

EFFECT OF NIGERIA'S COMMUNITY ACTION FOR RESILIENCE AND ECONOMIC STIMULUS (NG-CARES) PROGRAMME ON MAIZE FARMERS PRODUCTIVITY IN NORTH WESTERN NIGERIA

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Abstract

This study looked at how Nigeria's Community Action for Resilience and Economic Stimulus (NG-CARES) programme affected maize farmers in Kano and Jigawa States, North-West Nigeria. The research used a descriptive survey and causal-comparative design. It applied a multi-stage sampling method to select 260 beneficiaries and 260 non-beneficiaries, making a total of 520 respondents from six Local Government Areas in the two states. Data was collected with the aid of well-structured questionnaire and analyzed using descriptive statistics and Propensity Score Matching (PSM). The findings showed that the beneficiaries were mainly middle-aged farmers, with a mean age of 49.38 years. They had large households, with a mean of 13 people, and small farms, with a mean of 1.45 hectares. The programme mainly provided agricultural inputs like fertilizers, improved maize seeds, and agro-chemicals. The programme has demonstrated significant effect on the yield of its beneficiaries as revealed by the result of the PSM of an ATT of 5.06 bags/ha and an ATU of 4.83 bags/ha and an ATE of 4.95 bags/ha which represents what the non-beneficiaries would have gained in terms of productivity had they benefitted from the NG-CARES programme. Which was statistically significant ($p < 0.01$). The study concluded that the NG-CARES programme significantly improved the livelihoods of maize farmers in the area by boosting productivity. It recommended that the programme should be sustained since it made such a significant impact on the livelihood of its target beneficiaries as revealed by the result of the PSM with an average Treatment on Treated of about 5bags of 100kg per hectare in order to better maximize its impact and possible potentials.

Keywords: Community Action, Resilience, Maize, Productivity, NG-CARES

Introduction

Agriculture is a fundamental part of human civilization. Its significance is clear as it provides food for consumption, ensures food security, and meets the global food demand sustainably. It produces staple crops like rice, wheat, and maize, which are essential energy and nutrient sources for billions of people (FAO, 2022). Nigeria, an agricultural economy, depends heavily on this sector as a major contributor to its Gross Domestic Product (GDP) and employs about 70% of the workforce (World Bank, 2020). It also plays a crucial role in food security and rural livelihoods (National Bureau of Statistics, 2024). Maize is one of the most widely grown crops in Nigeria, serving as a staple food and providing income for millions of smallholder farmers (Igbalajobi et al., 2019). In 2024, maize production in Nigeria reached 11.22 million metric tons, marking a 3% increase over 2023 levels, despite a slight decline in cultivated area due to a shift toward rice

production. The national average yield is low at 2.22 metric tons per hectare, substantially below the potential yield of 6 to 8 metric tons per hectare that can be achieved with good farming practices (International Food Policy Research Institute, 2025). However, Nigeria's agricultural sector faces myriad of challenges, including low productivity, climate change, limited access to modern farming technologies, and outbreaks of pandemics and natural disasters (Adejuwon, 2018).

Notable among one of the natural disasters that poses challenge to agricultural production is the COVID-19 pandemic which further worsened the existing vulnerabilities in Nigeria's agricultural systems. It disrupted supply chains, restricted farmers' access to inputs, and reduced market access for smallholder producers. In response to these issues, the Federal Government of Nigeria, supported by the World Bank, launched the Nigeria Community Action for Resilience and Economic Stimulus (NG-CARES) Programme in 2020. The program was created as an emergency response to reduce the socio-economic impacts of the pandemic on poor and vulnerable households, smallholder farmers, and micro and small enterprises across all 36 states and the Federal Capital Territory (World Bank, 2020). The NG-CARES Programme represents a significant investment in social support and economic recovery, with initial financing from the World Bank of \$750 million and an additional \$500 million approved in 2025 for a second phase, bringing the total funding to \$1.25 billion (Balarabe et al, 2025).

The programme operates on a Performance-for-Results (PforR) model, where states receive reimbursement after implementing verified activities. The first phase of NG-CARES impacted over 17 million Nigerians directly, helping communities build schools and health facilities, revitalize small businesses, and support smallholder farmers with agricultural inputs and services (World Bank, 2025). The program has since evolved into a responsive platform providing interventions across various sectors. It addresses not only COVID-19 impacts but also economic difficulties resulting from recent changes, including the removal of fuel subsidies and unification of foreign exchange rates (World Bank, 2025).

The NG-CARES Programme's intervention or deliverables in these states includes providing improved seeds, fertilizers, agrochemicals, and extension services to smallholder maize farmers. The goal is to boost productivity, increase incomes, and build resilience against economic shocks. However, while the programme has scaled considerably, questions about its effectiveness among specific beneficiary groups, especially maize farmers in Kano and Jigawa States, remain. Understanding the programme's impact on yield, income, and livelihoods is crucial for guiding policy decisions, improving implementation strategies, and ensuring lasting results. Despite significant investments in agricultural intervention programmes in Nigeria, smallholder farmers still face low productivity and limited income growth. The productivity gap in Nigerian maize production is considerable, with actual yields averaging 2.17 to 3.59 metric tons per hectare compared to potential yields of 6 to 8 metric tons per hectare under optimal conditions (International Food Policy Research Institute, 2025). This gap is due to multiple constraints, including low use of productivity-boosting inputs like inorganic fertilizer and improved seeds, limited access to mechanization services, poor extension support, and inadequate market infrastructure (International Food Policy Research Institute, 2025).

Such constraints may limit the programme's impact on beneficiaries' livelihoods. Without thorough evaluations that establish causal connections between programme participation and outcomes, policymakers lack essential insights to refine implementation strategies, allocate resources effectively, and ensure the programme achieves maximum impact (FARA, 2025).

