Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Effects of the International Fund for Agricultural Development's (IFAD) Agri-Hub Initiatives on Youth's Employment Outcomes in Nigeria

Nathaniel Olutegbe

siji004u@yahoo.com

University of Ibadan, Nigeria

Omotomiwa Adesanya

International Institute of Tropical Agriculture

Waheed Oni

International Institute of Tropical Agriculture

David Otu

International Institute of Tropical Agriculture

Funmilayo Ilesanmi

International Institute of Tropical Agriculture

Fatimah Ajibola

International Institute of Tropical Agriculture

Jeremiah Omologbe

International Institute of Tropical Agriculture

Azeez Ibrahim

International Institute of Tropical Agriculture

Research Article

Keywords:

Posted Date: March 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9065263/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Effects of the International Fund for Agricultural Development's (IFAD) Agri-Hub Initiatives on Youth's Employment Outcomes in Nigeria

Nathaniel Siji Olutegbe[1]*, Omotomiwa Adesanya[2], Waheed Oni[2], David Otu[2]Funmilayo Illesanmi[2], Fatimah Ajibola[2], Jeremiah Omologbe[2] and Azeez Ibrahim[2]

Contributors: Adenmosun Adetola; Mugisho Aline; Mulinganya Noel; Chiqui Arregui

Corresponding Author:

[1]*Department of Agricultural Extension and Rural Development
University of Ibadan
Ibadan, Oyo State, Nigeria
Email: siji004u@yahoo.com

[2] International Institute of Tropical Agriculture (IITA)
PMB 5320, Ibadan, Oyo State, Nigeria

Omotomiwa Adesanya – o.adesanya@cgiar.org
Waheed Oni – W.ONI@cgiar.org
David Otu – d.otu@cgiar.org
Funmilayo Ilesanmi – o.ilesanmi@cgiar.org
Fatimah Ajibola – f.ajibola@cgiar.org
Jeremiah Omologbe – j.omologbe@cgiar.org
Azeez Ibrahim – ia.azeez@cgiar.org

Abstract
This study examines the effects of the International Fund for Agricultural Development's (IFAD) Agri-Hub Nigerian (IAN) project on youth employment status and income change in Nigeria. A multi-stage sampling procedure resulted in 320 beneficiaries and 541 matched non-beneficiaries across the Abuja, Imo, and Oyo hubs. A combination of Propensity Score Matching (PSM) and instrumental variable techniques was employed, generating 300 well-balanced matched pairs. Independent sample t-test, ANOVA, Binary logistic regression and incremental model building (multiple linear regression) were used to isolate the impact on employment status and income changes. Findings reveal higher employment rates among both entrepreneurship and employment track beneficiaries compared to non-beneficiaries. For employment status, beneficiaries (88.3% employed) were significantly influenced by participation intensity (OR = 1.022) and prior income (OR = 1.000), although the entrepreneurship track showed a decreased odds of being employed (OR = 0.050), while non-beneficiaries (38.7% employed) depended on years of agribusiness experience (OR = 3.122) and involvement in crop processing (OR = 2.396). The incremental model building results show that regarding income change and employment status positively predicted gains for both beneficiaries (β = 26,606.47) and non-beneficiaries (β = 16,968.62). Group membership was the strongest predictor of employment for beneficiaries (β = 68.275.96), whereas baseline income was for non-beneficiaries (β = 0.421). Track-level analysis shows higher income gains for entrepreneurship participants (₦156,825) than for those in the wage employment track (₦44,666). The IAN project significantly improved youth employment status, with higher participation rates increasing employment likelihood, and income gains primarily driven by group membership and programme support services.

Introduction

Youth unemployment remains a significant and persistent challenge in Nigeria, with over 60% of young people either unemployed or underemployed [1]. The unemployment crisis has far-reaching social consequences, including rising poverty levels, increased vulnerability to criminal activity, and the potential for social unrest. Economic instability in Nigeria is exacerbated by the limited livelihood options available to young people, with youth often resorting to informal or illicit activities for survival [2]. This trend is particularly troubling in rural regions. While the agricultural sector remains economically dominant and accounts for most jobs in rural areas, these areas suffer from seasonal unemployment and underemployment, with many young people working fewer hours than they would like, earning less than their urban counterparts, and generally being less productive [3]. Although the number of jobs has grown at 2.7% per annum from 2000-2019, almost matching labour force growth of 2.6%, the critical challenge is the absence of productive and decent employment opportunities for youth entering the labor market [3]. Labour market indicators in Nigeria have continued to deteriorate over the past decade. According to the National Bureau of Statistics (NBS), the unemployment rate increased from 8.9% in 2011 to 15.7% in 2015. By the end of the third quarter of 2018, the figure had risen to 23.1%, up from 18.1% the previous year [4]. More recently, data from the NBS [5] showed that the employment rate declined from 77.1% in Q2 2023 to 75.6% in Q3 2023, signaling a worrying trend in the nation's labor market performance.

Amidst several options, transforming the Nigerian agricultural sector holds significant potential to mitigate youth underemployment and unemployment and stimulate economic growth. The revitalization of agriculture could substantially contribute to increasing per capita income and reducing poverty levels. However, realizing this potential necessitates addressing systemic

challenges within the agricultural value chain. Olomu and Ekperiware [6] emphasize that optimizing Nigeria's agricultural value chain requires substantial investments and innovative strategies to enhance production and add value across the most profitable segments given systemic and service gaps that hinder performance. Recognizing the sector's potential, Yeboah and Jayne [7] note that agriculture will continue to be a significant source of employment for Nigeria's labour force in the coming decade, particularly within the production segment of value chains. Similarly, Fox and Thomas [2] highlight that agricultural value chains offer substantial opportunities to create gainful employment. Despite these prospects, agricultural value chains in Nigeria remain fragmented, with underdeveloped supply chains leading to missed opportunities for employment and income generation. Inadequate infrastructure, limited production, productivity and access to markets, climate change and insufficient technical capabilities restrict the sector's ability to grow and thus absorb the also growing labour force. Addressing these issues is crucial for transforming agriculture into a robust engine for economic development and youth employment in Nigeria.

Despite the Nigerian government's implementation of various agricultural initiatives aimed at enhancing the welfare of the Nigerian people, there has been limited focus on intentionally targeting youth employment through agricultural value chains. This gap is particularly troubling given that youth aged 18 to 35 years constitute over 60% of Nigeria's estimated population of over 200 million people [8]. In recent years, however, several agribusiness-related initiatives have emerged through collaborations with development partners such as the International Fund for Agricultural Development (IFAD) and the World Bank that do have youth targeting objectives. Yet the results of these programmes are localized, and have little effect on broader national data on youth employment trends [9, 10,].

The IFAD support IAN initiative implemented over five years, represents a unique and novel approach to addressing youth underemployment and unemployment in Nigeria by combining upskilling of youth, mentorship, business support, and market linkages [10]. These hubs manage these processes and in some instances act as incubators for young agripreneurs, providing the necessary knowledge and skills development opportunities for youth to thrive in the agribusiness sector Through its dual-track design, entrepreneurship and wage employment, the project aimed to generate immediate livelihood opportunities while laying the foundation for sustainable agribusiness ecosystems capable of supporting rural youth beyond the project’s lifespan. The IAN model seeks to overcome persistent barriers such as limited technical and soft skills hindering youth access to the labour market, weak market access, and restricted financial opportunities.

This study aims to assess the effects of the IAN Project on youth employment outcomes such as employment status and income, by comparing beneficiaries (participants) to non-beneficiaries (non-participants). The specific objectives are to:

- Identify the support systems that youth beneficiaries accessed through the IAN Project.
- Examine the causal effects of programme participation on employment outcomes using instrumental variables.
- Determine the programme's impact on beneficiaries' employment status and income change, compared to non-participants.
- Investigate how youth perceptions and participation constraints moderate the relationship between programme participation and employment outcomes.

- Elicit qualitative insights into how programme participation shaped beneficiaries' employment trajectories, income stability, and career aspirations.

Evidence from this research will not only support program accountability but also serve as a foundational basis for policy formulation aimed at scaling agri-value chain interventions that reduce youth underemployment and unemployment in Nigeria and other countries.

Literature review

Hubs have been developed as structured interventions to address youth underemployment and unemployment globally, particularly in agriculture. These hubs aim to lower barriers to entry employment by enhancing technical skills, providing financial support, and fostering entrepreneurial capacity among young people [11]. Agri-hubs initiatives provide a comprehensive support system by combining training, market linkages, financial assistance, and mentorship, making them a viable solution to youth unemployment in agriculture [12]. Research indicates that agribusiness hubs improve youth engagement by integrating training with value chain participation, which leads to higher employability and self-employment rates [13]. In sub-Saharan Africa, initiatives such as those implemented by IFAD have demonstrated success in equipping youth with the tools necessary for sustainable agricultural careers [14]. The impact of hubs is not always universally effective; it heavily relies on local infrastructure and the support provided by both government and private-sector partners [12].

Business hubs have been linked to improved job readiness among youth by offering technical training and soft skills development, including leadership, communication, and financial literacy [15]. Empirical studies highlight the positive impact of agri-hub models established to directly increase job readiness, encourage business formation, and enhance agribusiness participation on employment outcomes [11]. In Kenya, Ghana, and Ethiopia, youth participating in agribusiness hubs report higher rates of entrepreneurial success, particularly in agro-processing and value-added services [13, 16]. Programs like the Fadama initiative in Nigeria have significantly boosted youth engagement in agribusiness while improving income levels and reducing unemployment [14].

Youth who have participated in agri-hub initiatives often report higher rates of business formation and self-employment [12]. Studies indicate that agri-hub models increase employment outcomes by improving job readiness, fostering business formation, and enhancing agribusiness participation [15]. Rural agri-hubs, that provide the necessary infrastructure for youth to transition from informal subsistence farming to formal agribusinesses, result in increased job creation and improved economic conditions [17]. Increasing business formation through agri-hubs leads to not only immediate self-employment but also the creation of a broader business ecosystem that benefits the community as a whole [2]. Agri-hubs have shown that once youth are trained and provided with the necessary resources, they are more likely to engage in agribusiness ventures, thus contributing significantly to rural economic development [15].

