region's temperate weather, with average temperatures ranging from 18°C to 25°C and annual rainfall between 1,100 mm and 1,600 mm, creates fertile ground for diverse crops like potatoes, maize, rice, and an array of vegetables (Plateau State Ministry of Agriculture, 2023). Historically, Plateau's economy was shaped by tin and columbite mining, but agriculture now dominates, providing livelihoods for the majority of residents (National Bureau of Statistics, 2023).

This study used a multi-stage sampling approach to select respondents. In the first stage, six local government areas (LGAs) Shendam, Langtang North, Langtang South, Kanam, Kanke, and Pankshin were purposively selected from the Southern and Central Zones of Plateau State, due to their high rice production and prioritization under the Fadama III Additional Financing (AF) project (Fadama III AF Fact Sheet, 2015).

In the second stage, ten rice-producing communities Kalong, Shimankar, Shebyer, Zamko, Nasarawo, Sabon-gida, Kafel, Gaddi, Kabwir, and Lonkat were randomly selected from the chosen LGAs. Within these communities, farmers were proportionally sampled based on their population sizes, resulting in a total sample size of 259 participants and non-participants farmers combined. This was determined using Cochran's formula for finite populations to ensure adequate representation and statistical power (Yamane, 1967; Israel, 2023).

Data collection involved a structured questionnaire, field observations, and key informant interviews to capture both quantitative and qualitative information. Descriptive statistics including means and frequencies were used to profile farmer characteristics and identify participation constraints (Field, 2018).

To evaluate the impact of the Fadama III AF project on rice yield and income, Propensity Score Matching (PSM) was applied to address selection bias. Specifically: (i) Simple Mean Difference compared average outcomes between participants and non-participants. (ii) Nearest Neighbor Matching (NNM) matched each participant with a similar non-participant based on their propensity score. (iii) Radius Matching Method (RMM) paired each participant with non-participants within a defined radius of the propensity score, improving precision and reducing bias (Caliendo and Kopeinig, 2008).

The Average Treatment Effect on the Treated (ATT) was calculated as the difference in outcomes between participants and their matched counterparts. Given the challenge of estimating the counterfactual outcome in non-experimental settings, robust matching methods like NNM and

RMM were essential to ensure reliable results (Rosenbaum and Rubin, 1983). Through this multi-stage sampling design and robust analytical framework, the study offers credible insights into the Fadama III AF project's effects on rice farmers' productivity and income in Plateau State.

## RESULTS AND DISCUSSIONS

### Impact of participation in the Fadama III AF project on rice farmers' yield

Table 1 presents the estimated impact of the Fadama III Additional Financing (AF) project on rice farmers' yield using three econometric matching algorithms: Simple Mean (SM), Nearest Neighbor Matching (NNM), and Radius Matching Method (RMM). Across all methods, rice farmers who participated in the Fadama III AF project recorded significantly higher yields compared to non-participants.

Under the Simple Mean (SM) approach, participants had an average yield of 2,572.25 kg/ha, while non-participants had 1,481.75 kg/ha, resulting in a yield difference of 1,090.54 kg/ha. The estimated selection bias is 838.29, and the t-statistic of 17.57 indicates high statistical significance ( $P < 0.01$ ).

The Nearest Neighbour Matching (NNM) method further refines the estimate by pairing similar individuals. Here, participants recorded a yield of 2,700.26 kg/ha versus 1,603.67 kg/ha for non-participants. The difference in yield is 1,096.52 kg/ha, with a smaller bias of 404.07, and a t-statistic of 17.23, also highly significant.

The Radius Matching Method (RMM) produced similar results: participant yield was 2,603.17 kg/ha, non-participant yield was 1,511.76 kg/ha, yielding a difference of 1,091.40 kg/ha. The associated bias was 428.15, and the t-statistic of 13.36, again significant at  $P < 0.01$ .

The results suggest that participation in the Fadama III AF project had a positive and statistically significant impact on rice yield, regardless of the matching algorithm used. The consistent yield differential across all methods confirms the program's effectiveness in enhancing rice production among beneficiaries.

This finding aligns with earlier studies (Illo *et al.*, 2015; Lawal, 2013; Olaolu *et al.*, 2013; Ogwumba and Okechukwu, 2014), which documented positive impacts of Fadama interventions on crop yields across Nigeria. More recently, Badiro (2024) and Daily Trust (2023) have also highlighted notable yield increases in rice production among project beneficiaries, underscoring the ongoing relevance of targeted agricultural support programs.

**Table 1: Impact of Fadama III AF project on rice farmers’ yield**

Algorithm	Participants	Non-participants	Difference	Bias	t-stat
SM	2,572.25	1,481.75	1090.538	838.293	17.565
NNM	2,700.26	1,603.67	1096.523	404.067	17.230
RMM	2,603.17	1,511.76	1091.401	428.153	13.359

\*Significant at P<0.01 probability level

**Impact of the Fadama III AF Project on rice farmers’ income**

Table 2 presents the estimated effect of the Fadama III Additional Financing (AF) project on the income of rice farmers using three statistical matching algorithms: Simple Mean (SM), Nearest Neighbor Matching (NNM), and Radius Matching Method (RMM). The data show that participants consistently earned significantly higher income than non-participants across all methods, with all differences statistically significant at the 1% probability level (P < 0.01).