It is against these backdrop that this study raises the following research questions which are: what are the socioeconomic characteristics of the beneficiaries of NG-CARES in the study area and what are the effect of NG-CARES programme on the yield of beneficiaries in the study area while the objectives are to determine the socio-economic characteristics of the beneficiaries and to determine the effect of NG-CARES on the yield of beneficiaries. For the purpose of these study yield was calculated based on 100 bags of maize per hectare

This study specifically tests the hypothesis that participation in the NG-CARES programme significantly increases maize yield per hectare among small holder farmers in Kano and Jigawa states.

Literature Review

In a study conducted in the North-central part of Adamawa State, Nigeria, by Helon and Ornan (2022) in which they analyzed the socio-economic characteristics of participants of Growth Enhancement Support Scheme (GESS) revealed that the age bracket with the highest proportion of the respondents (41.82%) was between 31 and 40 years; 38.79% of the respondents were between 41 and 50 years; 9.70% were aged between 21 and 30 years; 7.88% were between 51 and 60, years, while 1.82% of the respondents were above 60 years. The average age of the respondents was 41.91 years. More than half (55.76%) of the respondents were males, while 44.24% were females. majority (71.52%) of the respondents were married, 20.61% were single, 4.85% were widow/widowers while 3.03% were divorced. The result of the educational level of the respondents revealed that 2.42% had postgraduate degree, 33.33% completed first degree or HND, 23.64% had NCE/OND, 26.67% had secondary education, 6.06% had primary education, while 7.88% had no formal education. Majority (82.42%) of the respondents had less than 3 hectares of farm size, 13.94% cultivated between 3.1 to 5 hectares, 1.82% cultivated between 5.1 and 7.0 hectares and 1.8% cultivated above 7.0 hectares. The average farm size was 2.58 hectares. This indicates that majority of the respondents were small scale farmers. With respect to farming experience, more than half (51.52%) of the respondents had farming experience between 5 and 9 years; 34.55% had less than 4 years; 10.91% had between 10 and 14 years; 0.61% had between 15 and 19 years, while 2.42% had above 20 years of farming experience. The mean years of farming experience was 7.49 years. More than half (52.73%) of the respondents had less than 4 members in their household, 35.15% had between 5 and 9 household members, 9.70% had between 10 and 14 household members, while 2.42% had between 15 and 19 household members. The mean household size was 5 people. The mean annual income of respondents in the study area was N393, 771. The result further showed that 43.03% of the respondents earned an annual income of less than N250, 000, 32.73% earned between N250,000 and N500,000, 13.94% earned between N500, 000 and N750, 000, 7.27% earned between N750, 000 and N1,000,000, while only 3.03% earned above N1,000,000 per annum.

Onoja et al. (2024) revealed that the anchor borrowers' programme has had a positive effect on rice yield in North-Central Nigeria, with beneficiaries achieving higher yields of 453.95kg/ha, compared to 367.36kg/ha for non-beneficiaries. Participants achieved an additional yield of 105.82 kg/ha due to better access to inputs and credit, driven by factors like education, household size, experience and household size. In the same vein, Obinna and Bassey (2021) research on Beneficiaries' Perception of Effectiveness of Rural Development Programmes: Cross River Agriculture Development Project, Cross River State, Nigeria found that beneficiaries attested to the fact that Commercial Agriculture Development Project (CADP) activities were effective in the areas of increased yield and expansion of farm enterprises, with a mean of 2.33 and 2.48, respectively, above the mean cut-off point of 2.00.

Nwankwo et al. (2024) shows the estimated yield of selected crops of participant farmers before and after the Commercial Agriculture Development Project in the study area. The result shows that 50.0% of the respondents had a yield of between 201 and 300kg of cocoa, 18.3% had a yield of between 301 and 400kg of cocoa and 14.7% had cocoa yield above 400kg before the Commercial Agriculture Development Project with a mean yield of 276.47kg of cocoa, while 85.0% had a yield above 400kg of cocoa and 10.6% had between 301 and 400kg of cocoa after the Commercial Agriculture Development Project with a mean yield of 580.38kg of cocoa. The result further shows that 71.4% of the respondents had a palm oil yield of between 10,001 and 20,000kg and 18.3% had palm oil yield of between 20,001 and 30,000kg of palm oil before the Commercial Agriculture Development Project with a mean yield of 17,570.78kg of palm oil, while 55.3% had palm oil yield of between 20,001 and 30,000kg of palm oil and 38.9% had above 30,000kg of palm oil after the Commercial Agriculture Development Project with a mean yield of 32,495.08kg. The result shows that 68.1% of the respondents had rice yield of less than or equal to 1000kg and 25.3% had rice yield of between 1,001 and 1,500kg of rice before the Commercial Agriculture Development Project with a mean yield of 920.95kg of rice, while 43.4% had rice yield of between 1,501 and 2000kg of rice, and 40.0% had above 2000kg of rice after the Commercial Agriculture Development Project with a mean yield of 2,125.36kg of rice. These results imply agricultural diversification under CADP and that most of the beneficiaries were increasing their yield after the Commercial Agriculture Development Project in the study area. This could be attributed to the dissemination and adoption of proper agricultural practices, expansion of land holdings, access to fertilizers and quality foundation seeds, and access to other production inputs and Commercial Agricultural Development Project support services. Other factors include continued government support in providing accessible road infrastructure for the transportation of agricultural produce, extension services, and availability of credit facilities and other essential inputs to farmers.

The fore-going concur with the findings of Idris and Jabo who studied the impact of Fadama III additional financing (AF) on income and food security status of beneficiaries in Sokoto state, Nigeria the study revealed that, there is a statistically significant difference in yield of Fadama III AF beneficiaries before and after intervention. This is also in tandem with Castle et al. (2021) examined the impacts of agroforestry interventions programme on agricultural productivity, ecosystem services, and human well-being in low-and middle-income countries The results of the meta- analysis for impacts on yields indicated that agroforestry interventions overall may lead to a large, positive impact on yield (Hedge's $g = 1.16 [-0.35, 2.67]$, though there was high heterogeneity in the results ($I^2 = 98.99\%$, $2\tau = 2.94$, $Q (df = 4) = 370.7$). There were positive yield impacts for soil fertility replenishment practices, including incorporating trees in agricultural fields and improved fallow practices in fields where there are severe soil fertility issues

Theoretical Frame-work

Impact Evaluation Theory

Causal inference in programme evaluation requires methods that establish counterfactual outcomes what would have happened to beneficiaries in the absence of the intervention. Randomized controlled trials (RCTs) represent the gold standard, but are often infeasible for large-scale government programmes. Quasi-experimental methods, particularly Propensity Score Matching (PSM), provide alternative approaches for estimating treatment effects in non-experimental settings (Caliendo and Kopeinig, 2008; Wooldridge, 2010).