Evidence from Kenya, Ghana, and Ethiopia demonstrates that youth participating in agribusiness hubs experience higher rates of entrepreneurial success, particularly in agro-processing and value-added services [17]. In Kenya, youth-led businesses in agro-processing have experienced rapid growth, contributing to job creation and economic development in rural areas [2]. In Ghana, youth

have successfully utilized the support from agri-hubs to create businesses in value-added agricultural products such as processed foods and natural fibers, thereby improving both their income and community food security [10]. In Ethiopia, youth-led agribusinesses in dairy and vegetable production have shown promising growth due to the targeted support provided by agri-hubs [10]. Such successes highlight the direct correlation between agri-hub participation and increased entrepreneurial activity, emphasizing the need for scalable models to reach wider populations [15].

Private sector involvement, through partnerships with agribusinesses, can provide agri-hubs with the necessary capital, expertise, and market access, while strong policy frameworks from governments can provide the regulatory environment needed to foster growth [10]. Only by aligning public policies with the goals of agri-hubs can their long-term impact on youth employment and rural development be maximized [15]. Collaborative efforts between the public and private sectors are essential for ensuring that agri-hubs can scale effectively and sustain their impact over time [12].

Methodology

Study area and sampling

The study was conducted in Nigeria, a country in West Africa, characterized by diverse agro-ecological zones and economic activities. Nigeria is divided into six geopolitical zones: North Central, North East, North West, South East, South South, and South West, each with distinct cultural, economic, and agricultural dynamics. The country's agricultural sector plays a crucial role in employment and food security, with varying levels of agribusiness adoption across regions.

The sampling for this study employs a multi-stage procedure. The first stage of the sampling process involved determining the appropriate sample size using the sampling formula for finite populations [18]. Based on the project's available data, which forms the study sampling frame, the total population of beneficiaries across all hubs is 4,868 beneficiaries spread across three hubs - Abuja (289), Imo (1,012), and Oyo (3,567). Hence, with a 95% confidence level and a 5% margin of error, we obtained an initial figure of 357. We applied a proportionate to size criteria to sample 70% and 30% of this number for wage employment and entrepreneurship tracks of the project (107 and 250, respectively). However, we could only make use of 320 entries, comprising 224 and 96, respectively of employment and entrepreneurship tracks. For the non-beneficiary side of the sampling, our final selection of 541 respondents employed a systematic matched referral sampling approach designed to mirror the treatment group's characteristics, implemented in three phases: In the first stage, we relied on beneficiary-mediated identification with each of the 340 sampled beneficiaries asked to nominate at least three individuals from their social networks who would have been comparable to them at the time they were selected into the project. This generated an initial pool of 1,530 referrals, from which we applied our matching protocol. We required matches to meet four key criteria: similar employment status, income levels within ±20% of the referring beneficiary's reported earnings, age within a ±5-year bandwidth, and identical educational attainment. The verification process yielded 1,127 qualifying matches (73.7% of initial referrals). From this pool, we randomly selected the final 541 non-beneficiaries using a stratified approach that precisely mirrored the treatment group's characteristics.

The study adhered to all ethical principles guiding research involving human participants. Formal approval from an institutional review board or ethics committee was not required, as the study was non-invasive in nature, involved voluntary participation, and collected only non-sensitive data. Institutional permission to conduct the study was obtained from the International Institute of Tropical Agriculture (IITA) and the IFAD Agri-Hub Project Coordination Unit prior to data collection.

Data and Variable Measurement

Primary data for this study were gathered using a carefully designed questionnaire administered via a hybrid approach: in-person, phone calls and an online KoboToolbox form shared by link. Enumerators received a two-day training on consent protocols, question delivery, and data validation checks, interviews were backchecked for quality. Prior to fieldwork, the instrument was pre-tested with 50 respondents to refine wording and response categories. The main data-collection phase spanned two months. Key variables in this study include participation, constraints to participation and practice in the agribusiness space, perception of agribusiness as a career path, and selected socioeconomic variables.

Participation in the programme was measured as a binary variable, coded as 1 for respondents who participated and 0 otherwise. Each of the constraints to participation/practice and perception of agribusiness were assessed using a 15-item Likert-type scale, and responses were aggregated into a composite index to capture the overall respective scores. Continuous variables such as age, household size, experience and income were retained in their actual numeric forms, while categorical variables such as sex, education level, and six geopolitical zones were recoded into binary variables as appropriate for regression analysis. To strengthen causal inferences, four instrumental variables were included: contacts with project officials and partners (binary), geopolitical zone (dummy-coded), number of friends or family members who are beneficiaries (continuous), and days since programme enrollment relative to the survey start date (continuous).

Also, a total of 21 focus group discussions (FGD) involved 170 youth beneficiaries selected from hubs and satellites across Yola, Abuja, Nasarawa, Kano and Kaduna, Imo, Anambra, Akwa Ibom, Ogun, Lagos and Ekiti states. These qualitative insights were conducted to provide insights into quantitative results, as the study remains 95% quantitative.

The study adhered to all ethical principles guiding research involving human participants. Formal approval from an institutional review board or ethics committee was not required, as the study posed minimal risk to participants, involved voluntary participation, and collected only non-sensitive data. Institutional permission to conduct the study was obtained from the International Institute of Tropical Agriculture (IITA) and the IFAD Agri-Hub Project Coordination Unit prior to data collection.

Empirical procedure

Propensity Score Matching: To estimate the causal effect of the IAN project on beneficiaries, PSM was used to adjust for baseline differences between treated (beneficiary) and control (non-beneficiary) groups as presented in Table 1. The analysis began with 320 treated individuals and 541 preselected control individuals. Using a 1:1 nearest-neighbour matching without replacement,

the procedure identified 300 comparable pairs, representing control individuals who were sufficiently similar to treated individuals on the measured covariates. A total of Covariates included age, sex, marital status, education, household size, agribusiness experience, prior business ownership, and organizational membership. Dummy variables were created for categorical covariates. Our matching procedure resulted in improved covariate balance after matching. For instance, the standardized mean difference (SMD) for monthly income before the IAN project reduced from 0.255 to 0.002, and the overall propensity score distance SMD improved from 0.412 pre-matching to 0.033 post-matching. Eight out of nine covariates were balanced after matching, with only agribusiness experience slightly above the conventional threshold (SMD = -0.138) (Appendix 1).

Table 1. Standard Mean Difference before and after matching

Variable	Before	After
Distance	0.4116	0.0329
Age	0.0120	0.0217
Female	0.0575	-0.0367
Secondary	-0.1023	0.0067
Tertiary	0.1008	-0.0300
Married	-0.0101	-0.0200
Household size	0.0503	-0.0028
Years of Experience in Agribusiness	-0.1252	-0.1380
Membership of farming Association	0.0127	-0.0200
Average monthly income before the IAN project	0.2551	0.0019

Empirical framework: The empirical framework for this study is designed to estimate the causal effects of participation in the youth employment program on employment outcomes, including employment status and income levels, while addressing selection bias using both Propensity Score Matching (PSM) and Instrumental Variables (IV) approaches. The PSM method is adopted to reduce possible bias from selection owing to the non-random procedure characterizing many interventions. The choice of PSM is essentially guided by earlier evaluation studies [9, 19-23]. Participation in the programme, Pr(Participation), was conceived as a function of several covariates such as age, gender, education, household income, access to similar interventions, state, value chain, and whether the individual had a business prior to starting the programme. These covariates were selected based on existing literature, theoretical and empirical considerations, in a way that ensures that beneficiaries and the control group share similar characteristics and as such, bias is eliminated to a significant level. The PSM model is specified as:

$$\Pr(D_i = 1) = \alpha + X_i'\beta + \varepsilon_i \quad \text{(equation 1)}$$

Pr(Participation) is the probability of participating in the IAN project; X1 to X9 are the covariates included in the model; and β1 to β9 are the estimated coefficients, and epsilon is the error term. The covariates X1 to X9 are defined in Table 2.

Table 1. Table showing covariates used for Propensity score matching

Variable Code	Variable Name	Description
X_1	Age	Respondent's age in years.
X_2	Female	Gender dummy; 1 if female, 0 if male.
X_3	Secondary Education	Dummy variable: 1 if the highest education attained is secondary school, 0 otherwise.
X_4	Tertiary Education	Dummy variable: 1 if the highest education attained is tertiary level, 0 otherwise.
X_5	Married	Marital status dummy; 1 if married, 0 otherwise.
X_6	Household Size	Total number of household members.
X_7	Years of Agribusiness Experience	Number of years of experience in agribusiness before the project.
X_8	Membership in Farming/agribusiness Association	Dummy variable: 1 if the respondent belongs to a farming association, 0 otherwise.
X_9	Average Monthly Income Before the IAN Project	Respondent's reported monthly income before joining the project (in Naira).

The second stage uses the predicted participation variable ($\hat{P}$) from the first-stage model to estimate the causal effects of participation on employment outcomes. The primary outcome variable in this stage is employment status, which is treated as a binary variable (1 if employed, 0 if unemployed). A logistic regression model is specified to estimate the relationship between participation and employment outcomes.

Recognizing the possibility of unobserved confounding in programme participation, a second-stage estimation was conducted using an Instrumental Variable approach. Unlike the traditional two-stage least squares method with a linear first stage, this study employed a machine learning algorithm, random forest classification (via the forest package in R), to model programme participation. This allowed for a more flexible, data-driven estimation of participation probabilities [24, 25]. The model used a set of instrumental variables that were assumed to influence programme participation but not directly impact the outcomes: distance to programme implementation site (proxied by geopolitical zone), number of contacts with project officials, number of known beneficiaries within one's social network, and timing of enrolment. The choice of instrumental variables is grounded in established programme evaluation and econometric literature. Variables capturing programme exposure and access, such as frequency of contact with project personnel, geographic location, and duration of engagement, have been widely used to instrument participation decisions while addressing endogeneity concerns [26-28]. These instruments influence the likelihood of participation through access, information, and encouragement mechanisms, but do not directly determine employment outcomes, thereby satisfying standard relevance and exclusion assumptions. Predicted participation scores from the model were converted to percentage values and reclassified into a categorical participation variable. Following a 33.3% threshold, scores were grouped into no participation (0.0), low (1.0 - 33.3%), moderate (>33.3%–66.6%), and high (>66.6%) participation categories. This classification was applied uniformly to beneficiaries and non-beneficiaries to enable comparative analysis of participation intensity.

