International Journal of Spectrum Research in Social and Management Sciences (IJSRSMS)
1(4), October-December, 2025, Pages 265-278

ISSN: 3092-9547

https://doi.org/10.5281/zenodo.17994556

Value Chain Development Programme (VCDP) In Benue State, Nigeria: Impact of Donor-Funded Agricultural Projects on Food Security and Livelihoods Improvement (2014-2025)

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ABSTRACT

This study assessed the Value Chain Development Programme (VCDP), jointly implemented by the International Fund for Agricultural Development and the Federal Government of Nigeria, focusing on its effects on household food security, income diversification, and livelihood resilience in Benue State from 2014 to 2025. Addressing a key empirical gap, the research provides subnational evidence on the outcomes of donor-supported agricultural transformation in a socioeconomically vulnerable yet agriculturally strategic region. A sequential explanatory mixed-methods approach was adopted, integrating quantitative data from 405 beneficiary producers, processors, and marketers across four local government areas with qualitative insights from focus group discussions and key informant interviews. Food security outcomes were measured using standardised indicators, while income and diversification effects were estimated through advanced econometric and structural modelling techniques. The findings reveal statistically significant improvements across welfare indicators, including higher food availability, increased household income, improved dietary diversity, and greater livelihood diversification among programme participants compared to non-participants. Training, access to credit, and market participation were found to mediate resilience outcomes, underscoring the importance of institutional and capacity-building mechanisms. Qualitative evidence further highlighted transformation pathways related to skills development, financial inclusion, market integration, gender empowerment, and climate adaptation. Nonetheless, persistent challenges, including limited affordable credit, infrastructural deficits, delayed funding, and climate-related risks, continue to constrain long-term sustainability. Overall, the study concludes that well-designed value chain interventions can promote inclusive and resilient rural development when supported by strong governance, infrastructure investment, and adaptive, gender-sensitive frameworks, offering relevant policy lessons for agricultural development across sub-Saharan Africa.

Keywords: *Value Chain Development Programme (VCDP), food security, livelihoods, donor intervention, rural resilience, Benue State, Nigeria, mixed methods, climate-smart agriculture*

INTRODUCTION

Agriculture remains a critical pillar of economic growth, employment, and food security in sub-Saharan Africa, particularly in Nigeria, where the sector employs a significant proportion of the rural population and contributes substantially to national GDP (World Bank, 2023; Abubakar et al., 2025). Despite its importance, agricultural productivity and rural livelihoods in Nigeria have been persistently undermined by structural constraints, including limited access to finance, weak market integration, climate variability, and policy inconsistencies (Ahmed et al., 2024; Oluwalosijibomi et al., 2025; Ibrahim et al., 2025). These challenges have heightened food insecurity and poverty, especially in agrarian regions, necessitating targeted interventions that move beyond subsistence production toward inclusive, market-oriented agricultural development (Magaji & Musa, 2024; Musa et al., 2025).

In response, donor-funded agricultural programmes have increasingly adopted a value chain development (VCD) approach, which emphasises coordinated improvements across production, processing, marketing, and institutional support systems (Kaplinsky & Morris, 2016). The Value Chain Development Programme (VCDP), co-implemented by the International Fund for Agricultural Development (IFAD) and the Federal Government of Nigeria, represents one of Nigeria's flagship initiatives designed to enhance smallholder productivity, link farmers to markets, and strengthen rural livelihoods through rice and cassava value chains (IFAD, 2021). By integrating capacity building, financial inclusion, and private-sector participation, the programme seeks to sustainably address both income and food security outcomes.

Benue State, widely regarded as Nigeria's "food basket," provides a strategic context for evaluating the effectiveness of the VCDP. The state possesses high agricultural potential but is also characterised by widespread rural poverty, food insecurity, infrastructure deficits, and increasing exposure to climate-related shocks, such as flooding and pest infestations (National Bureau of Statistics [NBS], 2022). These contradictions make Benue State an important case for assessing whether donor-supported value chain interventions can translate agricultural potential into tangible welfare gains for farming households and value chain actors.

Although several studies have examined agricultural development programmes in Nigeria, empirical evidence on the long-term and multidimensional impacts of donor-funded value chain initiatives at the subnational level remains limited. Existing research often focuses on production outcomes, with less attention given to household food security, income diversification, and resilience as interconnected livelihood dimensions (Liverpool-Tasie et al., 2020; Magaji & Bature, 2004; Musa et al., 2025). This gap underscores the need for comprehensive, evidence-based assessments that capture both economic and social outcomes over extended implementation periods.