The PSM approach assumes that selection into treatment is based on observed characteristics, and matches treated units with control units sharing similar propensity scores. Recent applications in agricultural programme evaluation, including the West Africa Agricultural

Productivity Programme (WAAPP), demonstrate the utility of *ex-ante* matching based on enumeration data to reduce sample size requirements while maintaining analytical rigor (Ainembabazi et al., 2022). This study applies PSM to estimate the Average Treatment Effect on the Treated (ATT), Average Treatment Effect on the Untreated (ATU), and overall Average Treatment Effect (ATE) of NG-CARES participation.

Propensity score matching (PSM)

To estimate the causal effect of the NG-CARES Programme on beneficiaries in the study area, propensity score matching (PSM) as used by Rosenbaum and Rubin, 1983 was employed. PSM involves pairing treated (beneficiaries) and control (non-beneficiaries) units with similar propensity scores, which represent the probability of participating in the programme given observed covariates.

The propensity score model is specified as:

$$P(X) = \Pr(D=1 | X) = F(X\beta) \text{-----(i)}$$

Where: $P(X)$ is the propensity score, D is the treatment indicator (1=beneficiary, 0=non-beneficiary), X is a vector of covariates influencing participation (e.g., age, education, household size, farm size), and F is a logistic distribution function (Khandker et al., 2010).

The average treatment effect on the treated (ATT) was estimated using nearest neighbor matching with a caliper of 0.01:

$$ATT = E[Y_1 | D=1] - E[Y_0 | D=1] \text{-----(ii)}$$

Where: Y_1 and Y_0 are the outcomes for beneficiaries and non-beneficiaries, respectively.

The core idea of matching, after obtaining estimated propensity scores, was to estimate the average treatment effect. First, logistic regression was done to get the propensity scores for the Beneficiaries and Non-Beneficiary groups. Secondly, matching was done using all the available methods obtainable in the Stata version 13.1 to get the estimates for the ATE, ATT and ATU respectively. The logistics regression model is expressed as:

$$Y_i = \alpha + [\beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \dots + \beta_n X_n] + \mu_i$$

$$Y_i = B$$

β_0 = Constant

$\beta_1 - \beta_8$ = Coefficients of variables $X_1 - X_7$

β_1 = Age (Years)

β_2 = Sex (Male/Female)

β_3 = Household size (Number)

β_4 = Education level (No Formal Education, Primary, Secondary, Tertiary)

β_5 = Marital Status.

β_6 = Assisting parent

β_7 = dummy ((1=Beneficiaries and 0=Non-Beneficiaries)

e = Error term

Propensity score matching (PSM) is a statistical technique used to estimate the causal effect of a treatment or intervention by matching treated and control units with similar propensity scores (Rosenbaum and Rubin, 1983). The propensity score represents the probability of receiving the treatment given observed covariates.

Key Steps in PSM Estimate propensity scores include Use of logit or probit model to estimate $P(X) = \Pr(D=1 | X)$, where D is the treatment indicator and X is a vector of covariates. Matching treated and control units: to Match units based on propensity scores using techniques like: Nearest neighbor matching Kernel matching Caliper matching Radius matching Check balance of covariates: Ensure matched groups have similar distributions of covariates (e.g., using standardized differences < 0.1). Estimate treatment effect: Use the matched sample to estimate

Average treatment effect on the treated (ATT): $E[Y_1|D=1] - E[Y_0|D=1]$ Average treatment effect (ATE): $E[Y_1 - Y_0]$

Advantages of PSM include; reduction of selection bias in observational studies, allows for causal inference and does not require parametric outcome model

Limitations: Assumes no unobserved confounding variables (selection on observables) Requires sufficient overlap in propensity scores can be sensitive to matching technique and specification

Applications: PSM is widely used in economics, medicine, and social sciences to evaluate program impacts (Khandker et al., 2010)

Analytical Technique

This study integrates the Sustainable Livelihoods Framework with impact evaluation theory to analyze the effect of NG-CARES participation on maize farmers' livelihood outcomes. The analytical framework posits that programme participation (treatment) influences livelihood outcomes through several pathways: Input Pathway Provision of improved seeds, fertilizers, and agrochemicals enhances productive capacity and enables yield increases. Knowledge Pathway Extension services and training improve technical efficiency and input utilization. Financial Pathway Cash transfers and income gains strengthen financial capital and enable reinvestment in production. Resilience Pathway Combined interventions reduce vulnerability to shocks and enhance adaptive capacity. The framework recognizes that outcomes are moderated by contextual factors including household characteristics (age, education, household size), farm characteristics (size, location), institutional factors (extension access, market access), and external shocks (climate, security, economic conditions). The study employs Propensity Score Matching to estimate the causal effect of NG-CARES participation on yield and income outcomes, controlling for observed differences between beneficiaries and non-beneficiaries. This approach enables robust inference about programme effectiveness while acknowledging limitations regarding unobserved confounding factors.