The predicted probabilities of participation from the random forest model were then used in the second stage to estimate the causal impact on the outcome variables of interest, employment status and income change, while controlling for effects of covariates (Equation 3). To further reduce omitted variable bias, additional confounders such as exposure to similar interventions during the programme period were included. The model also explored interaction effects to assess how the programme's impact varied with constraints faced, perception of agribusiness, and access to support services both as composite (Equation 4).

The first-stage IV model is specified as:

$$P_i = \alpha + \beta_1 \text{Pro} + \beta_2 \text{Cont} + \beta_3 \text{Enrol_time} + \beta_4 \text{Relation} + \varepsilon_i \quad \text{(Equation 2)}$$

$$Y = \delta + \theta \hat{P} + \lambda X_1\text{-}Xn + \varepsilon_i \quad \text{(Equation 3)}$$

Where: Y represents the employment status (binary variable: employed vs. unemployed) and income change (continuous variable for difference in income after and before); $\hat{P}$ is the predicted probability of participation from the first-stage IV model; X includes the control variables outlined in equation 1 and ϵ is the error term capturing unobserved factors affecting the employment outcomes.

$$Y_{it} = \alpha + \beta 1 \hat{P} + \beta_2 \text{Perception} + \beta_3 \hat{P} * \text{Perception} + \gamma_1 \text{Constraints} + \gamma_2 \hat{P} * \text{Constraints} + \Omega \text{support_service} + \lambda X_1\text{-}X_n + \varepsilon_i \quad \text{(Equation 4)}$$

Results and Discussion

Predicting participation in the IAN project using the IV approach

It was found from the analysis of instrumental variables predicting participation that among the predictors used in the random forest model, contact with project personalities (defined as the frequency of direct interactions with IAN field officers, trainers, mentors, or programme coordinators through meetings, training sessions, monitoring visits, phone calls, or digital communication platforms) emerged as the most influential variable, with the highest Mean Decrease in Accuracy (91.56) and Gini (112.38), indicating a strong association with participation likelihood (Appendix 2). Other important predictors included geopolitical zone and number of days on the project, though their predictive power was significantly lower.

The analysis of participation levels by category – beneficiary or non-beneficiary (Appendix 3) and employment track (Appendix 4) reveals distinct patterns. A majority of beneficiaries (75.7%) display high levels of participation in employment, namely, 79% had wage employment and 69% were actively engaged in entrepreneurship. Very few beneficiaries ranked "low" or "moderate". For non-beneficiaries, 70% had low participation index, and 19% had no participation at all. This sharp contrast points to the influence of project exposure and support, as those categorized as beneficiaries were substantially more engaged in across the board. However, the limited uptake among non-beneficiaries indicates that spillover effects beyond direct beneficiaries were minimal.

The results (see Figure 1) indicate that all at least 93% of beneficiaries on both employment tracks benefited from monthly stipends and training from the IAN. Market-linkup was accessed by 87.2%

of the entrepreneurship track beneficiaries, while job link-up was accessed by 93.3% of their counterparts in the wage employment track. The combination of stipends and training constituted a strategic effort to ensure both immediate support and long-term capacity building for beneficiaries.

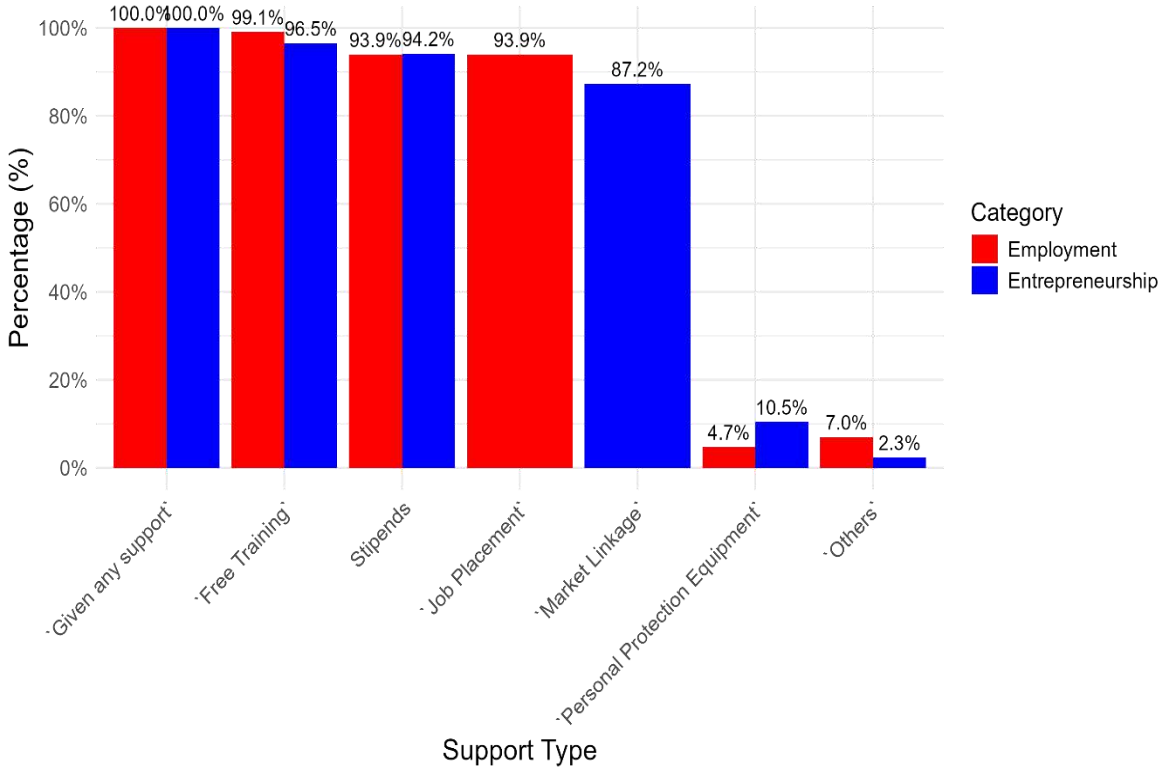


Figure 1. Support Services received by beneficiaries

Employment status of beneficiaries and non-beneficiaries

The findings (Figure 2) reveal a clear demarcation in employment outcomes across the three groups. Beneficiaries on the wage employment track recorded the highest employment rate, with 93.0% reporting to be employed. This was followed by those on the entrepreneurship track, where 76.7% reported being entrepreneurs. Only 38.7% of non-beneficiaries were employed, pointing to the impact of program participation. The higher employment rates among beneficiaries, especially those on the wage employment track, underscore the effectiveness of structured job placement and market link-up as defining features to access employment. They suggest that interventions emphasizing employability, in addition to entrepreneurship, can significantly boost labour market outcomes. Furthermore, the contrast with non-beneficiaries highlights the value of programme participation in bridging employment gaps among youth.

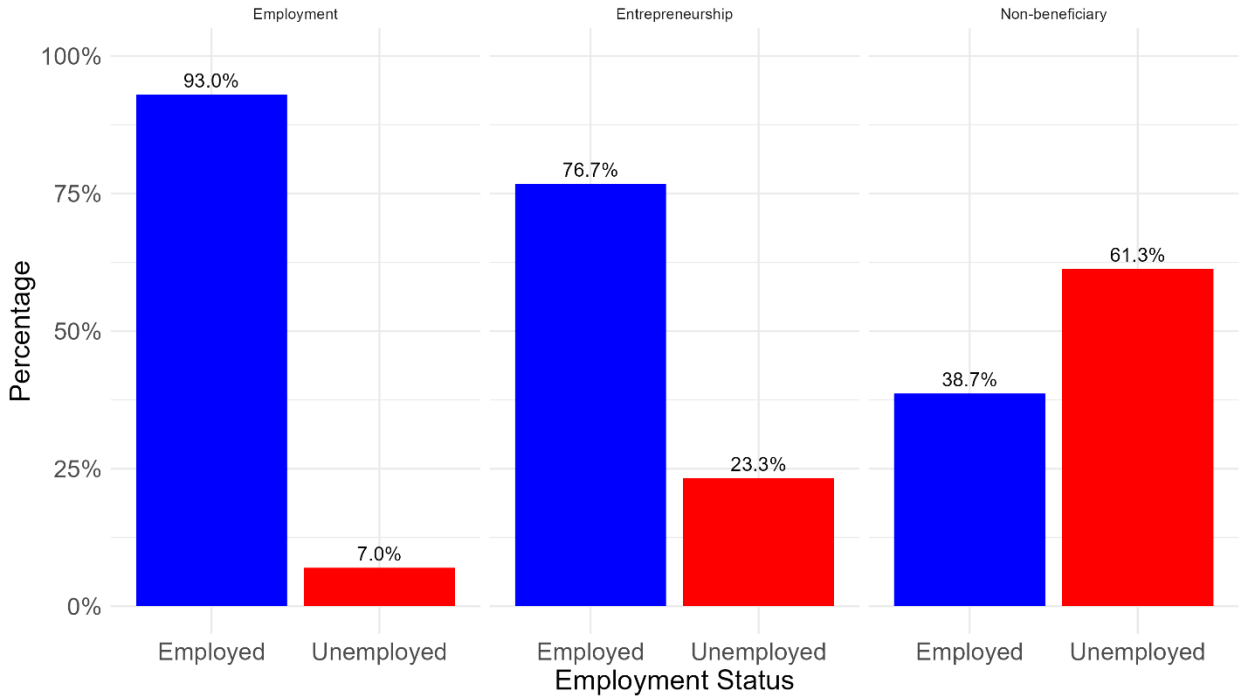


Figure 2. Employment status of respondents, post-intervention

ANOVA (Table 3) comparing income change among entrepreneurial track, employment track beneficiaries and non-beneficiary results indicates a significant difference in income change across the three groups ($F = 4.41$, $p = 0.0189$). Post-hoc Tukey HSD tests reveal that participants in the entrepreneurship track had significantly higher mean income change compared to those in the wage employment track, with a mean difference of ₦28,093 ($p = 0.009$). In contrast, the income change observed among non-beneficiaries did not differ significantly from either the wage employment track (₦8,999, $p = 0.386$) or the entrepreneurship track (₦–19,094, $p = 0.087$). These findings suggest that the entrepreneurship track was particularly effective in enhancing participants' income relative to the wage employment track. Individuals on the wage employment track, despite their relatively high employment rate (Figure 1), experienced lower increases in income.

