IMPACT OF NIRSAL ON SMALLHOLDER RICE FARMERS' PERFORMANCE IN NORTH CENTRAL, NIGERIA

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ABSTRACT
The study assessed the impact of NIRSAL on smallholder rice farmers' performance in North-Central Nigeria productivity. The specific objectives were to estimate the rice farmers productivity and analyze the effects of the NIRSAL scheme on the productivity. A multi-stage sampling procedure was employed for selection of the 486 respondents. Primary data were collected with the use of well-structured questionnaires and analyzed using descriptive, total factor productivity index, and propensity score matching. The result revealed that NIRSAL had an impact on the productivity of rice farmers, with an 18% change in total factor productivity between NIRSAL beneficiaries and non-beneficiaries. The study hereby concludes that NIRSAL has an impact on the performance of smallholder rice farmers in north central Nigeria. Therefore, it is highly recommended that NIRSAL stakeholders continually reach out to more smallholder farmers in the country, especially in rural areas, to attain sustainability and productivity in rice farming.

***Keywords**: rice, farmers, NIRSAL, productivity*

INTRODUCTION
Rice is one of the most valuable cereal crops cultivated and consumed all over the world. It is a staple food in several African nations and constitutes a large portion of the diet on a regular basis (Merem *et al.,* 2017). Bassey *et al.* (2016) reported that rice is one of the cereal crops that has assumed cash crop status in Nigeria because of its significant contribution to the agricultural sector, creating up to 80% employment for the inhabitants of the producing areas due to activities that take place along the distribution chains from production to consumption. The consumption of rice has continued to increase in recent years, but domestic production is yet to meet the demand of the populace. The increasing demand for rice is attributed to factors such as an increase in population, income levels, rural-urban migration, and poor production resulting from inadequate access to production and processing resources (Amaechina and Eboh, 2017; Cadoni and Angelucci, 2013; Adu *et al.,* 2012). There is a demand of 7 million metric tons of rice yearly in Nigeria; however, only about 4.2 million metric tons are produced locally (FMARD, 2020), resulting in a demand-supply gap of 2.8 million metric tons. The inability to meet rice consumption needs through local production makes the country import-dependent and has led to an increase in the activities of rice smugglers through Nigeria's porous land borders. As a result, the Federal Government of Nigeria in 2015 shut down all land borders in order to minimize these unlawful activities and to protect the economy, boost local production, and strengthen local marketing systems of rice to meet up with the demand-supply gap as well as provide an avenue for many poor households to gain employment and improve their standard of living (Umaru *et al.,* 2020; Aiyedun *et al.,* 2021). The rice demand gap in Nigeria can be minimized by boosting local production, enhancing yield performance, and increasing the efficiency of the rice value chain through financial support to the farmers. Performance enhancement, on the other hand, requires financial access, which is needed to acquire the required inputs.

Sustained public sector interventions in agriculture are critical to the growth and transformation of the sector in Nigeria. This is due to the low level of investment in the sector compared to its huge potential to create employment, generate wealth, and reduce poverty (Olomola *et al.,* 2014). Agricultural financing plays an important role in increasing agricultural productivity right from the pre-planting to post-harvest stages; hence, timely access and availability of funds is crucial to farmers' acquisition of the inputs and machinery required to execute farm activities at the appropriate agricultural seasons (Ojo *et al.,* 2019). There are about 38 million farmers in Nigeria (20% of the population), and 90% of these farmers do not have access to credit facilities (Oluwadare, 2019). According to Oluwadare (2019), to achieve productivity enhancement as well as profitability, welfare improvement, and economic development, financial institutions are expected to provide the required finances to rice farmers to enable them to increase rice production in the country. However, rice farmers face several challenges, such as inadequate access to finance, low productivity, high production costs, climate change, pests, and diseases, as well as limited market access. These challenges hinder the growth and sustainability of rice production in Nigeria as financial institutions shy away from financial support because they do not consider the agricultural sector as a high-risk enterprise for investment, leaving the sector highly vulnerable to risks. In response to these challenges, there are programs, policies, and institutions that have been put in place to address farmers and agribusinesses access to finance. Some of these are the Agricultural Credit Guarantee Scheme Fund (ACGSF), Agricultural Credit Support Scheme (ACSS), Cassava Bread Development Fund, Anchor Borrowers' Programme (ABP), and Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL). All these programs are aimed at enhancing agricultural performance with the view of bridging the demand-supply gap that exists in domestic production as well as raising the profit and welfare status of smallholder farmers.

The Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) was established by the Central Bank of Nigeria (CBN) in 2013 to reduce the perceived credit risk associated with the agricultural sector by putting in place a risk management mechanism to enhance agricultural lending. NIRSAL aims to improve access to agricultural credit, reduce risks associated with agricultural lending, and enhance the productivity and profitability of farmers, including rice farmers. Through risk-sharing mechanisms, financial support, and capacity-building initiatives, NIRSAL seeks to address the barriers to agricultural financing and support rice farmers in improving their productivity, thereby enhancing the overall performance of the agricultural sector and promoting food security in Nigeria. Basically, NIRSAL was established to put logistics in place to resolve or ameliorate the financial constraints, risks, and uncertainties militating against farmers' ability to raise production levels and close the agricultural produce demand-supply gap that exists in Nigeria (Tanko and Darma, 2022).

It's about a decade of intervention, but only a few organizations and educational institutions have researched and made projections on NIRSAL's performance. No particular study has elucidated the impact of NIRSAL on rice farmers performance in the study area, thus resulting in a literature gap. There are a few studies like that on the impact of NIRSAL on poultry performance in Oshimili South LGA, Delta State, by Odum and Chukwuji (2022), which found that NIRSAL influenced poultry farmers positively. It is against this background that this study seeks to assess the impact of NIRSAL on rice farmers' performance in North-Central Nigeria. While the specific objectives were to:

I. describe the socio-economic characteristics of smallholder rice farmers among
ii. estimated the productivity of rice production among smallholder farmers and
iii. analyze the effect of the NIRSAL scheme on the productivity of rice in the study area and

METHODOLOGY

The study area

The study will be conducted in the north-central part of Nigeria. The area is made up of Benue,

Kogi, Kwara, Niger, Nasarawa, and Plateau States and the Federal Capital Territory (FCT). It is bordered by Northwest Nigeria in the north, Northeast Nigeria in the east, Southwest Nigeria and Southeast Nigeria in the south, and Northwest Nigeria in the west. The zone occupies about 296,898 km² in land area, with a population of about 22,887,250 people as of 2016 (National Bureau of Statistics (NBS), 2016). It is located between longitudes 20°30′ to 10°30′ East and latitudes 6°30′N to 11°20′ North. The zone has the wet season from April to October and the dry season from November to April. The annual rainfall ranges from 1,000 to 1,500 mm, with an average of about 187 to 220 rainy days, and average monthly temperature ranges from 21°C to 37°C. The Forest Savannah Mosaic, the Southern Guinea Savannah, and the Northern Guinea Savannah make up the vegetation. The zone is characterized by extensive swampy lowland areas along the valleys of rivers Niger and Benue and large hills, mountains, plateaus, and deep valleys. The vegetation, soil, and weather patterns of the zone favor the cultivation and production of wide varieties of foods and industrial and cash crops of various types. The available rivers and dam enable irrigation farming during the dry seasons. More than 75% of the over 40 ethnic groups who live within the zone are rural dwellers engaged in farming, hunting, fishing, trading, and artisan work (Isonguyo and Adewumi, 2021). Rice, maize, millet, sorghum, yam, potatoes, cassava, cowpea, soybean, and vegetables are the major crops grown in the zone. The ethnic groups include the Egbira, Koro, Gade, Idoma, Tiv, Nupe, Kadara, Kambari, Kamuku, Agatu, Basa, Eggon, and Gbagyi ethnic groups, among others. Figure 1 shows maps of North-Central Nigeria.