Methodology

Study Area

The study was conducted in Kano and Jigawa states which are located in the northwestern part of Nigeria. Kano and Jigawa states are located in between latitudes $10^{\circ}32'16.17''N$ to $13^{\circ}00'23.96''N$ and longitudes $07^{\circ}04'12.60''E$ to $10^{\circ}13'35.90''E$ It covers $43,569 \text{ km}^2$ (National Bureau of Statistics, 2017), They are among the major producers of cereal crops include maize sorghum and millet (IITA 2022). They are representing 4.78% of Nigeria's total land area the estimated combined population of these states as of 2019 was 19,706,675 (National Bureau of Statistics, 2020), The soil is reddish brown or brown soils of the semi-arid and arid areas and are known as tropical ferruginous soils which are made up of about 85% sand with pH values that varied between 6.0-7.0 (Dogonyaro, Abaje and Bello (2022). The area is known for low annual rainfall with less than 1000 mm of rain with prolonged dry season of up to 9 months. The rainfall intensity is between the months of July and August with a minimum rainfall of 60mm and a maximum of 99mm. An annual variation in rainfall of between 15% and 20% Dogonyaro et al., (2022). The region is characterized by northern Guinea Savannah and Sudan Savannah with few trees. By implication, more arable crops are grown in the region, crops like maize, sorghum, millet, cowpea, wheat and vegetable crops. The major source of livelihood of the inhabitants of the region is agriculture although with variations across the States. Off-farm activities include trading, tailoring, bricklaying and carpentry among others. Farming practices used in the States are shifting cultivation, mixed farming, mixed cropping and pastoralism. The major crops grown in the region

are maize, millet, sorghum, cowpea and beans. The area is traversed by rivers and streams for instance, the Kano River (Kano State) and the Hadejia and Jama'are rivers (Jigawa State). This allows for the construction of many earth dams, which are being used for urban water supply irrigation agriculture and fishing. Hydrologically, the area falls within the Lake Chad basin and groundwater is the major source of water supply for the majority of the population. The area has a tropical continental (Aw) type of climate characterized by wet (June – September) and dry (October – May) seasons (Usman et al., 2023)

Kano and Jigawa States, located in Northwestern Nigeria, share a deep-rooted history as centers of the Hausa-Fulani civilization. Their religious and cultural landscapes are inextricably linked, characterized by a blend of Islamic tradition and ancient Sahelian customs. Maize production in the area relies mostly on both rain fed and irrigation systems.

Sampling Procedure and Sample Size

The study was carried out in two North Western states of Kano and Jigawa, and the population consists of identified beneficiaries of NG-CARES Programme in the states using the existing structures of Farmer community association (FCAs) and Farmer user groups (FUGs) a Multi-stage sampling technique was used to select the sample for the study which involves the following stages: Stage I: involves a purposive selection of two states out of the seven northwestern states (Kano and Jigawa States) base on the presence of the programme as well as the intensity of participation. Stage II: involves a purposive selection of three (3) LGAs from each state based on the high number of maize farmers promoted by the programme, Shanono, Kiru and Doguwa were purposively selected in Kano state while Auyo, in (Hadeja zone), Miga, in (Birnin kudu zone) and Ringim in (Ringim zone) were selected and the reason for the selection of the LGAs in these states was based on the maize farmers promoted by the NG-CARES programme in accordance to the FCA plan. Stage III: From a list of NG-CARES beneficiaries in each LGAs using existing structure a simple random sampling technique (balloting method) and proportionate sampling was used to draw the sample size of 260 beneficiaries from the sample frame of 731 in order to achieve greater precision 35.5% of the population were selected since the population is not too large as advanced by Leedy and Ormrod (2010) that a sample size of 30% is commonly employed in practical research when high precision is required, and the population is not too large. Stage IV: A same number of sample size from registered maize farmers who were non beneficiaries were randomly selected from each LGAs to serve as the control group. The reason for the variation in sample size selection is because the sample size was selected proportionately from the sample frame. Primary Data was collected and used for the research directly by training enumerators who were the extension staff in the communities and the researcher declare that there is no conflict of interest or whatsoever.

Table: 1: Sample Frame and Sample Size

States	LGAs	Sample Frame	Sample Size Beneficiaries	Non Beneficiaries	
Kano	Kiru	80	28	28	
	Shanono	80	28	28	
	Doguwa	363	126	126	
Jigawa	Miga	59	21	21	
	Ringim	80	31	31	
	Auyo	69	26	26	
	Total	731	260	260	520

Source: Field survey, 2025

Analytical Techniques

Descriptive statistics such as means, frequency, percentages were used to achieve objectives (i) which is to describe the socioeconomic characteristics of the beneficiaries of NG-CARES two (ii) which is to determine the effect of the programme on the yield of beneficiaries in the study area was achieved using propensity score matching score (PSM)

Propensity Score Matching (PSM)

Propensity score matching is a useful tool for evaluating the effectiveness of social programs." (Caliendo and Kopeinig, 2008)

The propensity score is a balancing score, which means that it can be used to balance the distribution of covariates between treatment and control groups." (Rosenbaum and Rubin, 1983) PSM use logistic regression or probit models to estimate the propensity score, which is the probability of being treated (i.e., participating in the NG-CARES program) given the covariates. Use matching algorithms (e.g., nearest neighbor, caliper matching) to match treatment and control groups based on their propensity scores.

PSM use the matched samples to estimate the treatment effect (i.e., the effect of the NG-CARES program on social protection outcomes) using difference-in-means or regression analysis then perform sensitivity analysis to assess the robustness of the results to different matching algorithms, caliper sizes, and propensity score models and finally Interpret the results in terms of the estimated treatment effect and its significance level. Rosenbaum and Rubin (1983). The propensity Score was estimated using a logit model with the following covariates, age, sex, marital status, household size, farm size in hectares, farming experience in years and location as dummies for Local Government Araes. Nearest neighbor matching with a caliper of 0.2 was implemented without replacement. Balancing score was assessed using a standardized difference with a threshold of $|d| < 0.25$ which is considered acceptable and the common support figure is 0.020 to 0.999.