The Simple Mean (SM) approach estimates that participating farmers earned an average of ₦1,423,000, compared to ₦941,557.75 for non-participants. The income difference is ₦481,442.25, with a small bias of ₦48,144.25 and a t-statistic of 16.057, indicating a strong and statistically significant effect of project participation on income.

With the Nearest Neighbour Matching (NNM) method, participants earned ₦1,060,000 while non-participants earned ₦780,000, resulting in a difference of ₦280,000. The bias is ₦23,000, and

the t-statistic of 17.501 confirms the reliability and significance of the estimate.

The Radius Matching Method (RMM) shows that participants had an average income of ₦1,020,000, compared to ₦661,557.00 for non-participants. The resulting income gain of ₦358,443.00 also reflects a meaningful impact, with a bias of ₦58,442.25 and a t-statistic of 17.549, again highly significant. The results confirm that the Fadama III AF project has been successful in improving rice farmers’ livelihoods, thereby contributing to poverty reduction and enhanced rural welfare

These findings align with earlier studies by Tijani *et al.* (2014), who reported that Fadama-supported farmers consistently achieved higher incomes than non-participants due to better access to inputs, credit, and extension services. Recent studies, such as Badiru (2024) and Daily Trust (2023), also highlight the continued success of Fadama III AF interventions in boosting farmers’ income and resilience.

**Table 2: Impact of Fadama III AF project on rice farmers’ income**

Algorithm	Participants (₦)	Nonparticipants (₦)	Difference (₦)	Bias	t-stat
SM	1,423,000.00	941,557.75	481,442.25	48,144.25	16.057***
NNM	1,060,000.00	780,000.00	280,000.00	23,000.00	17.501***
RMM	1,020,000.00	661,557.00	358,443.00	58,442.25	17.549***

\*Significant at P<0.01 probability level

**Constraints to participation in Fadama III AF project**

The study revealed several constraints that hindered effective participation in the Fadama III AF project in the study area, with security challenges ranking highest (86%). Other significant constraints included inadequate land for large-scale rice production (68%), high technology costs (64%), insufficient start-up funds (57%), and climate change (52%). Notably, security challenges were a major concern, with farmers reporting destruction of boreholes by suspected herdsmen, disrupting water access. These findings align with Obianefor (2018), who identified similar challenges in dry season rice farming, including high input costs, bird attacks, and cattle menace. Addressing these constraints, particularly security challenges, is essential to enhance participation in the Fadama III AF project and improve rice production in the study area.

**CONCLUSION AND RECOMMENDATIONS**

The study assessed the impact of the Fadama III Additional Financing (AF) project on rice farmers’ productivity and income, alongside the constraints affecting participation. Results from the Propensity Score Matching (PSM) models including Simple Mean (SM), Nearest Neighbor Matching (NNM), and Radius Matching Method (RMM) revealed a statistically significant and positive impact of the project on both rice yield and income. Participants recorded higher average yields and income levels than non-participants across all estimation methods, confirming the effectiveness of the Fadama III AF intervention in enhancing agricultural outcomes for rice farmers. However, despite these positive outcomes, the study also identified several key constraints limiting broader participation in the project. Security challenges, limited access to arable land, poor transportation infrastructure, high cost of technology, and inadequate funding were among the

top-ranked barriers. These findings highlight the need for comprehensive strategies that address both

economic and structural limitations faced by farmers in rural areas

**Table 3: Constraints to Participation in Fadama III AF project**

Variables	Percentages	Rank
Security challenges	86.9	1 <sup>st</sup>
Inadequate land for massive rice production	68.7	2 <sup>nd</sup>
Inadequate access to means of transportation	64.5	3 <sup>rd</sup>
High cost of technology	57.9	4 <sup>th</sup>
Inadequate funds for start up	52.9	5 <sup>th</sup>
Climate change	45.2	6 <sup>th</sup>
Inadequate training of farmers on improved rice technology	38.2	7 <sup>th</sup>
Late supply of inputs	34.7	8 <sup>th</sup>
Lack of extension agents	28.6	9 <sup>th</sup>
Inadequate market infrastructures	25.9	10 <sup>th</sup>
Difficulty in obtaining loan	23.2	11 <sup>th</sup>
Inadequate improved processing and milling machinery	21.2	12 <sup>th</sup>

Multiple Response Allowed\*

To enhance the effectiveness and inclusiveness of the Fadama III Additional Financing (AF) project, the study recommends targeted interventions to address the structural and institutional barriers faced by rice farmers. Strengthening rural security is critical to ensure farmers' safe access to land and project facilities. Improving land tenure systems and expanding access to cultivable land particularly for smallholder and female farmers will support increased participation and productivity. Equally important is the need for substantial investment in rural infrastructure, especially road networks and transportation systems, to reduce logistical bottlenecks that hinder access to inputs and markets.

Moreover, promoting affordable agricultural technologies and improving access to finance through farmer-friendly credit schemes will empower farmers to adopt modern practices. The government and development partners should prioritize capacity building by scaling up farmer training and increasing the number of extension agents to deliver timely and relevant advisory services. Additionally, timely supply of quality inputs and enhancement of processing and market infrastructure will ensure a more integrated and efficient value chain for rice production. These recommendations, if implemented, can significantly improve the sustainability and impact of agricultural development programs like Fadama III AF.

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