This may reflect job quality, i.e., underemployment together with the erosion of real income due to sharp inflation during the programme period in Nigeria, where inflation has surged significantly, particularly in food, fuel, and transport [29-31]. Oladejo et al. [32] remarked that as of March 2024, Nigeria's food inflation rate was 40.1%, Employees in such positions are vulnerable to a decline in purchasing power, as their static nominal incomes are unable to keep pace with rapidly rising living costs. Consequently, even where employment is secured, the economic value derived may be minimal, especially in entry-level or informal agribusiness roles that are poorly remunerated. Fixed-wage employment offers limited leverage.

In contrast, beneficiaries in the entrepreneurship track are more likely to have price-setting power or the flexibility to adjust the pricing of their goods and services in response to inflationary market changes. This aligns with findings by Ojo et al. [33] and Yami et al. [34], which demonstrate that entrepreneurs in agribusiness tend to fare better in inflationary environments due to their adaptive capacity and ability to exploit price fluctuations. In several sub-Saharan Africa contexts, small-

scale agri-preneurs have shown resilience by leveraging informal networks, seasonal market demands, and value addition to remain profitable despite macroeconomic instability [8, 35, 36]. Thus, the observed income advantage for the entrepreneurship track may reflect this context-specific adaptive economic behavior, rather than differences in programme delivery alone.

Some authors have reported underemployment in the agribusiness sector across various country contexts [37]. Studies have also linked underemployment in agribusiness to the poor economic conditions of agricultural households globally [38-41], suggesting the need for more targeted efforts to ensure that youths are not only employed, but gainfully employed.

Table 3. ANOVA and HSD Table comparing income change among entrepreneurship track, employment track and non-beneficiary beneficiaries

Term	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Diff	p adj
ANOVA							
track	2.0000E+00	5.0286E+10	2.5143E+10	4.4073E+00	1.2580E-02		
Residuals	5.9500E+02	3.3944E+12	5.7048E+09				
HSD Pairwise comparison							
Entrepreneurship-Employment						28092.959	0.009
Non-beneficiary-Employment						8998.904	0.386
Non-beneficiary-Entrepreneurship						-19094.055	0.087

Predictors of Employment Outcome

Logistic regression analysis in Table 3 revealed distinct employment determinants between programme beneficiaries and non-beneficiaries, with beneficiaries achieving a significantly higher employment rate of 88.3% compared to 38.7% among non-beneficiaries. For beneficiaries, the entrepreneurship track showed a strong negative association with being engaged (employment) ($OR = 0.050$, $p < 0.001$), while participation intensity in IAN emerged as a significant positive predictor ($OR = 1.022$, $p < 0.01$), suggesting that active engagement in programme activities enhanced employment outcomes.

Age ($OR = 1.024$, $p < 0.01$), household size ($OR = 1.037$, $p < 0.05$), and prior income ($OR = 1.000$, $p < 0.05$) also positively influenced employment among beneficiaries. In contrast, non-beneficiaries' employment prospects were significantly shaped by years of agribusiness experience ($OR = 3.122$, $p < 0.05$) and involvement in crop processing ($OR = 2.396$, $p < 0.05$), while being married unexpectedly reduced employment odds ($OR = 0.341$, $p < 0.01$).

The beneficiaries' model demonstrated superior fit (Pseudo $R^2 = 0.463$, AIC = 162.13) compared to the non-beneficiaries' model (Pseudo $R^2 = 0.289$, AIC = 328.81), indicating that programme-related variables more effectively explained employment variations among beneficiaries. The disparity in employment rates between beneficiaries and non-beneficiaries underscores the programme's effectiveness in facilitating labour market integration, with participation intensity emerging as a critical success factor rather than mere enrollment. This is consistent with Benus et al. [42] that service intensity predicts vocational outcomes more strongly than simple programme access. The negative coefficient in terms of employment rate for participating beneficiaries following the entrepreneurship track suggests longer gestation periods for entrepreneurial ventures

to generate sustainable income, as entrepreneurship training often shows substitution effects between wage employment and self-employment rather than increasing overall employment rates [43, 44]. The stronger predictive power of beneficiaries' model suggests that programme participation creates more structured and measurable pathways to employment compared to the more heterogeneous circumstances facing non-beneficiaries.

Table 4: Predictors of employment outcome among beneficiaries and non-beneficiaries

Variable	Beneficiaries			Non-beneficiaries		
	Est	OR	Sig	Est	OR	Sig
(Intercept)	-2.128	0.119		-7.143	0.001	***
Age	0.024	1.024		0.098	1.103	**
TrackEntrepreneurship	-3.007	0.050	***	-0.025	0.976	
Household_size	0.036	1.037		0.118	1.125	*
Years_experience_agribusiness	-0.061	0.941		1.139	3.122	*
Crop_production	0.504	1.656		0.891	2.437	
Crop_processing	0.931	2.538		0.874	2.396	*
Animal_production	-0.572	0.565		0.000	1.000	*
Income_before	0.000	1.000	*	0.967	2.630	
Animal_processing	-2.279	0.102		0.034	1.034	
Perception_composite	0.041	1.042		-0.443	0.642	
Female	0.228	1.256		0.336	1.399	
Secondary	-0.993	0.371		0.592	1.807	
Tertiary	-2.106	0.122		0.167	1.182	
Support_composite	0.540	1.716		0.522	1.686	
Married	0.931	2.536		-1.077	0.341	**
Prior_business	0.357	1.430		0.015	1.015	*
Participation_percent	0.021	1.022	**	-0.101	0.904	
`Geopolitical zone`Northeast	-1.017	0.362		0.704	2.021	
`Geopolitical zone`Northwest	1.201	3.325		0.449	1.566	
`Geopolitical zone`Southeast	-0.747	0.474		-0.621	0.537	
`Geopolitical zone`Southsouth	-1.948	0.143		-0.148	0.862	
N	300			300		
Employed	265			116		
Employment_Rate	88.3			38.7		
AIC	162.13			328.81		
BIC	247.32			410.3		
Null_Deviance	216.14			400.34		
Residual_Deviance	116.13			284.81		
Pseudo_R2	0.4627			0.2886		
Converged	Yes			Yes		

Determinants of Income Change Among IAN Agribusiness Project Beneficiaries in Nigeria

Across Models 1 to 3 (see Table 4, Appendix 6 and Appendix 7), association membership remained the strongest and most consistent determinant of income change among beneficiaries, with large and highly significant effects across all specifications (β = 68,821.94, $p < 0.001$; β = 66,296.81, $p < 0.001$; β = 68,275.96, $p < 0.001$). This result corroborates Adeyanju et al. [36], who report significant income gains among youths participating in agribusiness empowerment programmes. Among non-beneficiaries, association/network membership was also positive but of weaker effects ($\beta \approx$ 15,048–15,272), indicating limited income returns outside structured programmes. This result is consistent with Ogunmodede, Ogunsanwo & Manyong [45].

Employment status showed significant positive effects for beneficiaries (Model 1: β = 29,334.93, $p < 0.05$; Model 2: β = 32,001.19, $p < 0.05$) and remained significant for non-beneficiaries (B $\approx$ 16,770–16,969, $p < 0.05$), supporting earlier evidence from Bello et al. [8] about employment gains via youth-agribusiness initiatives. As a robustness check, income models were estimated separately for the entrepreneurship and employment tracks to examine whether the effect of association membership varied by programme pathway (Appendix 6). Results reveal that the variable is associated with income gains of ₦156,825 among entrepreneurship participants compared to ₦44,666 among employment track participants, a more than threefold difference. This finding suggests that while agricultural networks provide modest benefits universally, they are particularly transformational for self-employed youth who require market access, supplier relationships, and collective bargaining power. The effect of entrepreneurship and network membership strengthens the main finding by revealing that the entrepreneurship track's superior performance operates specifically through enabling conditions where agricultural networking yields maximum returns. This result points directly to the important role of social capital in agribusiness transformation. Studies consistently show that membership in associations and social networks improves market access, reduces transaction costs, and enhances income through information sharing, trust, and collective action [46-48]. Evidence from youth-focused agribusiness programmes further indicates that these benefits are amplified in entrepreneurial settings where networks facilitate access to markets, suppliers, and customers [49, 50]. In Nigeria, social capital has been linked to improved access to productive resources and enterprise performance, resulting in higher income outcomes [51, 52].

Consistently, employment status also shows a statistically significant positive influence on income in the first two models (β = 29334.93, β = 32001.19), suggesting that gainful employment within the agribusiness ecosystem enhances financial resilience. In Model 3, the introduction of the support composite variable (β = 15302.07*) demonstrates a significant positive relationship with income change. Further, beneficiaries from the Southwest geopolitical zone consistently show higher income changes, which attain significance in Models 2 and 3 (β = 32102.16*, β = 32482.94*), an indication of potential regional advantages in terms of market access, infrastructure, or institutional presence.

Primary education was marginally positive for beneficiaries, enterprise-level variables (crop production, processing, animal production) and interaction terms (e.g., perception × participation) were mostly insignificant. This aligns with Boye [53] and Berdegué [54], who highlight that productivity gains often stem from institutional support and system-level innovations rather than enterprise choice alone. Model fit improved with added control variables (beneficiary R^2 from

0.237 to 0.259; non-beneficiary R^2 from 0.256 to 0.504), indicating stable but moderate explanatory power across the models.

These findings have implications for agribusiness development policy and practice in Nigeria and comparable contexts. The coefficient of membership to associations further establishes the argument that peer networks and collective action mechanisms are vital and also aligns with existing evidence that peer networks and associations can enhance access to information, resources, agricultural innovation diffusion and market engagement [55-58]. Similarly, the role of institutional support aligns with existing research, demonstrating that access to finance, inputs, and capacity-building services significantly boosts farm and non-farm income [59, 60].

Hence, our results agree with numerous studies in Nigeria and SSA sub-region reporting improved income among youth beneficiaries in different agribusiness projects owing to the integration of targeted support structure in the intervention [8, 34-36, 61]. Regional disparities, particularly the income advantage in the Southwest, support earlier evidence that localized infrastructure, governance, and economic dynamics often play mediating roles on the effectiveness of agricultural interventions [62].