Results and Discussion

Socioeconomic Characteristics of Beneficiaries and non-Beneficiaries of NG-CARES intervention Programme

The result in table 2 reveals that the mean age of beneficiaries and non-beneficiaries in kano were 49.64 and 48.14years respectively implying that the beneficiaries are older than non-beneficiaries. In Jigawa state, the mean age was 49.84 and 44.81 years for beneficiaries and non-beneficiaries respectively with margin of 5 years which also implies that beneficiaries are older than non-beneficiaries. The mean age for the pooled was 49.70 years for the beneficiaries and 47.18 years for the non-beneficiaries with marginal difference. The average age of beneficiaries of NG-CARES Programme implies that they are still in active and productive age group of farming activities. This age profile is as reported by National Agricultural Performance Survey 2024, which reported that the mean age of Nigerian farmers are within 47 - 48 years and that this age distribution indicates that Nigerian farmers are within their economically active age group which is necessary for agricultural production activities and significantly influences their decision-making processes regarding the adoption of technologies and farm operations. In Kano state, (85.4%) of the beneficiaries of NG-CARES Programme were males and (93.5%) for non-beneficiaries indicating only 14.6% and 6.5% of female beneficiaries and non-beneficiaries in kano state respectively indicating wide gender gap among the maize farmers in the state. while in Jigawa state, 85.3% and 98.7% of maize farmers for beneficiaries and non-beneficiaries were male

respectively indicating also 14.7% and 1.3% females maize farmers for both beneficiaries and non-beneficiaries in the state. The Pooled data shows 85.4% and 95% males for beneficiaries and non-beneficiaries respectively were males. This indicates male dominate maize farming in the states which is common practice in the northern states as stressed by Banseka et al (2024) that to achieved gender balance women farmers and other groups such as youths programmes must adopt women-only farmer groups, female extension agents, and childcare support. The distribution of respondents based on their marital status as presented in table 3 below, shows that married individuals dominate both groups, in Kano state, 81% and 93.5% were married for beneficiaries and non-beneficiaries respectively while in Jigawa state, 89.3 and 93.3% were married for both beneficiaries and non-beneficiaries indicating married dominated groups for both states while the pooled data reveals that 83.5% of beneficiaries and 93.5% of non-beneficiaries being married in the pooled sample. Notably, divorced individuals constitute 3.8% of beneficiaries but are absent (0%) among non-beneficiaries, while widows represent 12.7% of beneficiaries compared to 6.5% of non-beneficiaries. Marital status significantly influences agricultural productivity and programme participation as advanced by Akinbile and Abdulrahman (2024) that marital stability enhances access to labour and decision-making in agricultural operations. The higher proportion of widows among beneficiaries suggests that the intervention may have successfully targeted vulnerable groups, which is crucial for pro-poor development. Etuk and Ayuk (2021). Table 2 further reveals that the mena Household size for beneficiaries and non-beneficiaries in kano were 13.15 and 15.64 household size respectively implying existence of margin in household size among the beneficiaries while in Jigawa mean household size among beneficiaries and non-beneficiaries were 11.49 and 13.04 households size respectively also indicating higher household size among non-beneficiaries. The pooled mean of household size for beneficiaries and non-beneficiaries 12.67 and 13.15 indicated higher household size among non-beneficiaries. This implies that larger households increase labour availability and technical efficiency thereby increases farm production conversely, it can imply more mouth to feed which could be a driving force for the beneficiaries. However, the NG-CARES Programme pattern is as set by its goals that is supporting the vulnerable more so, Olanrewaju et al., (2020) states that household size is an important key in rural development intervention which can affect intervention outcome Distribution based on farm size as presented below reveals that the mean farm size for Beneficiaries and non-beneficiaries in Kano states were 1.45 and 1.51 hectares of land respectively indicating a slight margin among the beneficiaries and non-beneficiaries indicating slight increase among the non-beneficiaries while, in Jigawa state the mean farm size for beneficiaries and non-beneficiaries were 1.45 and 1.50 respectively indicating little margin for non-beneficiaries. The pooled data reveals that beneficiaries cultivated 1.45hectare of land while non-beneficiaries cultivated mean of 1.51 hectare of land. The fore-going implies that the non-beneficiaries have access and cultivated more farmland (1.51ha) than the beneficiaries who cultivated 1.45ha. The fact that the beneficiaries have smaller land size though very marginal could be the reason why they benefitted from the programme as the programme targets the most vulnerable. Table 2 also reveals that the beneficiaries and non-beneficiaries' mean farming experience in Kano state is 23.52 and 23.25 years of farming experience respectively. This indicates decades of accumulated experience in farming which also aligns with age distribution. In jigawa state, the mean farming experience is 22.73 and 22.73 years of farming experience for both beneficiaries and non-beneficiaries respectively showing a slight margin of experience among the two states. The pooled data reveals that beneficiaries had 23.30 years of farming experience while non-beneficiaries had a mean of 23.09 years of farming experience. The implication is that there is accumulation of vast experience in farming which enables them to acquire more knowledge of local agro-ecological conditions, risk management capabilities, and

social network that facilitates information access. As reported by Ebenehi, (2024) farming experience can have both negative and positive effect and influence on programme participation, with more experience farmers can be cautious and unwilling to take risk but with little experience farmers might be eager and anxious to participate in an intervention that promise to improve their living standard.

Table 2: Socio-Economic Characteristics of Beneficiaries and Non-Beneficiaries of NG-CARES intervention programme in Kano and Jigawa States.