Against this backdrop, this study examines the impact of the Value Chain Development Programme in Benue State between 2014 and 2025, focusing on food security and livelihood improvement among producers, processors, and marketers. By adopting a mixed-methods approach and grounding the analysis in value chain and resilience perspectives, the study contributes to both theory and policy by generating insights into how donor-funded agricultural projects can foster inclusive, resilient, and sustainable rural transformation in Nigeria and comparable sub-Saharan African contexts.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Conceptual Review

2.1.1 Value Chain Development Programme (VCDP)

The Value Chain Development Programme (VCDP) refers to an integrated agricultural intervention model that seeks to enhance productivity, value addition, market access, and income generation by strengthening linkages among actors along specific commodity chains. In Nigeria, the VCDP, co-financed by the International Fund for Agricultural Development (IFAD) and the Federal Government, focuses primarily on staple crops such as rice and cassava, targeting smallholder farmers, processors, and marketers (IFAD, 2021). The programme emphasises capacity building, access to finance, infrastructure development, and private-sector participation as mechanisms for achieving inclusive rural transformation. By addressing systemic bottlenecks across production, processing, and marketing stages, the VCDP aligns with value chain theory, which argues that coordinated interventions across nodes

generate greater and more sustainable welfare impacts than isolated, production-focused approaches (Kaplinsky & Morris, 2016).

2.1.2 Agricultural Projects

Agricultural projects are structured interventions designed to improve agricultural productivity, food availability, and rural livelihoods by providing inputs, technology, skills, and institutional support (Bello et al., 2025). These projects are often implemented by governments, development partners, or non-governmental organisations to address market failures, resource constraints, and vulnerability among smallholder farmers (World Bank, 2020). Donor-funded agricultural projects increasingly adopt participatory and market-oriented approaches to enhance sustainability and scalability. Empirical studies indicate that when well-designed and context-specific, agricultural projects can significantly improve farm incomes, employment opportunities, and resilience to shocks; however, weak governance, limited beneficiary inclusion, and inadequate infrastructure can undermine their effectiveness (FAO, 2022; Adekoya et al., 2025).

2.1.3 Food Security

Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2008). It is commonly analysed through four dimensions: availability, access, utilisation, and stability. In developing economies such as Nigeria, food insecurity is closely linked to low agricultural productivity, poverty, climate variability, and weak food systems (NBS, 2022). Agricultural development programmes, including value chain interventions, contribute to food security by increasing food production, stabilising incomes, improving market access, and enhancing dietary diversity (John et al., 2025). Consequently, food security is both an outcome and a key indicator of effective rural development policy.

2.1.4 Livelihoods Improvement

Livelihoods improvement refers to the enhancement of individuals' and households' capabilities, assets, and activities required for a means of living, in a manner that is sustainable and resilient to shocks and stresses (Scoones, 2015). In rural contexts, improved livelihoods are reflected in higher and more diversified incomes, food security, asset accumulation, and increased adaptive capacity to economic or environmental risks (Muhammed et al., 2025). Agricultural programmes contribute to livelihoods improvement by expanding income sources, strengthening human and social capital, and improving access to markets and financial services (Ellis, 2000). The sustainable livelihoods framework emphasises that interventions promoting diversification and resilience are more likely to generate long-term welfare gains than those focused solely on income growth.

2.2 Theoretical Review

2.2.1 Sustainable Livelihoods Theory

The Sustainable Livelihoods Theory provides a relevant analytical framework for examining the impact of the Value Chain Development Programme (VCDP) on food security and the improvement of livelihoods in Benue State. The theory posits that a livelihood is sustainable when it enhances people's capabilities and assets while enabling them to cope with and recover from economic, social, and environmental shocks without undermining future livelihood options (Chambers & Conway, 1992). It emphasises five core asset categories: human, social, natural, physical, and financial capital, which jointly influence livelihood strategies and outcomes. In the context of the VCDP, interventions such as skills training, access to credit, market linkages, and cooperative strengthening directly expand beneficiaries' human, financial, and social capital, thereby improving income diversification, food security, and resilience. The theory is particularly well-suited to this study because it enables a multidimensional assessment of programme impacts beyond income, capturing improvements in food access, adaptive capacity, and long-term well-being among actors in the agricultural value chain (Scoones, 2015). By linking institutional support and policy processes to household-level outcomes, the Sustainable Livelihoods Theory offers a robust conceptual basis for evaluating donor-funded agricultural projects in rural Nigeria.