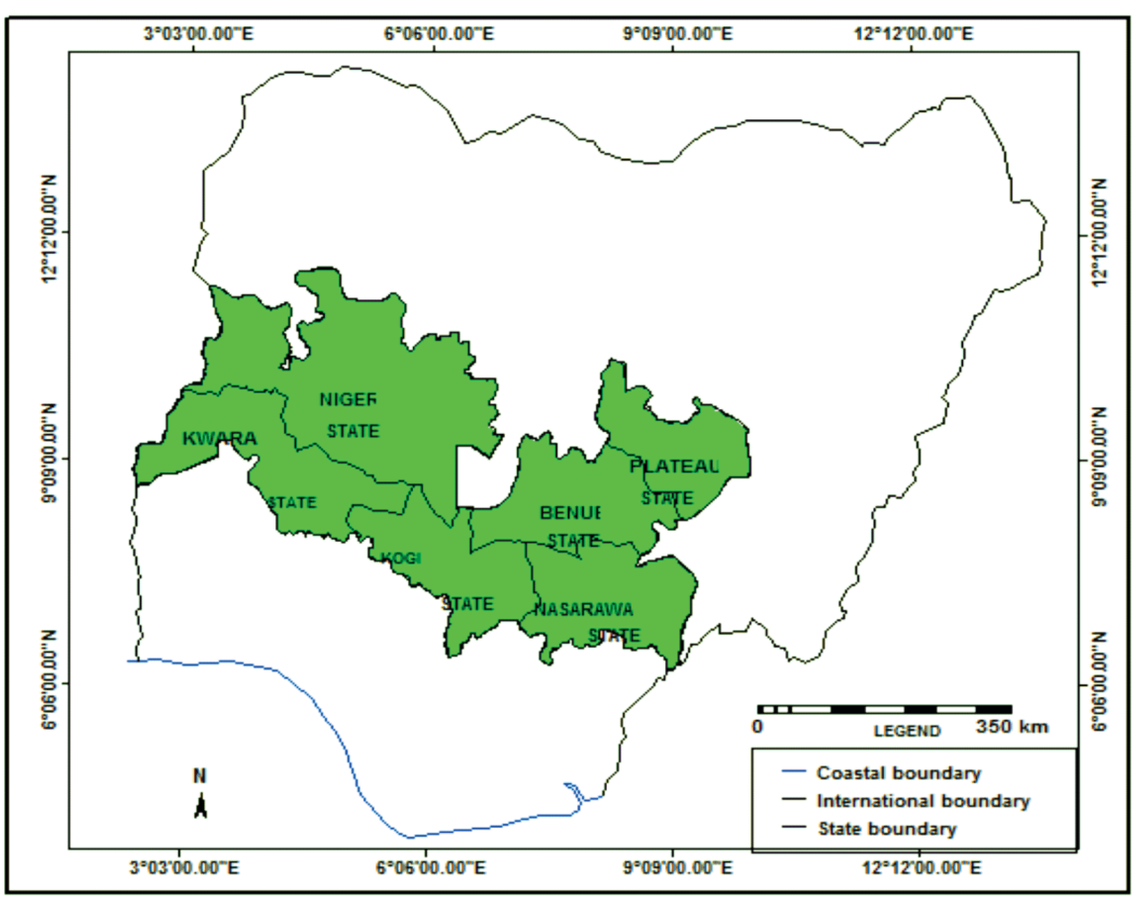

Figure 1: map of Nigeria showing North-central Nigeria

Sampling Technique and Sample Size

This study employed a multi-stage sampling procedure. In the first stage, the Federal Capital Territory and Benue and Nasarawa States were purposively selected from North-Central Nigeria, based on the high level of involvement in rice production activities across the rice value chain and on the basis of the presence of NIRSAL in the study area. In the second stage, six (6) Local Government Areas, including Abaji, Gwagwalada, Karu, Lafia, Markudi, and Oturkpo, were randomly selected from the three states. In the third stage, three (3) wards were randomly selected from each of the Local Government Area Councils, making a total of eighteen (18) wards. In the fourth and final stage, a proportionate random sampling formula indicated in equation (1) was used to select a total sample size of four hundred and eighty-six (486) respondents comprising two hundred and forty-six (246) NIRSAL beneficiaries and two hundred and forty (240) non-NIRSAL beneficiaries. The sampling frame for the NIRSAL beneficiaries was six hundred and thirty-seven (637), while that for non-NIRSAL beneficiaries was six hundred (600), making a total sample frame of one thousand two hundred and thirty-seven (1237). The study used Yamane (1967) in Otabor and Obahiagbon (2016) for estimating sample sizes, as shown in Table 1.

$$n = \frac{N}{1 + N\,(e2)} = 246 \text{ and } 240 \qquad 1$$

Where,
n = Sample Size (Units),
N= Sample Frame/Population size (Units), and
e = Level of Precision (5%).