	Kano		Jigawa		Pooled	
Age	B	N.B	B	N.B	B	N. B
20-30	0	2(1.1)	0	2(2.7)	0	4(1.5)
31-40	0	18(9.7)	0	25(33.3)	0	43(16.5)
41-50	136(73.5)	118(63.8)	54(72)	33(44)	190(73.1)	151(58.1)
51-60	44(23.8)	41(22.2)	19(25.3)	14(18.7)	63(24.2)	55(21.1)
61>	5(2.7)	6(3.2)	2(2.7)	1(1.3)	7(2.7)	7(6.7)
X	49.64	48.14	49.84	44.81	49.70	47.18
Sex						
Male	158(85.4)	173(93.5)	64(85.3)	74(98.7)	222(85.4)	247(95)
Female	27(14.6)	12(6.5)	11(14.7)	1(1.3)	38(14.6)	13(5)
X	1.15	1.06	1.15	1.01	1.15	1.05
Marital Status						
Single	0	0	0	0	0	0
Married	150(81.1)	173(93.5)	67(89.3)	70(93.3)	217(83.5)	243(93.5)
Divorced	10(5.4)	12(6.5)	8(10.7)	5(6.7)	10(3.8)	0
Widow	25(13.5)	0	0	0	33(12.7)	17(6.5)
Widower	0	0	0	0	0	0
X	2.24	2.06		2.07	2.20	2.07
HH Size						
1-8	65(35.1)	19(10.3)	6(8)	19(25.3)	71(27.3)	38(14.6)
9-16	80(43.2)	121(65.4)	40(53.3)	44(58.7)	120(46.2)	165(63.5)
17-23	34(18.4)	42(22.7)	23(30.7)	8(10.7)	57(21.9)	50(19.2)
24-31	6(3.2)	3(1.6)	6(8)	4(5.3)	12(4.6)	7(2.7)
32 >						
X	13.15	15.64	11.49	13.04	12.67	13.15
Farm size						
<1	6(3.2)	5(2.7)	2(2.7)	3(4)	8(3.1)	8(3.1)
1-<2	111(60)	106(57.3)	45(60)	39(52)	156(60)	145(55.8)
2-3	68(36.8)	74(40)	28(37.3)	33(44)	96(36.9)	107(41.2)
3>	0	0	0		0	
X	1.45	1.51	1.45	1.50	1.45	1.51
Farming Experience						
1-9	0	0	0	0	0	0
10-18	45(24.3)	46(24.8)	21(28)	21(28)	66(25.4)	68(26.1)
19-27	99(53.5)	99(53.5)	39(52)	39(52)	138(53.1)	137(52.7)
28-36	21(11.3)	21(11.4)	8(10.7)	8(10.7)	29(11.1)	29(11.15)
37-45	20(10.8)	19(10.2)	7(9.3)	7(9.3)	27(10.3)	26(10)
46-54	0	0	0	0	0	0
55>	0	0	0	0	0	0
X	23.52	23.24	22.73	22.73	23.30	23.09
Total	185(100)	185(100)	75(100)	75(100)	260(100)	260(100)

Source: Fieldwork, 2025

KEY:

1. B=Beneficiaries
2. N.B=Non-Beneficiaries
3. X=Mean

Effect of NG-CARES Intervention Programme on Respondents

The effect of NG-CARES Programme on the beneficiaries was assessed. However, before the assessment of the effect, a comparison of the socio-economic characteristics of both beneficiaries and non-beneficiaries was carried out and the socio-economic factors that influenced participation were established and the result presented accordingly on Table 7 and 8. The probability of participation in NG-CARES programme was predicted by the propensity score and this was estimated from a logistic regression of NG-CARES participation status on the predictor variables as revealed by Table 5. The probability for all households was which means that a household had percent chance of been selected to participate in the programme when randomly selected with respect to the outcome variable. The common support graph was drawn to test the balancing as well as the matching quality. The region of common support was found to be between 0.02 – 0.999 these is the region were the overlap in the distribution of the propensity scores of both treated and untreated groups concentrated.

Common Support Region

The study imposes the common support condition in the estimation by matching in he region of common support. Based on this condition, the result in Figure 12 shows the Distribution of propensity scores for the treated (beneficiaries) and untreated (non-beneficiaries) group and the region of common support. The bottom half of the figure shows the propensity scores distribution for the untreated group, while the upper-half refers to the treated individuals. The densities of the scores are on the y axis. It is very clear, from the observation of this figure, that the common Support condition is satisfied as there is overlap in the distribution of the propensity scores of both the treated and the untreated groups

The region of common support was found to be between 0.02 – 0.999 this were the region were the overlap in the distribution of the propensity scores of both treated and untreated groups concentrated.

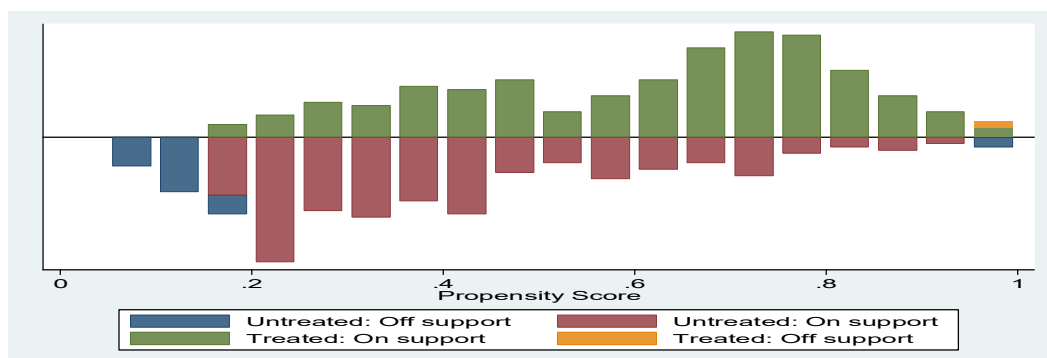


Figure 8: Common region graph

Note: Propensity score is on the x-axis while Density is on the Y-axis

Effect of NG-CARES Programme on the Yield of Beneficiaries

As explained in the methodology section the first step of the econometric approach is to estimate the propensity score that is the probability to be a beneficiary of NG-CARES programme is conditional on observable variables. To generate the propensity scores for the matching process, the probability of a household to be beneficiary is estimated using logit model. The variables included in the model are age, marital status, educational level, farm size, major crop grown, major source of income, farming experience, access to credit, source of credit, household size and access to basic amenities

The model revealed in table 5 was statistically significant and the regression coefficients give the change in the z-score for unit change in the predictor. More over the value of Pseudo-R2 (0.1771) indicates that there was no systematic difference in the distribution of covariates between beneficiaries and non-beneficiaries in the study area.