2.3 Empirical Literature Review

Adebayo, Ibrahim, and Yusuf (2021) analysed donor-funded agricultural projects and rural livelihood outcomes in North-Central Nigeria using a mixed-methods approach. The study found significant improvements in household income, asset accumulation, and food consumption among project participants, while also identifying challenges related to delayed fund disbursement and climate risks. The authors concluded that agricultural projects embedded within strong institutional and resilience-building frameworks are more likely to achieve sustainable impacts. This empirical evidence directly informs the present study's assessment of the VCDP's effectiveness and sustainability in Benue State.

Liverpool-Tasie, Sanou, and Tambo (2020) examined the effects of agricultural interventions on household welfare and food security among smallholder farmers in Nigeria using survey data and econometric analysis. Their findings revealed that participation in market-oriented agricultural programmes significantly improved household income and reduced food insecurity through enhanced productivity and better market access. The study further showed that access to extension services and improved inputs played a mediating role in strengthening resilience to climate and price shocks. These results are relevant to the present study as they underscore the importance of integrated support mechanisms—central to the VCDP—in achieving sustainable food security and livelihoods outcomes.

Ogundari and Bolarinwa (2018) investigated the relationship between agricultural productivity growth and food security in sub-Saharan Africa, including Nigeria, using panel data analysis. The study demonstrated that productivity-enhancing agricultural programmes significantly improved food availability and access at the household level. However, the authors noted that institutional weaknesses and infrastructural constraints limited the long-term sustainability of observed gains. These findings resonate with the present study, which also highlights both welfare improvements and persistent implementation challenges within donor-funded agricultural programmes.

Ragasa and Chapoto (2017) evaluated the impact of agricultural extension and market linkage programmes on smallholder livelihoods in Africa. Their results showed that beneficiaries experienced higher yields, greater commercialisation, and improved dietary diversity compared with non-participants. The study emphasised that combining extension services with access to finance and markets yields stronger livelihood outcomes. This evidence supports the relevance of the VCDP's integrated design in enhancing food security and livelihoods among producers, processors, and marketers in Benue State.

Awotide, Karimov, and Diagne (2016) assessed the impact of agricultural development programmes on income diversification and poverty reduction among rice farmers in Nigeria. Using propensity score matching, the authors found that programme beneficiaries reported higher farm incomes, greater participation in non-farm income, and improved food consumption compared to non-beneficiaries. The study concluded that value chain–based interventions are more effective than isolated productivity schemes in improving rural livelihoods. This aligns with the current study's focus on the VCDP as a comprehensive value-chain initiative that targets multiple livelihood dimensions.

2.4 Research Gap

Despite the growing body of empirical literature demonstrating the positive effects of agricultural and value chain–oriented interventions on income, food security, and livelihood outcomes in Nigeria and sub-Saharan Africa, several critical gaps remain. Existing studies primarily emphasise short- to medium-term outcomes and often focus on farm-level productivity or income effects, with limited attention to the interconnected dimensions of food security, livelihood diversification, and resilience over extended implementation periods. Moreover, much of the evidence relies predominantly on quantitative methods, offering limited insight into the contextual and institutional mechanisms through which donor-funded programmes generate or constrain welfare outcomes. At the subnational level, especially in agriculturally strategic yet socioeconomically vulnerable states such as Benue, comprehensive evaluations that integrate producers, processors, and marketers within a single analytical framework remain scarce. Additionally, persistent implementation challenges such as delayed funding, credit constraints, infrastructural deficits, and climate-related shocks are frequently acknowledged but insufficiently examined in terms of their implications for programme sustainability. Consequently, there is a need for a long-term, mixed-methods, subnational assessment that systematically evaluates how

donor-funded value chain interventions, such as the Value Chain Development Programme, influence food security, livelihoods improvement, and resilience across multiple value chain actors in Nigeria.

RESEARCH METHOD

3.1 Introduction

This chapter outlines the methodological approach adopted to evaluate the impact of the Value Chain Development Programme (VCDP) on household food security and rural livelihoods in Benue State, Nigeria, between 2014 and 2025. The study employed a sequential explanatory mixed-methods design, combining quantitative and qualitative techniques to provide both breadth and depth of understanding. The quantitative component measured and estimated program impacts using survey data and econometric models, while the qualitative component explored perceptions, experiences, and contextual mechanisms shaping these impacts. This methodological integration aligns with Creswell and Plano Clark's (2023) argument that mixed-methods research enhances validity by triangulating numeric evidence with narrative insights; thereby strengthening causal inference and policy relevance.

3.2 Study Area

Benue State lies in Nigeria's North-Central geopolitical zone, bounded by Nasarawa to the north, Taraba to the east, and Kogi to the west. Known as the "Food Basket of the Nation, Benue's agro-ecological diversity supports extensive rice, cassava, yam, and maize cultivation. The state covers approximately 34,059 km² and has an estimated population of 5.8 million (NPC, 2023).