Table 5. Model 3: Last stage predictors of income change among IAN project beneficiaries in Nigeria

Variable	Beneficiaries	Non-Beneficiaries
(Intercept)	-38879.535 (92899.342)	
Age	466.070 (874.451)	-796.043 (622.209)
Trackentrepreneurship	14143.841 (9967.326)	
Household_size	-953.362 (848.382)	-916.755 (528.816)†
Employed	26606.466 (14562.739)†	16968.618 (7812.414)*
Years_experience_agribusiness	-1499.173 (1433.663)	-237.861 (972.392)
Crop_production	3039.666 (10686.025)	9906.391 (9375.524)
Crop_processing	32111.069 (21400.765)	-12580.960 (23996.448)
Animal_production	-12497.582 (10491.063)	11680.277 (9237.929)
Income_before	0.057 (0.123)	0.421 (0.097)***
Animal_processing	-29256.819 (22921.651)	-5832.764 (20986.720)
Perception_composite	-1023.358 (1292.782)	398.150 (503.136)
Participation_percent	-118.840 (1005.767)	-266.755 (775.848)
Constraints_composite	1115.737 (682.336)	
Female	-12627.725 (9002.600)	-17536.094 (7121.239)*
Primary	61086.622 (38505.668)	4509.911 (31699.608)
Secondary	-22745.227 (16360.027)	-25947.399 (13955.144)†
Tertiary	-5194.734 (15124.396)	-18898.561 (12731.157)
Married	12375.128 (10793.013)	-5234.432 (8144.229)
Membership	68275.957 (17358.775)***	15271.724 (12602.468)
Prior_business	602.052 (10561.511)	-13443.839 (8160.601)
`Geopolitical zone`northeast	23979.728 (24351.864)	48442.522 (40254.096)
`Geopolitical zone`northwest	9882.470 (17445.069)	48556.151 (37559.928)
`Geopolitical zone`southeast	-1695.679 (16013.599)	45372.763 (35062.355)
`Geopolitical zone`southsouth	1633.806 (18125.849)	49589.498 (37346.976)
`Geopolitical zone`southwest	32482.944 (14716.790)*	61396.631 (34141.281)†
Support_composite	15302.069 (6744.610)*	
Perception_composite:participation_percent	12.771 (16.109)	2.807 (13.122)
Participation_percent:constraints_composite	-11.601 (8.072)	
`Geopolitical zone`northcentral		46230.073 (34509.364)
N	300	300
R^2	0.259	0.504
Adjusted R^2	0.182	0.459
F-statistic	3.383	11.189
F p-value	<0.001	<0.001

Note: † p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Conclusion

The findings indicate that income improvement under the IAN Agrihub project is influenced not only by employment track (wage employment and entrepreneurship) but also, more importantly, by the broader support ecosystem, regional context, and the strength of beneficiaries' networks. Being employed, whether through wage employment or as an entrepreneur, showed a significant association with income gains in the first two models (Model 1 and Model 2). In contrast, the programme tracks variables themselves (employment and entrepreneurship) did not independently predict income change once other factors were controlled for. This suggests that actual employment status, whether beneficiaries secured work, matters more for income improvement than which programme track they participated in. We also observed that the influence of employment status on change in income diminished in magnitude in the third model, i.e., Model

3, suggesting some stronger variables than just being employed. This highlights potential risks of underemployment and the erosion of wage income value, where securing a job does not necessarily equate to improved livelihoods.

The study also underscores the central role of social capital and institutional support in shaping income related outcomes. Group membership emerged as the strongest and most consistent predictor of income change among entrepreneurs, while support-composite scores had a significant positive effect, suggesting that targeted, task-enabling assistance can be more impactful than broad financial handouts or job placement alone (in the case of wage employment). Overall, the evidence affirms that beyond individual characteristics, well-structured support systems, strong peer networks, and regionally adaptive strategies have been essential to maximise the effectiveness of agribusiness interventions.

Future programming efforts in the realm of rural youth employment would benefit from considering the following issues emerging from this research paper:

1. IFAD should prioritise rural youth employment in future interventions, whether through entrepreneurship or formal jobs as income gains were driven by whether beneficiaries secured work, rather than by which programme track they enrolled in. However, employment strategies should be designed with awareness of potential effect of inflation during the early stage, since wage placements may offer limited real income gains unless paired with measures that reduce underemployment and strengthen earning potential.
2. FAD, in collaboration with the Federal Ministry of Agriculture and Food Security and state-level Ministries of Agriculture, should prioritize the formation and strengthening of inclusive agricultural youth inclusive associations. This includes funding structured group formation, leadership training (with gender balance and the promotion of gender equality and women´s empowerment), and linking associations to existing sector benefits such as input subsidy schemes, credit providers, and output markets to boost smallholder incomes.
3. Future research should investigate how intervention strategies can be tailored to the specific agro-ecological, infrastructural, and socio-economic conditions of different geopolitical zones. While this study observed regional variations in outcomes, further analysis is needed to identify which contextual factors (e.g., market access, infrastructure quality, cultural norms around entrepreneurship) drive these differences and how programme design should adapt accordingly.
4. IFAD and implementing partners should design integrated, multi-dimensional support packages that combine technical training, mentorship, market linkages, and material inputs, rather than relying on single-intervention approaches such as financial transfers or job placements alone.

Declarations

Data Vailability: The anonymized data that support the findings of this study are available from the corresponding author upon reasonable request

References

1. International Labour Organisation Report on Employment in Africa (Re-Africa); Tackling the Youth Employment Challenge. ILO, Geneva, 2021.
2. Fox L and A Thomas Africa's Got Work to Do: A Diagnostic of Youth Employment Challenges in Sub-Saharan Africa. *J. Afr. Econ.* 2016; 25: i16–i36.
3. African Union, International Labour Organization Youth Employment Strategy for Africa (YES-Africa). 2024.
4. World Bank World Development Indicators. World Bank, Washington, D.C., 2018.
5. National Bureau of Statistics Labor Force Statistics: Unemployment and Underemployment Report. NBS, Abuja, Nigeria, 2023.
6. Olomu MO, Ekperiware MC and T Akinlo Agricultural Sector Value Chain and Government Policy in Nigeria: Issues, Challenges and Prospects. *Afr. J. Econ. Manag. Stud.* 2020; 11(3): 525–538.
7. Yeboah FK and TS Jayne Africa's Evolving Employment Trends: Implications for Economic Transformation. Michigan State University, East Lansing, MI, 2016.
8. Bello LO, Baiyegunhi LJS, Mignouna D, Adeoti R, Dontsop-Nguezet PM, Abdoulaye T and others Impact of Youth-in-Agribusiness Program on Employment Creation in Nigeria. *Sustainability* 2021; 13(14): 7801.
9. Adeyanju D, Mburu J and D Mignouna Youth Agricultural Entrepreneurship: Assessing the Impact of Agricultural Training Programmes on Performance. *Sustainability* 2021; 13(4): 1697.
10. International Fund for Agricultural Development (IFAD) The IFAD Agri-hub Nigeria Project: Empowering Youth Through Agribusiness. IFAD Reports, 2023.
11. Aliu OR Effect of Digitizing Food Systems from Agriculture on Youth Employment in African Countries. *Discov. Agric.* 2024; 10(1): e11da1563.
12. Awotodunbo AA, Adesanya O, Adebayo AS, Mugisho MA and DS Otu The Achievement of Rural Youth Employment Opportunities: Support to Integrated Agribusiness Hubs Project in Nigeria, Implication for Sustainable Development. *Int. J. Agric. Vet. Sci.* 2025; 7(1): 100–114.
13. Kubik Z The Challenges of Rural Youth Employment in Africa: A Literature Review. ZEF Working Paper Series, No. 212, 2022.
14. ECDPM Youth Employment Opportunities in African Agrifood Systems. 2017.
15. Mueller B Rural Youth Employment in Sub-Saharan Africa: Moving Away from Urban Myths and Towards Structural Policy Solutions. In: ILO (Ed). Is the Future Ready for Youth? Youth Employment Policies for Evolving Labour Markets. ILO, Geneva, 2021: 127–151.
16. Brookings Institution The Case for Job Creation Hubs to Reduce Youth Unemployment in Africa. 2022.
17. World Bank Youth Employment in Sub-Saharan Africa: Opportunities and Challenges. Africa Regional Studies. World Bank, Washington, D.C., 2014.
18. Krejcie RV and DW Morgan Determining Sample Size for Research Activities. *Educ. Psychol. Meas.* 1970; 30(3): 607–610.
19. Asfaw S and B Shiferaw Agricultural Technology Adoption and Rural Poverty: Application of an Endogenous Switching Regression for Selected African Countries. Contributed Paper presented at the Joint 3rd African Association of Agricultural

Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, 2010.
20. Ahmed MH and J Haji Impact of Improved Vegetable Varieties on Farmers' Income in Ethiopia: A Propensity Score Matching Approach. *J. Dev. Agric. Econ.* 2014; 6(7): 312–322.
21. Bello LO, Baiyegunhi LJS, Danso-Abbeam G and AA Ogundeji Impact of Youth Agribusiness Programme on Income and Employment in Nigeria: A Propensity Score Matching Approach. *Afr. J. Sci. Technol. Innov. Dev.* 2025; 1–12.
22. Haji J and B Legesse Impact of Sedentary Farms on Livelihood of Pastoralists: A Propensity Score Matching Analysis. *J. Dev. Agric. Econ.* 2017; 9(4): 90–101.
23. Balde R, Boly M and E Avenyo Labour Market Effects of Urban Riots: An Experimental Matching Approach. *World Dev.* 2019; 122: 141–155.
24. Athey S and GW Imbens Machine Learning Methods that Economists Should Know About. *Annu. Rev. Econ.* 2019; 11: 685–725.
25. Breiman L Random Forests. *Mach. Learn.* 2001; 45(1): 5–32.
26. Angrist JD and J-S Pischke Mostly Harmless Econometrics: An Empiricist's Companion. Princeton University Press, Princeton, 2009.
27. Wooldridge JM Econometric Analysis of Cross Section and Panel Data. 2nd ed. MIT Press, Cambridge, MA, 2010.
28. Imbens GW and DB Rubin Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction. Cambridge University Press, Cambridge, 2015.
29. Adeosun O and others Poor Agricultural Productivity, Insecurity Affecting Farming Regions, and Volatile Exchange Rates. *J. Agric. Econ.* 2023; 15: 234–256.
30. Sadiq MS, Singh I and M Ahmad The Influence of Armed Banditry on Food Supply Chains in North-West Nigeria: A Comprehensive Review. *Krjals* 2024; 1: 1–19.
31. Ezeh P Insecurity in Nigerian Farming Regions. *J. Afr. Secur. Stud.* 2021; 9: 245–267.
32. Oladejo T, Onakoya A, Oseni E, Ajibola J and I Akintoye Monetary Policy, Inflation and Economic Growth in Nigeria. *Open J. Bus. Manag.* 2025; 13: 813–836.
33. Ojo T and L Baiyegunhi Determinants of Climate Change Adaptation Strategies and its Impact on the Net Farm Income of Rice Farmers in South-West Nigeria. *Land Use Policy* 2020; 95: 103946.
34. Yami M, Feleke S, Abdoulaye T, Alene AD, Bamba Z and V Manyong African Rural Youth Engagement in Agribusiness: Achievements, Limitations, and Lessons. *Sustainability* 2019; 11(1): 185.
35. Adeyanju D, Baiyegunhi LJS, Mignouna D, Abdoulaye T, Alene AD and V Manyong Impact of Agribusiness Empowerment Interventions on Youth Livelihoods: Insight from Africa. *Heliyon* 2023; 9(11): e21291.
36. Nyabam VS, Tarawali G and BA Ijie Empirical Analysis of IITA Youth in Agribusiness Model as a Panacea for Solving Youth Unemployment Problem in Nigeria. *Int. J. Gov. Dev.* 2018; 5(1 & 2): 117–121.
37. Han J and C Chung Impact of Aging and Underemployment on Income Disparity between Agricultural and Non-Agricultural Households. *Sustainability* 2021; 13(21): 11737.
38. Seok J, Moon H, Kim G and M Reed Is Aging the Important Factor for Sustainable Agricultural Development in Korea? Evidence from the Relationship between Aging and Farm Technical Efficiency. *Sustainability* 2018; 10: 2137.