Table 1: Sampling **Procedure and** Sample **Size of the** Respondents **in the** Study **Areas**

			Beneficiaries			**Non-Beneficiaries**		
States	**Area Councils/LGAs**	**Wards**	**Sample Frame**	**Proportion**	**Sample Size**	**Sample Frame**	**Proportion**	**Sample Size**
FCT	Abaji	Yaba	34	0.05	13	24	0.04	10
		Ebaji	50	0.08	19	49	0.08	20
		Pandaji	29	0.05	11	22	0.04	9
	Gwagwalada	Paiko	23	0.04	9	20	0.03	8
		Gwako	21	0.03	8	43	0.07	17
		Dukpa	37	0.06	14	31	0.05	12
Nassarawa	Karu	Maraba	49	0.08	19	34	0.06	14
		Nunku	40	0.06	15	42	0.07	17
		Angwan Zaria	44	0.07	17	24	0.04	10
	Lafia	Adadu	34	0.05	13	36	0.06	14
		Biye	44	0.07	17	32	0.05	13
		Dare	26	0.04	10	31	0.05	12
Benue	Markurdi	Ugboko	29	0.05	11	45	0.08	18
		Oiji	24	0.04	9	37	0.06	15
		Ojantele	23	0.04	9	25	0.04	10
	Oturkpo	Shorov	47	0.07	18	43	0.07	17
		Etulo	46	0.07	18	39	0.07	16
		Mbaityough	37	0.06	14	23	0.04	9
Total			**637**	**1**	**246**	**600**	**1**	**240**

Source: Authors Computation from NIRSAL and ADP (2023)

Method of Data Collection

Cross-section data was collected from farmers with the use of well-structured questionnaires and used for this study. Trained enumerators from ADP (Agricultural Development Programme) were engaged for data collection using a well-structured questionnaire.

Method of Data Analysis

Descriptive statistics, the total factor productivity index (TFP), and propensity score matching were used for data analysis in this study.

Total Factor Productivity Index (TFP)

Following Sadiq et al. (2019), the TFP approach was adopted, and it is given as:

$$TFP = \frac{Y}{TVC} \quad 2$$

$$TFP = \frac{Y}{\epsilon Pi\ Xi} \quad 3$$

Where;

Y = Output (kg),

TVC = Total Variable Cost (N),

Pi = Unit Price of Rice of the ith Variable Input (N), and

Xi = Quantity of ith Variable Input (kg).

Because the study focused on smallholder farmers, this technique excludes the impact of total fixed cost (TFC), which does not affect both profit maximization and resource use efficiency conditions. Total fixed cost is constant, as it is fixed.

From Cost Theory:

From Cost Theory:

$$AVC = \frac{TVC}{Y} \quad 4$$

Where, AVC = Average Variable Cost in naira (₦)

Therefore, the transpose of AVC was TFP

$$TFP = \frac{Y}{TVC} = \frac{1}{AVC} \quad 5$$

As such, TFP is the inverse of the AVC. The partial productivity estimate is the marginal products (MP) given as

$$MP = \frac{\triangle TFP}{\triangle X} \quad 6$$

Propensity Score Matching

The effect of NIRSAL credits on the productivity of beneficiaries was determined using propensity score matching. This tool was chosen to check for confounding bias by balancing on variables that are different in the treatment and control groups. The most common evaluation parameter of interest is the Average Treatment Effect on the treated (ATT), which is defined as:

$$ATT = E\left(\frac{Y_1 - Y_2}{P = 1}\right) - \left(\frac{Y_1}{P = 1}\right) \quad 7$$

The propensity score is the probability of the participation for farmers, if given a set X = X*i* of characteristics. Following Ali et al. (2018) the formula is stated thus;

$$P(X) = P_r \left(\frac{P = 1}{X_1 - X_2}\right) \quad 8$$

The propensity scores were derived from a regression model in which these characteristics were compared. The effect of the treatment on the treated (causal effect of project participants) was estimated by computing the differences across both groups:

$$ATT = \left(\frac{1}{N_1}\right) \left[Y_1 - Y_0 \right]$$

Where;
ATT = Average Impact of Treatment on the Treated,
N_1 = Number of Matches (From Regression Model),
Y_1 = Productivity Index by beneficiaries, and
Y_0 =Productivity Index by Non-beneficiaries.
A positive (Negative) value of ATT will usually suggest that participants in a programme have higher (lower) outcome variable than non-beneficiaries.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Rice Farmers in North-Central Nigeria

Table 2 below shows the results for the socio-economic characteristics of rice farmers who were beneficiaries and non-beneficiaries of credits from NIRSAL. From the results, the majority (60%) of the non-beneficiaries were male, while 40% were female. In the same vein, the majority (52.85%) of the beneficiaries were male, while 47.15% were female. This suggests that most of the farmers in the study area were males, who are most likely the heads of their households. This corroborated previous findings by Ayinde et al. (2016) and Benabise et al. (2017) that rice was mostly produced by men.