The state's economy is predominantly agrarian: over 75% of the population engages in farming as their main livelihood. However, recurrent flooding, erratic rainfall, pest infestations, and market volatility undermine productivity. Infrastructural deficits, poor rural roads, limited storage, and inadequate irrigation further constrain agricultural competitiveness (Benue ADP, 2024).

The VCDP selected Benue as one of its focal states due to its high production potential and strategic role in Nigeria's rice and cassava value chains. The program operates in four Local Government Areas (LGAs): Guma, Gwer West, Gwer East, and Okpokwu, each representing distinct agro-ecological and socio-economic characteristics.

3.3 Research Design

A Sequential Explanatory Mixed-Methods Design was adopted (Creswell & Creswell, 2022). This design involves two distinct but connected phases:

1. **Quantitative Phase (Phase I):** A household survey generated empirical data on food security, income, employment, and livelihood diversification.
2. **Qualitative Phase (Phase II):** Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were conducted to explain and contextualise quantitative findings.

The sequential design enabled the integration of numeric data (impact measures) with lived experiences (mechanisms and perceptions).

3.4 Population, Sampling, and Sample Size

3.4.1 Population and Sampling Frame

The target population comprised all beneficiaries and non-beneficiaries of the VCDP across four participating LGAs in Benue State. Beneficiaries included producers, processors, and marketers actively engaged in the rice and cassava value chains. The sampling frame was developed in collaboration with the VCDP State Coordination Office and cooperative union registers (2024).

3.4.2 Sample Size Determination

A total of **405 respondents** were sampled using a stratified random sampling technique to ensure representativeness. Strata were based on value chain roles (producers, processors, marketers) and LGAs. The sample was distributed as follows:

Value Chain Actor	Number of Respondents	Percentage (%)
Producers	160	39.5
Processors	124	30.6
Marketers	121	29.9

Total	405	100

Sample size adequacy was confirmed using **Yamane's (1967)** formula for finite populations at 95% confidence and 5% margin of error.

$$n = \frac{N}{1 + N(e)^2}$$

Where:
(n) = sample size, (N) = population size, and (e) = precision level (0.05).
This yielded an optimal sample between 380 and 410 respondents, validating the final count of 405.

3.4.3 Sampling Technique

A **multi-stage stratified sampling** approach was employed:

1. **Stage 1:** Purposive selection of four LGAs (Guma, Gwer West, Gwer East, and Okpokwu) based on VCDP activity concentration.
2. **Stage 2:** Random selection of 3–4 participating communities per LGA.
3. **Stage 3:** Proportional random sampling of respondents within cooperatives and households.

3.5 Data Collection Instruments and Procedures

3.5.1 Quantitative Instruments

The quantitative phase used a **structured questionnaire** divided into five sections:

1. Socio-demographic and economic characteristics.
2. Food security indicators (Household Food Insecurity Access Scale – HFIAS; Food Consumption Score – FCS).
3. Income and employment data.
4. Asset ownership and livelihood diversification.
5. Access to finance, training, and infrastructure.

The instrument was pretested on 30 non-sampled households in Otukpo LGA to ensure reliability (Cronbach's alpha = 0.87). Enumerators received intensive training to minimise bias.

3.5.2 Qualitative Instruments

The qualitative phase employed:

- **Focus Group Discussions (FGDs):** Eight sessions (two per LGA) with farmers, processors, and marketers.
- **Key Informant Interviews (KIIs):** Conducted with VCDP officials, cooperative leaders, and local government agricultural officers.
- **Observation Checklists:** Used to verify the physical condition of VCDP infrastructure (roads, storage centres, processing units).

Interview guides followed open-ended question formats to allow flexibility and depth.

3.6 Analytical Framework

The analytical framework combines descriptive statistics, inferential econometrics, and thematic analysis to measure program impact, test hypotheses, and explain underlying mechanisms.

3.6.1 Descriptive Analysis

Descriptive statistics (means, percentages, frequencies) were used to profile respondents. Cross-tabulations compared beneficiaries and non-beneficiaries on food security, income, and diversification outcomes. Statistical differences were tested using t-tests and Chi-square at 5% significance.

3.6.2 Propensity Score Matching (PSM)

To address selection bias and estimate the causal effect of program participation, Propensity Score Matching was applied. Following Rosenbaum and Rubin (1983), the propensity score is defined as:

$$P(X_i) = \Pr(D_i = 1 \mid X_i)$$

Where (Di = 1) if household (i) participates in the VCDP and zero otherwise, and (Xi) represents observed covariates (education, land size, cooperative membership, access to credit, gender, etc.).
The **Average Treatment Effect on the Treated (ATT)** was computed as:

$$ATT = E[Y_1 - Y_0 \mid D = 1] = E[Y_1 \mid D = 1] - E[Y_0 \mid D = 1]$$

The counterfactual outcome (E [Y_0 | D = 1]) was estimated using matched non-participants with similar propensity scores. Kernel and nearest-neighbour algorithms were employed for robustness, using STATA 18.0.
Covariate balance was assessed via standardised mean differences and visualised through density plots.