Furthermore, the Pseudo R-square indicates that about 17.71 % of the variation in the being beneficiary decision model can be explained through the included explanatory variables. The overall model is statistically significant at a P-value of 0.000. Hence, the chosen observable characteristics adequately explain the probability of being beneficiary in the NG-CARES Programme. Among the factors assumed to affect inclusion in the programme among the household in the study area, age, (p-value of 0.000) is highly significant marital status (p-value 0.000) educational level, (p-value 0.014) is significant, access to credit,(p-value 0.000) source of credit (p-value 0.000) were statistically significant and household size (p-value 0.090) significant at 10% This means that age is a highly significant determinant of being participated in the NG-CARES Programme as it was reported by Olanrewaju, et al., (2020). Also educational level is found to be statistically significant determinant of participation that less educated are much likely to be included among the beneficiaries possibly due to programme design that favours most vulnerable which less educated and this is in contrary to the opinion of Bala and Nwosu (2022),who reported that more educated individuals are more likely to accept and adopt innovations and that education does not guarantee exclusion from poverty more so Ebenehi et al. (2024) found that age and education negatively affect decision to use climate smart agriculture among rice farmers in Niger and Kwara states

Table 3 Logit Model predicting probability of NG-CARES Programme participation

Explanatory variables	Coefficient	Standard Error	Z	P> z
Constant	-11.20879	1.477435	-7.59	0.000 ***
Age	.0840807	.0186194	4.52	0.000 ***
Marital status	1.256952	.2970023	4.23	0.000***
Educational level	-.2538121	.1035002	-2.45	0.014
Farm size	-.1310063	.1712982	-0.76	0.444
Major crop grown	.0804927	.1835809	0.44	0.661
Major Source of income	-.0852254	.1367253	-0.62	0.533
Farming experience	-.015069	.0127253	-1.18	0.236
Access to credit	2.967008	.4205887	7.05	0.000
Source of credit	2.067026	.2537898	8.14	0.000
Household size	-.035472	.0209395	-1.69	0.090
Access to basic amenities	.0222426	.213256	0.10	0.917
Goodness of fit				
LR Ch2(11)	127.64			
Prob> Chi2	0.0000			
Pseudo R2	0.1771			

Note; NS= not significant and *** $p < 0.01$ ** $p < 0.10$ * $p < 0.05$

Source: Field survey, 2025

Effect of NG-CARES Programme on the yield of maize farmers in the study area.

The effect of NG-CARES Programme on the beneficiaries' yield is presented in the table 8. The result revealed that NG-CARES Programme had a positive and significant effect on the maize farmers' yield in the study area with an average treatment effect on treated (ATT) of (5 bags/ha) in terms of yield obtained from maize production per hectare by the farmers who benefited. In a similar manner, the result of the analysis revealed that the average treatment effect on the treated (ATE) on the entire farmers population that is picking any farmer at random will earn an increase yield of (4bags/ha) this implies that the use of NG-CARES inputs will result in an increase in yield of 4.95bags/100kg/ha while for the effect on untreated category (ATU) yield was about 4 bags/ha implying that, categories of non-beneficiaries if assume they were treated their yield will increase by 4.83bags/100kg/hectare. This is consistent with recent empirical evidence from similar agricultural interventions in Nigeria. Balarabe et al. (2025) found that NG-CARES participation significantly increased yield by 34–37% (kg ha) in Northwestern Nigeria-. The 27.5% increase observed in this study falls within the lower end of this range, likely reflecting the specific agro-ecological conditions and input utilization patterns in Kano and Jigawa States.

The yield advantage of 5.06 bags per hectare (506 kg/ha) represents a 27.5% increase over non-beneficiaries' yield levels. The t-test value of 11.43 indicates strong statistical significance, providing robust evidence that the observed yield differences are attributable to programme participation rather than selection bias or random variation. The standard error of 0.442 indicates precise estimation relative to the effect size.

This result implies that expansion of the programme and inclusion of all eligible maize farmers could generate meaningful aggregate production increases as it was stated by Balarabe et al. (2025), Habtemariam et al. (2020), and Maviko et al. (2025) that a well-designed agricultural input support programmes when effectively implemented can achieve transformative productivity gains in sub Saharan African smallholder agriculture.

Table 4 Effect of participation in NG-CARES Programme on yield

Outcome	Sample	Treated	Control	Difference	SE	t-test
	Unmaatched		18.5373076	4.88115392	.251034821	19.44
Yield	ATT	23.4430233	18.3856589	5.05736438	.442362385	11.43
	ATU	18.5782222	23.4084444	4.83022227		
	ATE			4.95155284		

Source: Field survey, 2025

Conclusion

Based on the findings of this study, the following conclusions were drawn:

The programme has significantly enhanced agricultural productivity among beneficiaries. The estimated 5.0 bags per hectare yield advantage as revealed by the ATT for the beneficiaries as against an ATU of 4.8 bags per ha for the non-beneficiaries demonstrates that the provision of improved inputs (fertilizers, seeds, and agrochemicals) effectively addressed critical production constraints and enabled farmers to achieve higher output levels. The Propensity Score Matching

approach successfully demonstrated causal effects of programme participation, providing robust evidence that the observed differences in yield are attributable to the NG-CARES intervention.

In conclusion, the NG-CARES programme has achieved its immediate objectives of enhancing resilience and providing economic stimulus to maize farmers in the study area. The programme represents a viable model for emergency agricultural interventions, though refinements are needed to address implementation constraints and maximize long term impact.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are proposed for policy makers, programme implementers, and stakeholders:

The programme has demonstrated significant effect on the yield of its beneficiaries as revealed by the result of the PSM of an ATT of 5.0 bags/ha and an ATU of 4.8 bags/ha and an ATE of 4.9 bags/ha which represents what the non-beneficiaries would have gained in terms of productivity had they benefitted from the NG-CARES programme.

"While the 5.06 bags/ha yield advantage is statistically significant and economically meaningful, beneficiaries still achieve only 29-38% of potential yield (6-8 tons/ha). This suggests that input provision alone is insufficient; complementary investments in irrigation, mechanization, and market access are necessary to close the remaining yield gap."

Recommendation 1 (Programme Continuation): Based on the ATT of 5.06 bags/ha ($p < 0.01$), the Federal Government should secure funding for NG-CARES Phase III with a specific target of reaching 50% female beneficiaries.