The age classification signifies the physical abilities of the farmers. From the results, the mean age for non-beneficiaries of credits from NIRSAL was 46.38 years, while that of beneficiaries was 44.28 years. This suggests that most of the farmers were young, agile, and energetic enough to carry out various rice farming activities. Thus, the likelihood existed of increasing activities in the study area to earn more income, as they are in an economically active stage. This result is corroborated by the study by Akinwale (2021) and Nguyen and Tofael (2022), which found that farmers between the ages of 41 and 50 are still active and capable of improving farm productivity.

Also, the majority (95%) of the non-beneficiaries of credits were married or living as partners, while 5% were single. For the beneficiaries, the majority (90.65%) were married or living as partners, while 9.35% were single. This suggests that the majority of the farmers are household heads and are responsible for the needs of those who are dependent on them. This agrees with the findings of Sadiq et al. (2021) and Sulili et al. (2021), which posited that married people are mostly involved in farming activities.

Also, the mean household size for non-beneficiaries and beneficiaries was 7 and 9, respectively. This has a direct impact on labor supply to the farm because it indicates the potential contribution to labor availability for rice farming. Larger household sizes have been reported to enhance family labor availability; hence, the need for hired labor will be maximal, thereby increasing labor constraints. The small household size contradicted the finding of Offor et al. (2020), who stated that technology adoption is aided by large household sizes since larger households ensure a robust labor force.

From the results, the majority (83.33%) of the non-beneficiaries of credits from NIRSAL microfinance institutions have undergone at least 6 years of formal education, while 16.37% have no formal education. In the same vein, the majority (89.02%) of the beneficiaries have undergone at least 6 years of formal education, while 10.98% have no formal education. This suggests that the majority of the farmers were literate enough to read, understand, and communicate, as well as practice agricultural knowledge gained effectively.

Furthermore, the mean farm size was 1.85 and 2.83 hectares for non-beneficiaries and beneficiaries, respectively. The total farm cultivated is related to the total farm size available to the farmers, and this implies that most of the farmers had small farm holdings. Ebrima et al. (2020) opined that farm size increases the likelihood of farmers' accessing credit.

The mean farming experience for non-beneficiaries and beneficiaries of credits from NIRSAL microfinance institutions was about 17.43 and 16.48 years, respectively. This suggests that, on average, a rice farmer in the study has over 17 years of experience because rice production is one of the major occupations of the respondents in the study area. Farmers' experience enhances productivity levels on their farms (Akinwale, 2021).

The result also reveals that about 100% and 98.75% of beneficiaries and non-beneficiaries of credits from NIRSAL microfinance institutions, respectively, had contacts with extension agents. This suggests that both beneficiaries and non-beneficiaries had access to extension agents. Adoption of rice production technologies is highly facilitated by the efforts of extension workers in introducing and demonstrating new research findings and innovation to the farmer on how to use the technologies. This result agrees with the findings of Ayinde et al. (2016), Benabise et al. (2017), and Nneka et al. (2019).

About 98.78% and 1.28% of beneficiaries and non-beneficiaries of credits through NIRSAL, respectively, had access to credits. This suggests that most of the non-beneficiaries in the study area fund their operating costs through other means, without any intervention from the government. The higher percentage of farmers that accessed credit is a clear indication that the NIRSAL credit support scheme of the Federal Government of Nigeria trickled down to the rice farmers in the study area. This contradicts the result of Offor et al. (2020), who stated that rice farmers in Bende LGA of Abia State had no access to credits; thus, rice production in the area was influenced negatively.

The result further reveals that about 18.33% and 93.90% of non-beneficiaries and beneficiaries of credits through NIRSAL, respectively, were members of the cooperative societies. According to Offor et al. (2020), membership of cooperative societies helps in promoting the level of participation in agricultural production, as it grants farmers the opportunity to enjoy privileges exclusive to group members.