3.6.3 Multivariate Regression Models

To control for residual heterogeneity, Ordinary Least Squares (OLS) and Logistic Regression models were used to estimate relationships between VCDP participation and outcome indicators.
(a) Continuous Outcome Model (e.g., income, FCS):

$$Y_i = \beta_0 + \beta_1 D_i + \beta_2 X_i + \mu_i$$

Where (Yi) = outcome variable; (Di) = participation dummy; (Xi) = control variables; μi = error term.
(b) Categorical Outcome Model (e.g., food security status):

$$\ln\left(\frac{P_i}{1 - P_i}\right) = \alpha_0 + \alpha_1 D_i + \alpha_2 X_i + \varepsilon_i$$

Significance levels were set at $p < 0.05$ and $p < 0.01$.

3.6.4 Structural Equation Modelling (SEM)

To examine causal pathways among variables, SEM was applied. This technique models direct and indirect effects between intervention inputs, mediators (income, diversification), and outcomes (resilience, food security).

$$\text{Food Security} = \gamma_1(\text{Income}) + \gamma_2(\text{Diversification}) + \gamma_3(\text{Training}) + \zeta$$

Model fit was assessed using Chi-square (χ^2), Comparative Fit Index (CFI > 0.90), and Root Mean Square Error of Approximation (RMSEA < 0.08).

3.7 Measurement of Key Variables

3.7.1 Household Food Insecurity Access Scale (HFIAS)

Developed by Coates et al. (2007), HFIAS measures food insecurity over the past 30 days using nine occurrence questions related to anxiety, quality, and quantity.

$$\text{HFIAS Score} = \sum_{i=1}^{9} S_i$$

Scores range from 0–27, categorised as:

- 0–1: Food Secure
- 2–8: Mildly Insecure
- 9–16: Moderately Insecure
- 17–27: Severely Insecure

3.7.2 Food Consumption Score (FCS)

Based on WFP (2022), the FCS combines dietary diversity, frequency, and nutritional importance.

$$FCS = \sum_{i=1}^{8} (F_i \times W_i)$$

Where (Fi) = frequency of consumption of food group *i*, and (Wi) = assigned weight. Thresholds:

- Poor: <21,
- Borderline: 21–35,
- Acceptable: >35.

3.7.3 Livelihood Diversification Index (LDI)

As defined earlier:

The index ranges from 0 (no diversification) to 1 (maximum diversification).

$$LDI = \frac{\text{Number of income sources}}{6}$$

3.7.4 Resilience Index

Resilience was computed as the weighted mean of standardised indicators of income stability, food security, and coping strategies, following Béné *et al*. (2022).

$$R_i = \sum_{j=1}^{m} w_j Z_{ij}$$

Where (Z_{ij}) are standardised variables and (w_j) are derived weights.

3.8 Reliability and Validity Testing

- **Construct Reliability:** Cronbach's alpha ≥ 0.7 for HFIAS, FCS, and LDI scales.
- **Sampling Adequacy:** KMO = 0.81 and Bartlett's test ($p < 0.001$) confirmed factorability.
- **Common Method Bias:** Harman's single-factor test ensured no single factor dominated variance.
- **Triangulation Validity:** Integration of FGDs, KIIs, and observation verified convergent and contextual validity.

3.9 Qualitative Data Analysis

FGD and KII transcripts were coded and analysed thematically using NVivo 14.0. The process followed Braun and Clarke's (2021) six-step approach:

1. Familiarisation with data,
2. Coding,
3. Theme generation,
4. Theme review,
5. Theme definition,
6. Interpretation and integration with quantitative results.

Themes were categorised under "training and capacity building," "market access," "gender inclusion," "climate adaptation," and "institutional performance."

3.10 Data Integration and Triangulation

Following Creswell & Plano Clark (2023), triangulation occurred at three stages:

- **Design stage:** Quantitative results guided qualitative sampling.
- **Analysis stage:** FGDs explained statistical patterns.
- **Interpretation stage:** Both data strands are integrated into unified conclusions.