Recommendation 2 (Gender Inclusion): Given that only 14.6% of beneficiaries are female, the programme should adopt women-only farmer groups, female extension agents, and childcare support during training sessions (Banseka et al, 2024).

Recommendation 3 (Sustainability): Implement a graduated input credit scheme transitioning beneficiaries from free inputs to subsidized credit over three or more production cycles.

References

- Adejuwon, S. A. (2018). Climate change and agricultural production in Nigeria. *Journal of Agricultural Sciences*, 63(2), 145–162. <https://doi.org/10.2298/JAS1802145A>
- Ainembabazi, J. H., Mutambi, A., and others. (2022). Exposure to agricultural technologies and adoption: Evidence from the West Africa Agricultural Productivity Programme. *Food Policy*, 126, 102–115. <https://doi.org/10.1016/j.foodpol.2022.102115>
- Balarabe, A., Ibrahim, H. Y., and Solomon, A. S. (2025). Evidence from Nigeria's NG-CARES social protection programme on heterogeneous impact of program participation on productivity and food security of rural farming households in Northwestern Nigeria. *Journal of Agriculture and Rural Development, Tropical and Subtropical*, 126(2), 205–211. <https://doi.org/10.17170/kobra-2025081111373>
- Banseka, R. F., Murtala, N., and Sani, R. M. (2024). Impact of Fadama III Additional Finance II on yield and income of Faro-44 rice farmers beneficiaries in Taraba State, Nigeria. *Nigerian Journal of Agriculture and Agricultural Technology*, 4(1), 74–82. <https://doi.org/10.59331/njaat.v4i1.627>
- Caliendo, M., and Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, 22(1), 31–72. <https://doi.org/10.1111/j.1467-6419.2007.00527.x>
- Dogonyaro, M. M., Abaje, I. B., and Bello, A. L. (2022). Characteristics of soils in the semi-arid region of Northwestern Nigeria. *Nigerian Journal of Soil Science*, 32(1), 12–24.
- Ebenehi, O. Fawole B.F., and Musab I. (2024). Effect of usage of climate smart agricultural Practices on rice farmers income in Niger and Kwara States, Nigeria. *Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)*, 9(2), 112–125.
- Food and Agriculture Organization (FAO). (2017). The future of food and agriculture: Trends and challenges. FAO. <https://www.fao.org/3/i6583e/i6583e.pdf>
- Forum for Agricultural Research in Africa (FARA) (2024). Annual Report
- Habtemariam, L. T., Tesfaye, W., and Tsige, M. (2020). Adoption of improved agricultural technology and its impact on household income: A propensity score matching estimation in eastern Ethiopia. *Agriculture and Food Security*, 9(1), Article 8. <https://doi.org/10.1186/s40066-020-00278-2>
- Igbalajobi, O., Fatuase, A. I., and Ajibefun, I. (2019). Determinants of maize production in Nigeria. *Agricultural Economics Research Review*, 32(1), 45–58.
- International Food Policy Research Institute (IFPRI). (2025). violent conflicts reshape input use and productivity in smallholder farming: Findings from Nigeria. IFPRI Blog. <https://www.ifpri.org/blog/violent-conflicts-reshape-input-uses-and-productivity-in-smallholder-farming-findings-from-nigeria/>
- Leedy, P. D., and Ormrod, J. E. (2010). Practical research: Planning and design (9th eds.). Pearson.
- Maviko, I., Jumbe, C. B. L., and Machira, K. (2025). Impact of sustainable intensification technologies on farm income among rural households: Empirical evidence from Dedza district, Malawi. *African Journal of Agricultural and Resource Economics*, 20(2), 89–104. [https://doi.org/10.53936/afjare.2025.20\(2\).12](https://doi.org/10.53936/afjare.2025.20(2).12)

- Mohammed, A. B. (2023). Impact of Fadama III project on beneficiaries' productivity in Oyun Local Government Area of Kwara State, Nigeria. *African Journal of Agricultural Technology and Environment (AJATE)*, 7(1), 78–89. <https://ajate.com.ng/wp-content/uploads/2023/02/9-Mohammed-AJATE-Vol-7-no-1.pdf>
- National Bureau of Statistics (NBS). (2017). Annual abstract of statistics. NBS.
- National Bureau of Statistics (NBS). (2020). National living standards survey 2018-2019. NBS. https://nigerianstat.gov.ng/pdfuploads/NLSS_2018-19_Final_Report.pdf
- National Bureau of Statistics (NBS). (2024). Nigeria General Household Survey-Panel (Wave 5) 2023/2024: Survey report. NBS. <https://www.nigerianstat.gov.ng/pdfuploads/GHS-Panel%20Wave%205%20-%20Survey%20Report.pdf>.
- Olanrewaju, W. O., Adewuyi, K. O., and Olurinola, I. O. (2020). Determinants of participation in agricultural development programmes in Nigeria. *Journal of Agricultural Extension*, 24(1), 45–58.
- Preprints.org. (2025). The potential and productivity of agriculture in Nigeria. <https://www.preprints.org/manuscript/202507.0223/v1>
- Rosenbaum, P. R., and Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41–55. <https://doi.org/10.1093/biomet/70.1.4>
- Usman, B. A., Abdullahi, A., and Bello, A. K. (2023). Climate variability and agricultural production in Northwestern Nigeria. *Journal of Climate Change and Agriculture*, 4(2), 78–92.
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). MIT Press.
- World Bank. (2020). Nigeria COVID-19 Action Recovery and Economic Stimulus Program Project. World Bank Documents. <https://documents1.worldbank.org/curated/en/142411608260520935/pdf/Nigeria-COVID-19-Action-Recovery-and-Economic-Stimulus-Program-Project.pdf>
- World Bank. (2025). Expanding support for human capital in Nigeria: World Bank approves new financing for education, nutrition, and economic resilience. World Bank Press Release. <https://www.worldbank.org/en/news/press-release/2025/04/02/support-for-human-capital-in-nigeria-world-bank-approves-new-financing-for-education-nutrition-and-economic-resilience>