Table 2: Socio-Economic Characteristics of rice farmers

	Non-Beneficiaries			Beneficiaries		
Socio-economic Variables	**Freq**	**Per**	**Mean**	**Freq**	**Per.**	**Mean**
Sex						
Male	144	60.00		130	52.85	
Female	96	40.00		116	47.15	
Age			46.38			44.28
Marital status						
Single/Never Married	12	5.00		23	9.35	
Married /Living as partner	228	95.00		223	90.65	
Household Size			7			9
Level of Education						
Non-Formal Education	40	16.67		27	10.98	
Primary	17	7.08		3	1.22	
Secondary	39	16.25		36	14.63	
Post Secondary	144	60.00		180	73.17	
Farm Size			1.85			2.83
Years of Farming Experience			17.43			17
Contacts with Extension Agents						
No	3	1.25				
Yes	237	98.75		246	100.0	
Number of Contact with Extension Agent			3			4
0-3	89	54.27		97	48.26	
4-6	75	45.73		104	51.74	
Access to Credit						
No	231	98.72		3	1.22	
Yes	3	1.28		243	98.78	
Member of Cooperative						
No	196	81.67		15	6.10	
Yes	44	18.33		231	93.90	
Total	240	100		246	100	

Source: Computed from Field Survey (2023)

Productivity of Rice Farmers in the Study Area

The summary statistics of the total factor productivity indices in Table 3 show that 69.17% and 31.30% of the non-NIRSAL beneficiaries and beneficiaries were at sub-optimal productivity. This shows that the number of beneficiary farmers performing below their maximum potential is lower (31.30%) than that of non-NIRSAL beneficiaries (69.17%). It also revealed that 22.08% and 31.71% of the non-beneficiaries and beneficiaries, respectively, were optimally productive. This indicates that a higher percentage (31.71%) of the beneficiaries operated at their maximum potentials, while a lower percentage (22.08%) of the non-beneficiary farmers operated at an optimal level of productivity. Furthermore, 8.75% and 36.99% of the non-beneficiaries and beneficiaries, respectively, were super-optimally productive. Implying again that a higher percentage (23.05%) of NIRSAL beneficiary farmers operated above the maximum productivity potentials, while only 8.75% of non-beneficiary farmers exceeded optimum productivity potentials. The mean total factor productivity for non-NIRSAL beneficiaries and NIRSAL beneficiaries was 0.856 and 1.039, respectively. The result shows 18% change in total factor productivity between non-NIRSAL beneficiaries and beneficiaries. This implies that the total factor productivity of beneficiary farmers is higher than that of non-

beneficiary farmers by 18%. The significant difference might be associated with their contact with NIRSAL, implying NIRSAL has an impact on the productivity of beneficiary farmers. This result is in line with the findings of Balogun et al. (2021) and Akinwale (2021).

Table 3: Total factor productivity indices

	Non-Beneficiaries		Beneficiaries	
TFP Index	**Freq**	**Percentage**	**Freq**	**Percentage**
Sub-Optimal (< 1.00)	166	69.17	77	31.30
Optimal (1.01–1.09)	53	22.08	78	31.71
Super-Optimal (= 1.10)	21	8.75	91	36.99
Total	**240**	**100**	**246**	**100.00**
Mean	**0.856**		**1.039**	
Minimum	**0.125**		**0.48**	
Maximum	**1.604**		**1.80**	
Standard Deviation	**0.299**		**0.422**	
% Change in TFP	**18%**			

Effect of NIRSAL Credit on Productivity of Rice Farmers in the Study Area

Table 4 shows the propensity score matching of the impacts of NIRSAL credit facilities on the productivity of rice farmers. The coefficient of average treatment effect for the propensity score and nearest neighbor matching were all positive for both the treatment effect on the population and on the treated. All the matching algorithms were significant at 1% probability levels. This implies that the NIRSAL credit facilities had a significant impact on the rice productivity of the beneficiaries. The values of average treatment effects for propensity score were 0.196 and 0.224 for the population and the treated, respectively, implying that NIRSAL Credit Facilities led to a 0.224 unit increase in the productivity of the treated.

Table 4: Average Treatment (NIRSAL Credit Facilities) Effect on the Productivity of Rice Farmers

	Population			Treated		
Matching Algorithm	Coefficient	Standard Error	t-Value	Coefficient	Standard Error	t-Value
Propensity Score	0.196***	0.036	5.49	0.224***	0.036	6.19
Nearest Neighbour	0.202***	0.036	5.59	0.233***	0.038	6.07

Source: Computed from Field Survey (2023)

Conclusion and Recommendations

Rice production in North-Central Nigeria is a profitable venture, as NIRSAL had an impact on the productivity of rice farmers, with 18% difference in total factor productivity between beneficiaries and non-beneficiaries. Therefore, it is highly recommended that NIRSAL stakeholders continually reach out to more smallholder farmers in the country, especially in rural areas, to attain sustainability and productivity in rice farming.

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