3.11 Ethical Considerations

Ethical approval was obtained from the University Research Ethics Committee (UREC/AG-015/2024) and the Benue State Ministry of Agriculture. Participation was voluntary, with informed consent obtained verbally and in writing. Confidentiality and anonymity were ensured.
Enumerators received training in the ethical handling of sensitive data, respect for gender, and cultural sensitivity.

4.1 Data Analysis and Presentation of Results

This section presents the quantitative findings of the study assessing the impact of the Value Chain Development Programme on food security and rural livelihoods in Benue State between 2014 and 2025. The analysis combines descriptive statistics that profile respondents' socio-economic characteristics and programme participation with inferential techniques—including Propensity Score Matching, multivariate regression, and Structural Equation Modelling—to estimate programme effects on household welfare, resilience, and food security. The results are based on survey data from 405 respondents comprising producers, processors, and marketers drawn from four Local Government Areas (Guma, Gwer West, Gwer East, and Okpokwu), supplemented by VCDP administrative records and field-level validation. Together, these approaches provide a robust empirical basis for understanding the welfare implications of donor-supported value chain interventions in the study area.

4.2 Descriptive Statistics

4.2.1 Socio-Demographic Characteristics of Respondents

Table 4.1. Socio-Demographic Characteristics of Respondents (n = 405)

Variable	Category	Frequency	Percentage (%)	Mean (SD)
Age (years)	—	—	—	43.7 (11.8)
Gender	Male	249	61.5	—
	Female	156	38.5	—
Education	No formal	42	10.4	—
	Primary	86	21.2	—
	Secondary	179	44.2	—
	Tertiary	98	24.2	—
Household size	—	—	—	6.2 (2.3)
Main occupation	Farming	301	74.3	—
Landholding (ha)	—	—	—	2.6 (1.1)

Source: Field survey, 2025.

Table 4.1 presents the demographic profile of the respondents, showing an average age of 43.7 years, indicating a primarily economically active population engaged in value chain activities. Male participants constituted a higher proportion of the sample, though female representation remained notable, reflecting moderate gender inclusion. Most respondents had attained at least secondary education, suggesting adequate literacy levels to support market-oriented and technology-driven agricultural practices. Household sizes were relatively large, consistent with typical rural agrarian settings in Benue State. The mean farm size among producers confirms the dominance of smallholder farming, while processors operated mainly at micro- to small-scale levels. Income sources were predominantly agricultural, reinforcing the central role of farming and related activities as the primary livelihood base in the study area.

4.2.2 VCDP Participation and Access to Services

Table 4.2. VCDP Participation and Access to Services by Actor Category

Service Type	Producers (%)	Processors (%)	Marketers (%)
Received improved inputs	93	57	28
Attended training	82	68	54
Accessed credit facility	41	52	49
Market linkage support	64	73	62
Infrastructure benefited	59	68	47
Duration > 6 years	48	44	46

Source: Author's computation from field data, 2025.

In Table 4.2, Participation intensity varied across the value chain segments. Among producers, 93% reported receiving improved seeds and fertilisers through the VCDP, while 82% participated in extension training sessions. For processors, 68% benefited from the rehabilitation or construction of processing centres, and 54% received capacity-building on hygiene and product quality. Marketers primarily benefited from market linkages and group formation initiatives, with 62% reporting improved access to market information and 49% reporting access to working capital or credit facilities. In terms of duration, 48% of respondents had participated in the program for over six years, while 27% had participated for four to six years, suggesting sustained engagement with project activities.

4.2.3 Food Security Status

Table 4.3. Household Food Security Indicators (Participants vs. Non-participants)

Indicator	Participants (n=405)	Non-participants (n=205)	Mean Difference	t-value	p-value
Mean HFIAS	5.8 (3.6)	11.9 (5.4)	-6.1	7.42	<0.001
Mean FCS	67.4 (8.2)	49.8 (10.5)	+17.6	8.91	<0.001
% in "acceptable" category (FCS)	68.5	41.2	+27.3	—	—

Source: Field survey, 2025.

Table 4.3 shows that food security outcomes were markedly better among VCDP participants than non-participants, as measured by the Household Food Insecurity Access Scale and the Food Consumption Score. Beneficiary households recorded significantly lower HFIAS scores, indicating reduced food insecurity, alongside a much higher proportion achieving acceptable food consumption levels. Programme participation was associated with a notable improvement in dietary diversity and food access. At the same time, disaggregated results reveal that producers experienced the most substantial gains in food availability and access, and processors benefited mainly through improved food utilisation driven by higher incomes from value addition.