39. Du H, King RB and P Chi Income Inequality is Detrimental to Long-term Well-being: A Large-scale Longitudinal Investigation in China. *Soc. Sci. Med.* 2019; 232: 120–128.
40. Bell DN and DG Blanchflower The Lack of Wage Growth and the Falling NAIRU. *Natl. Inst. Econ. Rev.* 2018; 245: R40–R55.
41. Guo G, Wen Q and J Zhu The Impact of Aging Agricultural Labor Population on Farmland Output: From the Perspective of Farmer Preferences. *Math. Probl. Eng.* 2015; 2015: 1–7.
42. Benus J, Bittleman B, Gallagher D and T Shen Are Self-employment Training Programs Effective? Evidence from Project GATE. *Labour Econ.* 2012; 19(5): 695–705.
43. Groh M, Krishnan N, McKenzie D and T Vishwanath The Impact of Soft Skills Training on Female Youth Employment: Evidence from a Randomized Experiment in Jordan. *IZA J. Labor Dev.* 2016; 5(1): 9.
44. Premand P, Brodmann S, Almeida R, Grun R and M Barouni Entrepreneurship Education and Entry into Self-employment among University Graduates. *World Dev.* 2016; 77: 311–327.
45. Ogunmodede AM, Ogunsanwo MO and V Manyong Unlocking the Potential of Agribusiness in Africa through Youth Participation: An Impact Evaluation of N-power Agro Empowerment Program in Nigeria. *Sustainability* 2020; 12: 5737.
46. Abate GT, Bernard T and DJ Spielman The Impact of Farmers' Organizations on Smallholder Farmers' Welfare in Ethiopia. *World Dev.* 2014; 64: 345–358.
47. Bernard T and DJ Spielman Reaching the Rural Poor through Rural Producer Organizations? A Study of Agricultural Marketing Cooperatives in Ethiopia. *Food Policy* 2009; 34(1): 60–69.
48. Fafchamps M and B Minten Impact of SMS-based Agricultural Information on Indian Farmers. *World Bank Econ. Rev.* 2012; 26(3): 383–414.
49. Campos F, Frese M, Goldstein M, Iacovone L, Johnson HC, McKenzie D and M Mensmann Teaching Personal Initiative Beats Traditional Training in Boosting Small Business in West Africa. *Science* 2017; 357(6357): 1287–1290.
50. Karlan D, Möbius M, Rosenblat T and A Szeidl Trust and Social Collateral. *Q. J. Econ.* 2009; 124(3): 1307–1361.
51. Agbim KC and GO Oriarewo Spirituality, Social Capital and Survival of Family Businesses in Nigeria. *J. Fam. Bus. Manag.* 2019; 9(1): 77–96.
52. Liverpool-Tasie LSO, Kuku O and A Ajibola A Review of Literature on Agricultural Productivity, Social Capital and Food Security in Nigeria. Nigeria Strategy Support Program (NSSP) Working Paper, IFPRI, 2011.
53. Boye SR Institutional Support and Agricultural Transformation: A Review. *J. Rural Stud.* 2024; 105: 103–115.
54. Berdegué JA Systems Thinking in Agricultural Innovation. *Agric. Syst.* 2025; 223: 104–118.
55. Shen J and Y Bian The Causal Effect of Social Capital on Income: A New Analytic Strategy. *Soc. Netw.* 2018; 54: 82–90.
56. Paarlberg LE, Hoyman M and J McCall Heterogeneity, Income Inequality, and Social Capital: A New Perspective. *Soc. Sci. Q.* 2018; 99: 699–710.
57. Chen Y and B Volker Social Capital and Homophily Both Matter for Labor Market Outcomes–Evidence from Replication and Extension. *Soc. Netw.* 2016; 45: 18–31.

58. Tadesse G and G Bahiigwa Mobile Phones and Farmers' Marketing Decisions in Ethiopia. *World Dev.* 2015; 68: 296–307.
59. Maertens M and JFM Swinnen Trade, Standards, and Poverty: Evidence from Senegal. *World Dev.* 2009; 37(1): 161–178.
60. FAO The State of Food and Agriculture: Making Agri-food Systems More Resilient to Shocks and Stresses. Food and Agriculture Organization of the United Nations, Rome, 2021.
61. Ogunmodede AM, Ogunsanwo MO and V Manyong Unlocking the Potential of Agribusiness in Africa through Youth Participation: An Impact Evaluation of N-power Agro Empowerment Program in Nigeria. *Sustainability* 2020; 12: 5737.
62. Alene AD, Manyong VM, Omanya G, Mignouna HD, Bokanga M and G Odhiambo Smallholder Market Participation under Transactions Costs: Maize Supply and Fertilizer Demand in Kenya. *Food Policy* 2009; 33(4): 318–328.

Funding: This research was funded by the International Fund for Agricultural Development (IFAD) for the study.

Ethics approval and consent to participate: Informed consent was obtained digitally: the first page of the KoboCollect questionnaire included a consent statement outlining the purpose of the study, the voluntary nature of participation, the approximate time required, and the right to withdraw at any point without penalty. Respondents were required to indicate agreement before proceeding to the questionnaire. Privacy and confidentiality were protected by designing the survey to collect no identifying information such as names, phone numbers, or email addresses. Responses were stored securely and were accessible only to the research team. All data were reported in aggregate form, ensuring that individual participants could not be identified. The study did not obtain formal ethical approval from an Institutional Review Board (IRB) due to the minimal-risk nature of the survey. However, measures were taken to minimize risks to participants: ensuring anonymity, using non-sensitive survey items, and maintaining secure data storage. These safeguards align with internationally accepted ethical standards for social science research. Institutional permission to conduct the study was obtained from the International Institute of Tropical Agriculture (IITA) and the IFAD Agri-Hub Project Coordination Unit prior to data collection.

Consent for Publication: Not applicable.

Clinical Trial Number: Not applicable.

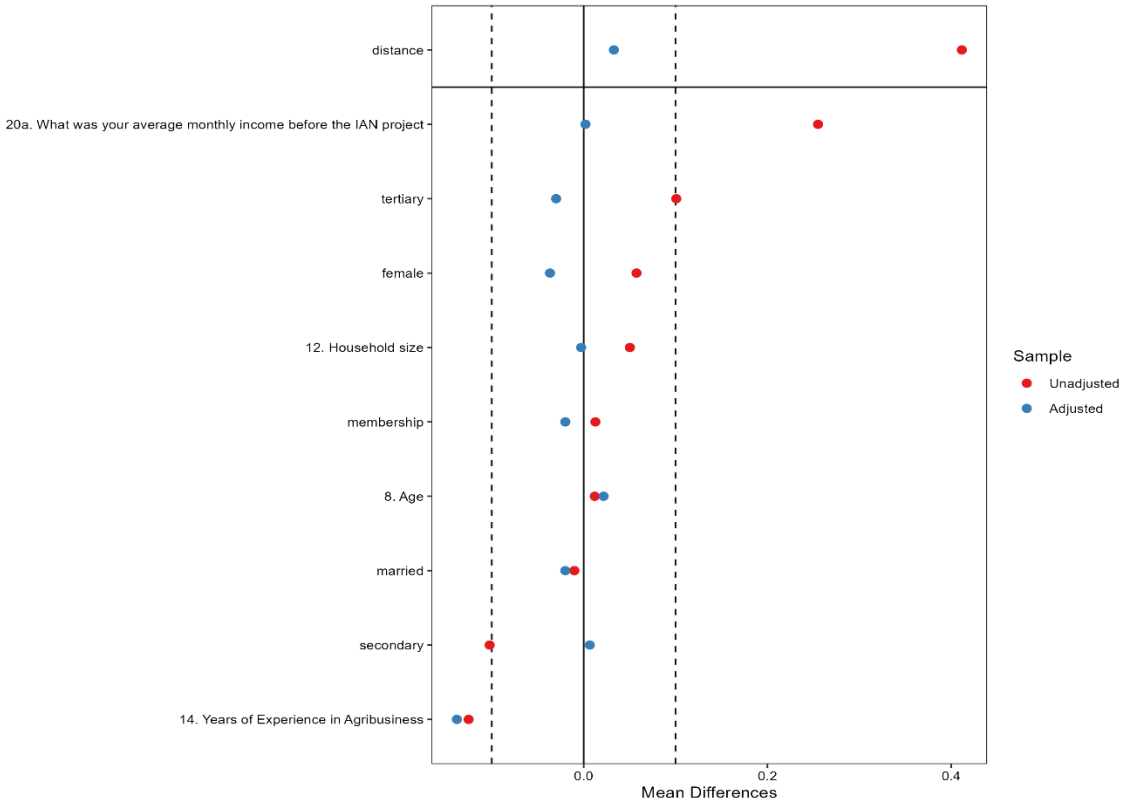
Author Contributions: N.S.O. conceptualized the study, designed the methodology, supervised the data collection process, and wrote the main manuscript text. O.A. coordinated the entire project, oversaw all field and data collection activities, and reviewed and corrected manuscript drafts. W.O. and D.O. managed project administration, monitored the data collection exercise, facilitated field logistics, contributed to data interpretation, and reviewed manuscript drafts. D.O. also managed qualitative data collection and co-developed the data collection instruments. F.I. coordinated data validation, performed validation checks, and reviewed manuscript drafts. F.A. facilitated field logistics, supervised field activities, and validated the data. J.O. contributed to qualitative data collection and co-validated the data. A.I. facilitated field logistics and supervised

field activities. A.A., M.A., M.N., and C.A. contributed to data collection, field coordination, and manuscript review. All authors read and approved the final manuscript.