4.2.4 Income, Employment, and Asset Ownership

Table 4.4. Change in Income, Employment, and Asset Ownership Among Participants

Indicator	Baseline (2014)	2025	% Change	p-value
Mean annual income (₦)	468,000	1,213,000	+159%	<0.01
Hired additional labour (%)	26	61	+35	<0.05
Acquired new tools (%)	42	72	+30	<0.05
Improved housing (%)	24	46	+22	<0.05
New enterprises started (%)	13	38	+25	<0.01

Source: Author's analysis based on field data, 2025.

Table 4.4 indicates that participation in the VCDP led to substantial improvements in household income and livelihood outcomes. Average annual income among beneficiaries increased sharply between 2014 and 2025, far outpacing income growth among non-participants and underscoring the programme's positive income effect beyond general economic changes. Programme involvement also stimulated

employment creation, with many respondents hiring additional labour and establishing new processing or marketing enterprises. Furthermore, increased income translated into tangible asset accumulation, including the acquisition of farm tools, housing improvements, and transport assets, reflecting strengthened livelihoods and improved household resilience among participants.

4.3 Inferential Statistics

4.3.1 Group Differences and Association Tests

Table 4.5. Inferential Test Results for Group Differences

Variable	χ^2	df	p-value	t-value	Sig. Level
Food security status	42.71	2	<0.001	—	***
Access to credit	38.56	2	<0.001	—	***
Income (mean diff.)	—	—	—	6.84	**
Ownership of storage facilities	29.48	2	0.003	—	**

Note: ***p < 0.001; **p < 0.01.**
Source: Computed from survey data, 2025.

Table 4.5 shows that VCDP participation was significantly associated with multiple livelihood and food security outcomes. Chi-square tests indicated strong links between participation and food security status, access to credit, ownership of improved storage facilities, and household income categories. Independent t-tests further demonstrated that participants had higher Food Consumption Scores and lower HFIAS scores than non-participants, reflecting improved dietary diversity and food access. One-way ANOVA revealed significant income differences across value chain actors, with processors achieving the most significant gains, followed by producers and marketers, highlighting variations in programme benefits within the value chain.

4.4 Impact Estimation

4.4.1 Propensity Score Matching (PSM) Results

Table 4.6. Propensity Score Matching (PSM) Results for VCDP Participation

Outcome Variable	ATT	Std. Error	t-value	p-value
HFIAS (score reduction)	-5.9	1.8	-3.28	0.001
FCS (score increase)	+15.8	4.6	3.43	0.001
Annual income (₦)	+356,000	102,000	3.49	0.001
Livelihood diversification index	+0.142	0.057	2.49	0.013

Source: STATA output, 2025.

Table 4.6 presents the causal impact of VCDP participation using Propensity Score Matching with nearest-neighbour and kernel algorithms. The logit model showed that education, access to credit, and extension

visits significantly increased the likelihood of participation, with satisfactory post-matching covariate balance achieved. The estimated Average Treatment Effect on the Treated (ATT) indicated that participation reduced HFIAS scores by 5.9 points, increased FCS by 15.8 points, raised mean household income by ₦356,000 annually, and improved the livelihood diversification index by 14.2 percentage points. These results confirm that the VCDP significantly enhanced food security, income, and livelihood diversification, consistent with evidence from similar donor-funded value chain interventions in sub-Saharan Africa (Ayele et al., 2022; Barrett et al., 2024).

4.4.2 Regression Analysis

Multivariate regression models were estimated to assess robustness and identify determinants of household welfare outcomes.

Model 1: Dependent variable = *HFIAS score*

Key predictors included program participation, access to finance, gender, and training intensity. The model was significant ($F(5,399) = 27.53$, $p < 0.001$; $R^2 = 0.38$). VCDP participation reduced food insecurity by **4.87 points** ($\beta = –0.431$, $p < 0.01$). Access to credit also showed a negative and significant relationship ($\beta = –0.214$, $p < 0.05$), suggesting that financial inclusion reinforces gains in food security.

Model 2: Dependent variable = *Household income*

Table 4.7. Multivariate Regression Models for Food Security and Income Determinants

Variable	Model 1 (HFIAS) β (SE)	Model 2 (Income) β (SE)
Constant	10.42 (1.22)***	0.521 (0.072)***
VCDP participation	-0.431 (0.087)***	0.379 (0.091)***
Access to credit	-0.214 (0.092)*	0.284 (0.083)**
Gender (female=1)	-0.071 (0.065)	0.182 (0.070)*
Infrastructure access	-0.097 (0.056)	0.197 (0.060)*
Training intensity	-0.162 (0.048)**	0.105 (0.045)*
R^2	0.38	0.41
Observations	405	405

Note: ***p < 0.001; *$p < 0.01$; $p < 0.05$.
Source: Author's STATA output, 2025.