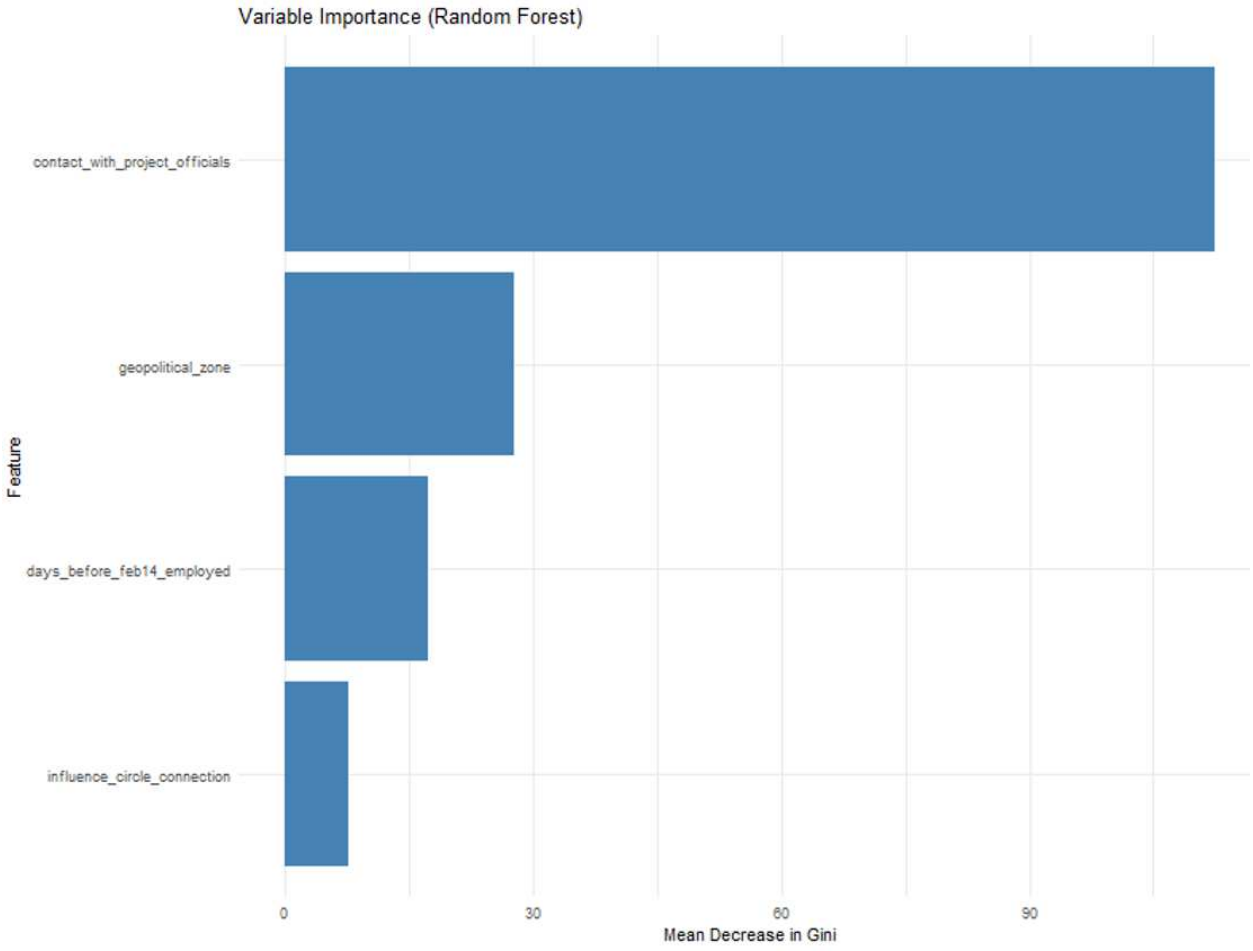
Acknowledgements: The authors extend their sincere gratitude to the International Fund for Agricultural Development (IFAD) for funding the Nigerian Agri-Hub Project, which provided the foundation for this research. We appreciate the International Institute of Tropical Agriculture (IITA) for logistical coordination across the various study locations. Special thanks are due to the individuals who participated in surveys and focus group discussions across 11 states; their willingness to share their time, perspectives, and lived experiences was indispensable to this work. We also recognize the essential role played by hub managers, field coordinators, enumerators, and local community leaders in facilitating access to participants and ensuring the smooth execution of data collection activities. Finally, we acknowledge the intellectual contributions of Adenmosun Adetola, Mugisho Aline, Mulinganya Noel, and Chiqui Arregui, whose insights enhanced multiple dimensions of this study.

Appendices

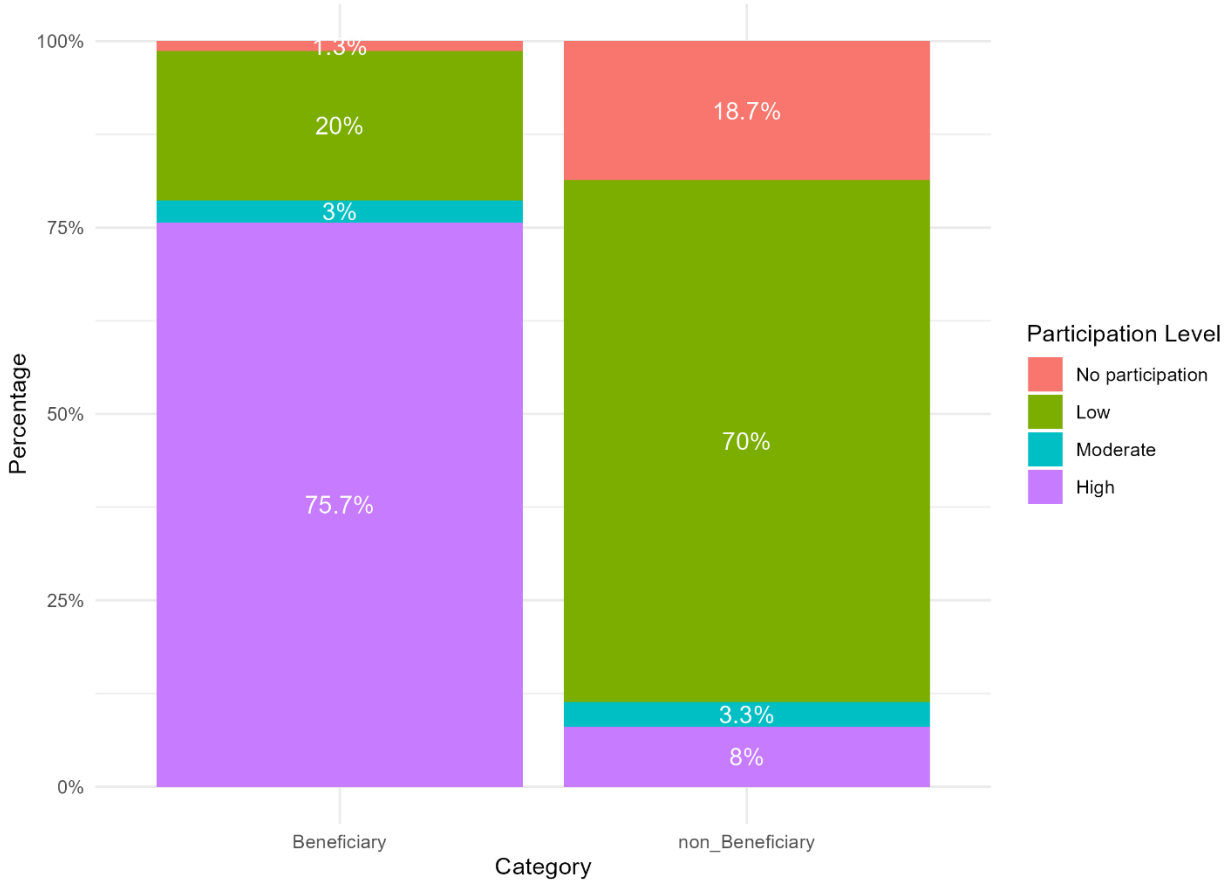
Appendix 1. Standard Mean Different results for PSM covariates before and after matching



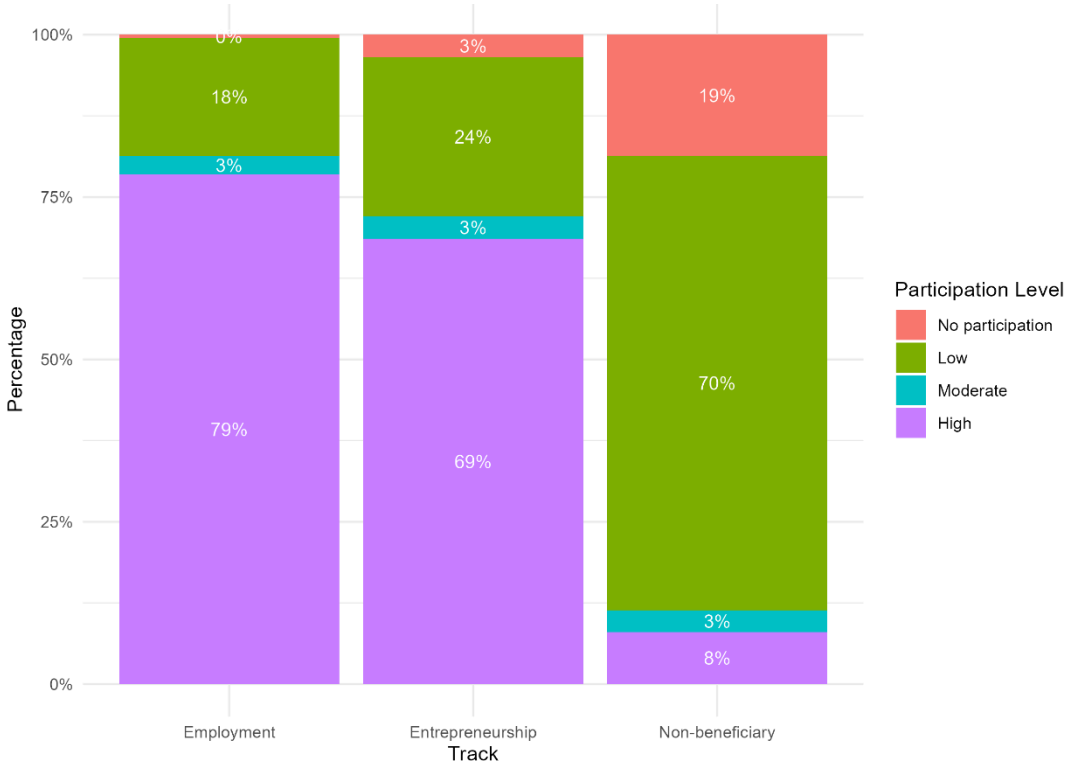
Appendix 2. Variable importance Mean Decrease in Accuracy and Gini for instrumental variable



Appendix 3. Participation levels by category – beneficiaries vs. non-beneficiaries



Appendix 4. Participation levels by category – beneficiaries (entrepreneurship vs employment tracks) vs. non-beneficiaries



Appendix 5. Participation and practice-related challenges faced by youth beneficiaries

Constraint	Percentage					Weighted Mean		
	VS	S	Mod.S	Mild.S	NB	Pooled	Emp	Ent
1. Cultural norms/restrictions on participation	10.3	17.9	11	12.3	48.5	2.29	2.37	2.07
2. Difficulty in balancing work and family life	6.3	21.3	19.3	21.9	31.2	2.49	2.61	2.2
3. Lack of/inadequate childcare support	4.3	21.9	15	15	43.9	2.28	2.32	2.17
4. Poor access to financial resources	17.6	36.5	21.3	10	14.6	3.32	3.38	3.17
5. Poor access to agricultural inputs, tools, or equipment	17.9	41.2	14	10	16.9	3.33	3.46	3
6. Lack of access to transportation/mobility	12.3	30.6	24.3	15.3	17.6	3.04	3.18	2.69
7. Program schedules/timing conflicts	7.3	24.9	23.6	21.6	22.6	2.73	2.84	2.44
8. Organisational policies not accounting for needs	5.3	18.9	22.9	16.3	36.5	2.4	2.43	2.3
9. Inability to build professional networks/partnerships	9	30.6	20.6	16.9	22.9	2.85	2.97	2.57
10. Lack of access to timely and relevant program information	10.6	32.9	22.6	13.6	20.3	3	3.16	2.59
11. Unavailability of gender-friendly mentorship/guidance	4	16.3	17.9	13.6	48.2	2.14	2.2	1.99
12. Difficulty in business registration or employment	9	29.2	19.6	14.6	27.6	2.77	2.89	2.48
13. Physical/mental stress from activities	3.7	26.9	21.9	22.9	24.6	2.62	2.71	2.41
14. Inadequate access to digital tools (e.g., computers, internet)	13.3	34.9	20.6	11.3	19.9	3.1	3.21	2.83
15. Lack of proficiency in using technology for business	13	30.9	17.9	13.3	24.9	2.94	3.08	2.58

Appendix 6. Model 1: **Predictors of Income Change Among IAN Agribusiness Project Beneficiaries in Nigeria**

Variable	Beneficiaries	Non-Beneficiaries
(Intercept)	-8534.700 (53591.253)	43455.792 (31924.448)
Age	629.074 (877.962)	-794.354 (621.082)
Trackentrepreneurship	12541.049 (10027.867)	
Household_size	-943.149 (855.964)	-912.835 (527.584)†
Employed	29334.932 (14379.425)*	16877.378 (7787.266)*
Years_experience_agribusiness	-1023.673 (1434.382)	-251.296 (968.682)
Crop_production	1749.029 (10771.079)	9619.712 (9263.197)
Crop_processing	34102.304 (21392.853)	-13696.845 (23382.090)
Animal_production	-13033.913 (10575.340)	11457.074 (9162.935)
Income_before	0.083 (0.123)	0.419 (0.096)***
Animal_processing	-30330.482 (23093.135)	-6403.837 (20780.224)
Perception_composite	-199.405 (633.334)	458.181 (416.884)
Constraints_composite	141.151 (336.763)	
Female	-12146.061 (9081.554)	-17589.573 (7104.536)*
Primary	68804.202 (38407.262)†	4493.562 (31644.670)
Secondary	-22904.922 (16505.121)	-25896.207 (13928.951)†
Tertiary	-3111.232 (15202.939)	-18962.060 (12705.675)
Married	11124.769 (10856.526)	-5286.471 (8126.510)
Membership	68821.939 (17429.842)***	15048.987 (12537.651)
Prior_business	-163.206 (10638.267)	-13576.287 (8123.001)†
`Geopolitical zone`northeast	15387.550 (24187.291)	1680.542 (22063.729)
`Geopolitical zone`northwest	6920.122 (17561.110)	2199.661 (15360.871)
`Geopolitical zone`southeast	-3779.168 (16091.489)	-1277.456 (11345.980)
`Geopolitical zone`southsouth	-2217.978 (17988.705)	3020.987 (14065.713)
`Geopolitical zone`southwest	27339.114 (14581.309)†	14994.308 (8540.149)†
Participation_percent	167.242 (124.497)	-103.668 (143.720)
N	300	300
R^2	0.237	0.256
Adjusted R^2	0.167	0.194
F-statistic	3.403	4.133
F p-value	<0.001	<0.001

Note: † p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Appendix 7. Model 2 Predictors of Income Change Among IAN Agribusiness Project Beneficiaries in Nigeria

Variable	Beneficiaries	Non-Beneficiaries
(Intercept)	6680.144 (91391.910)	46230.073 (34509.364)
Age	480.185 (881.070)	-796.043 (622.209)
Trackentrepreneurship	12450.269 (10014.824)	
Household_size	-923.203 (854.721)	-916.755 (528.816)†
Employed	32001.185 (14476.424)*	16968.618 (7812.414)*
Years_experience_agribusiness	-1160.542 (1436.702)	-237.861 (972.392)
Crop_production	1910.929 (10755.510)	9906.391 (9375.524)
Crop_processing	29996.753 (21542.851)	-12580.960 (23996.448)
Animal_production	-12758.524 (10570.108)	11680.277 (9237.929)
Income_before	0.077 (0.124)	0.421 (0.097)***
Animal_processing	-28872.306 (23095.110)	-5832.764 (20986.720)
Perception_composite	-1091.101 (1302.254)	398.150 (503.136)
Participation_percent	-87.755 (1013.311)	-266.755 (775.848)
Constraints_composite	1049.551 (686.890)	
Female	-12050.037 (9067.346)	-17536.094 (7121.239)*
Primary	66366.685 (38727.191)†	4509.911 (31699.608)
Secondary	-22856.176 (16484.208)	-25947.399 (13955.144)†
Tertiary	-4039.621 (15230.629)	-18898.561 (12731.157)
Married	11499.570 (10868.032)	-5234.432 (8144.229)
Membership	66296.809 (17468.516)***	15271.724 (12602.468)
Prior_business	797.445 (10641.372)	-13443.839 (8160.601)
`Geopolitical zone`northeast	22668.478 (24529.905)	2212.448 (22241.394)
`Geopolitical zone`northwest	7366.579 (17542.017)	2326.078 (15398.838)
`Geopolitical zone`southeast	-2126.344 (16134.089)	-857.311 (11534.093)
`Geopolitical zone`southsouth	681.680 (18258.620)	3359.425 (14178.634)
`Geopolitical zone`southwest	32102.161 (14827.600)*	15166.558 (8592.761)†
Perception_composite:participation_percent	12.760 (16.231)	2.807 (13.122)
Participation_percent:constraints_composite	-12.268 (8.128)	
N	300	300
R^2	0.245	0.256
Adjusted R^2	0.170	0.191
F-statistic	3.268	3.949
F p-value	<0.001	<0.001

Note: † p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Appendix 8: Modelling Membership effects on income change by track

Variable	Entrepreneurship track	Employment track
(Intercept)	73,534 (153,617)	-32,348 (49,456)
Age	4,240 (3,233)	86 (776)
Household_size	-2,476 (4,871)	-582 (727)
Employed	68,563 (33,197)*	4,432 (15,345)
Years_experience_agribusiness	-7,975 (3,687)*	313 (1,373)
Crop_production	-16,216 (31,775)	10,275 (9,654)
Crop_processing	151,554 (56,788)**	-2,517 (19,273)
Animal_production	-27,444 (30,632)	1,990 (9,678)
Income_before	-0 (0)	0 (0)
Animal_processing	-37,486 (57,349)	-27,809 (21,918)
Perception_composite	-3,515 (1,777).	1,155 (580)*
Constraints_composite	1,030 (1,035)	-594 (313).
Female	-48,884 (27,664).	-1,071 (8,059)
Primary	25,053 (60,784)	
Secondary	-34,597 (49,987)	-8,771 (15,181)
Tertiary	-15,364 (42,616)	4,202 (14,367)
Married	27,818 (33,721)	3,522 (10,163)
Membership	156,825 (43,965)***	44,666 (17,366)*
Prior_business	15,455 (29,541)	-6,461 (9,933)
`Geopolitical zone`northeast	-3,933 (54,634)	-23,004 (30,601)
`Geopolitical zone`northwest	23,069 (55,077)	-6,828 (15,875)
`Geopolitical zone`southeast	5,594 (60,250)	-10,105 (14,339)
`Geopolitical zone`southsouth	45,723 (61,143)	-13,648 (15,958)
`Geopolitical zone`southwest	12,480 (44,199)	32,407 (13,359)*
Participation_percent	392 (334)	83 (113)
R-squared	0.447	0.299
Adj R-squared	0.230	0.214
F-statistic	2.058	3.516
p-value	0.012	0.000
N observations	86	214

Entrepreneurship Track	Membership coefficient: ₦156,825*** ($p < 0.001$)
Employment Track	Membership coefficient: ₦44,666* ($p = 0.011$)