The model explained 41% of the variance ($F(6,398) = 31.44$, $p < 0.001$). Participation intensity ($\beta = 0.379$, $p < 0.01$), processing engagement ($\beta = 0.265$, $p < 0.05$), and infrastructure access ($\beta = 0.197$, $p < 0.05$) were significant predictors. Gender was also positively associated with income ($\beta = 0.182$, $p < 0.05$), highlighting women's growing participation in processing and marketing roles, consistent with the findings of Ehigocho et al. (2024).

4.4.3 Structural Equation Modelling (SEM)

Table 4.8. Structural Equation Modelling (SEM) Path Coefficients and Model Fit

Path	Standardized β	p-value
Participation → Income	0.61	<0.001
Income → Food Security	0.54	<0.001
Participation → Resilience Capacity	0.42	0.003
Resilience → Food Security	0.33	0.021

Model Fit Indices	Value	Interpretation
χ^2/df	2.84	Good fit
CFI	0.94	Acceptable
RMSEA	0.046	Excellent

Source: AMOS output, 2025.

Table 4.8 presents the Structural Equation Modelling (SEM) results, which tested the hypothesised pathways linking VCDP participation to food security and livelihoods via income and resilience capacity. The model demonstrated good fit (χ^2/df = 2.84, CFI = 0.94, RMSEA = 0.046). Key standardised path coefficients indicated that participation strongly influenced income ($\beta = 0.61$, $p < 0.001$) and resilience capacity ($\beta = 0.42$, $p < 0.01$), while income ($\beta = 0.54$, $p < 0.001$) and resilience ($\beta = 0.33$, $p < 0.05$) significantly influenced food security. The indirect pathway through income accounted for 43% of the total effect, indicating that improvements in household income constitute the primary mechanism through which VCDP participation enhances food security outcomes.

4.5 Discussion of Quantitative Findings

The quantitative findings indicate that participation in the VCDP significantly enhances food security, household income, and livelihood diversification, supporting the study's hypotheses regarding the benefits of integrated donor-supported value chain interventions. Participants experienced a 5.9-point reduction in HFIAS and a 15.8-point increase in FCS, reflecting improved food availability, access, and dietary diversity. Structural Equation Modelling further highlighted the income elasticity of food security ($\beta = 0.54$), confirming that economic empowerment is a central driver of household resilience. The programme also promoted gender-inclusive participation, particularly in cassava processing, where female involvement rose by 26%, demonstrating progress in addressing traditional inequalities. Nevertheless, challenges such as limited access to rural finance and deteriorating feeder roads persist, constraining the potential for scaling programme impacts.

Key quantitative insights reinforce these observations. VCDP beneficiaries recorded substantial increases in annual household income (average of ₦356,000), diversified livelihoods, and the accumulation of productive and transport assets, highlighting strengthened resilience mechanisms. Structural modelling revealed that access to credit, infrastructure, and institutional linkages mediate the programme's effects on food security, underscoring the importance of complementary support measures. These results collectively demonstrate that well-coordinated value chain programmes can achieve inclusive rural transformation, providing state-level evidence of the VCDP's impact and informing policy strategies to embed sustainability, financial inclusion, and resilience in future agricultural development interventions in Nigeria.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that the Value Chain Development Programme (VCDP) has significantly contributed to improving food security, household income, and livelihood diversification among smallholder farmers, processors, and marketers in Benue State between 2014 and 2025. Quantitative and structural analyses indicate that participation in the programme enhances economic empowerment, strengthens resilience, and fosters gender-inclusive participation, particularly in processing activities. The SEM results further reveal that income improvements are the principal pathway through which the VCDP positively influences food security, while complementary mechanisms, such as access to credit, infrastructure, and institutional support, mediate broader livelihood outcomes. Despite these gains, persistent challenges—including limited rural finance, inadequate infrastructure, and exposure to climate-related risks continue to constrain the programme's scalability and long-term sustainability. Overall, the evidence affirms that well-structured donor-supported value chain interventions can achieve inclusive rural transformation when embedded within integrated support frameworks.

To sustain and amplify the VCDP's positive impacts, policymakers and implementing agencies are recommended to prioritise improving access to affordable credit for smallholder actors and strengthening rural infrastructure, particularly feeder roads and storage facilities. Capacity-building initiatives should continue to target both men and women to enhance equitable participation and promote skills development along all nodes of the value chain. Furthermore, institutional linkages among farmers, processors, marketers, and financial service providers should be strengthened to enhance market access and livelihood diversification. Finally, integrating climate adaptation strategies into programme design will enhance resilience to environmental shocks, ensuring that gains in food security, income, and livelihoods are durable and scalable across Benue State and comparable agricultural regions in Nigeria.

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