AN EMPIRICAL EVALUATION OF THE IMPACT OF AGRICULTURAL PROGRAMS ON FOOD SECURITY IN ADAMAWA STATE

Ahmed Abubakar Abdullahi
Adamawa State University, Mubi
Department of Accounting,
Faculty of Administration &,
Management Sciences
aabuahmed157@gmail.com

Adamu Jibrilla, ***Ph.D***
Adamawa State University, Mubi
Department of Economics,
Faculty of Social Sciences,
Communication & Media Studies
jibrilla653@adsu.edu.ng

Babangida Adamu
Adamawa State University, Mubi
Department of Economics,
Faculty of Social Sciences,
Communication & Media Studies
adamubabangida92@gmail.com

Corresponding Author
Ahmed Abubakar Abdullahi
Adamawa State University, Mubi
Department of Accounting,
Faculty of Administration &,
Management Sciences
aabuahmed157@gmail.com

ABSTRACT

This study empirically evaluates the impact of agricultural programs on food security in Adamawa State, Nigeria, focusing on the availability of staple food crops and household access to food. Despite government interventions including the State Subsidised Input Program, Fadama projects, and the Anchor Borrowers' Program, food insecurity persists due to poverty, youth unemployment, climate variability, and conflict. Using a quantitative survey design, data were collected from 450 respondents across six purposively selected Local Government Areas. Regression analyses employing Ordinary Least Squares (OLS), robust OLS, and log-linear models were conducted. Results show that participation in agricultural programs significantly improves staple food availability ($\beta = 0.284$, $p < 0.01$) and household food access ($\beta = 0.241$, $p < 0.01$). Access to subsidised inputs ($\beta = 0.219$, $p < 0.01$) and agricultural credit ($\beta = 0.182$, $p < 0.01$) further enhance food availability, while household income ($\beta = 0.318$, $p < 0.01$) and education of household heads ($\beta = 0.124$, $p < 0.01$) positively influence food access. Larger household sizes, however, negatively affect food access ($\beta = -0.067$, $p < 0.05$). These findings support the Sustainable Livelihoods Theory by highlighting the role of financial, human, and physical capital in improving production, income, and resilience. The study recommends strengthening program implementation through expanded input support, improved extension services, enhanced credit facilities, and promotion of education and income diversification to ensure sustainable food security.

Keywords: *Agricultural programs, Food security, Household income, Adamawa State, Sustainable livelihoods*

Introduction

Adamawa State, located in northeastern Nigeria, faces significant challenges related to youth unemployment, poverty, and crime. The National Bureau of Statistics (NBS) reported that as of the second quarter of 2020, the state had an unemployment rate of 29.3% and an underemployment rate of 38.4%, with a labour force population of 1,789,609 and 523,719 unemployed individuals (National Bureau of Statistics, 2020). This high unemployment rate has been linked to increased poverty levels and a rise in criminal activities among the youth.

A study focusing on Yola South Local Government Area revealed that youth unemployment leads to drug abuse, criminal activities, and heightened poverty (Abubakar & Mohammed, 2018). In response to these challenges, the Adamawa State Government has implemented various skill acquisition programs to empower youth and reduce unemployment. One such initiative is the Farming Skills Acquisition Programme, designed to equip participants with agricultural skills to promote self-reliance and economic development (Adebayo et al., 2023). Additionally, the state has introduced entrepreneurship skills training in selected local government areas, emphasising the importance of skill acquisition for self-reliance and economic growth (Okonkwo & Usman, 2022). These programs aim to reduce unemployment and provide youth with the necessary skills to become independent and contribute positively to the economy.

In fact, during Governor Murtala Nyako's administration (2007–2014), the government established Farming Skills Acquisition Centres and vocational and technical training centres across the state. These centres were equipped with advanced technology and managed by experts to provide youth with practical skills in agriculture and trades, aiming to promote self-reliance and economic development (The Daily Reality, 2022). The initiative targeted rural and urban youth, focusing on building capacity in crop production, livestock farming, and small-scale entrepreneurship.

Following Nyako, Governor Muhammadu Umaru Jibrilla Bindow (2015–2019) pledged to revitalise these centres to ensure continuity in youth empowerment. However, reports indicate that many of these programs were discontinued during his tenure, leading to a decline in the state's skill acquisition initiatives (The Daily Reality, 2022). While the administration introduced some youth-focused programs, critics argue that these were less impactful or sustained than those under Nyako's leadership.

In 2019, Governor Ahmadu Umaru Fintiri's administration took significant steps to revive and expand skill acquisition programs. In August 2022, the government reopened eight technical skills acquisition centres that had been abandoned for eight years, aiming to train approximately 20,000 youths annually in various trades (Punch, 2022). Additionally, the administration launched the Fintiri Business Wallet, a program designed to empower 60,000 women and youths across the state by providing financial support and training to enhance entrepreneurial skills (Adamawa State Government, 2024). These initiatives reflect the government’s commitment to reducing unemployment and fostering economic growth through skill development.

Despite these efforts, challenges persist. The effectiveness of these programs in significantly reducing youth unemployment, poverty, and crime remains a subject of ongoing evaluation. Continuous assessment and enhancement of these initiatives are crucial to ensure they meet their objectives and effectively address the socio-economic issues in Adamawa State.

Agricultural programs are critical to enhancing food security, especially in regions with significant challenges like Adamawa State. Despite the efforts of successive administrations in the state, including initiatives like Fadama programs, the Anchor Borrowers’ Program (ABP), and the Agricultural Program for Poverty Alleviation and Climate Change Adaptation (APPACCA), food insecurity persists. The state continues to grapple with issues of low agricultural productivity, limited access to food, and widespread

hunger and malnutrition. These challenges are compounded by conflict, climate variability, and socioeconomic inequalities, disproportionately affecting smallholder farmers and vulnerable households.

Furthermore, while these programs have been implemented to boost food production and improve livelihoods, there is little empirical evidence assessing their impact on food security dimensions such as availability, accessibility, utilization, and stability. This lack of comprehensive evaluation undermines measuring progress, identifying shortcomings, and optimising future interventions.

In addition, many of these programs face significant challenges, including inadequate funding, limited access to modern inputs and technologies, weak extension services, and poor infrastructural support. These barriers hinder the effective implementation and scalability of agricultural programs, reducing their potential to address food insecurity in the state sustainably.

The objectives of this study are two: (i) to assess the contribution of agricultural programs to the availability of staple food crops in Adamawa State; and (ii) to evaluate the role of agricultural programs in improving household access to food through increased income levels. This study is structured into introduction, literature review, methodology, results and discussion, conclusion and recommendation sections.

Literature Review

The relationship between agricultural programs and food security has been a focal point of academic inquiry, with studies emphasising the critical role of agricultural interventions in ensuring food availability, accessibility, and utilisation. FAO (2022) states that targeted agricultural policies and programs are fundamental to addressing food insecurity in developing regions, particularly in areas with high poverty and unemployment rates. In Adamawa State, government-led initiatives like Fadama II and the Anchor Borrowers' Program have sought to improve agricultural productivity by providing subsidised inputs, credit facilities, and extension services (World Bank, 2020).

Agricultural productivity has been identified as a key driver of food availability. For instance, Ayuba and Kwaghe (2021) found that programs promoting improved seed varieties and irrigation systems significantly increased cereal crop yields in Northern Nigeria. In Adamawa State, adopting mechanised farming under initiatives such as the Fertilizer and Mechanization Drive has enhanced the efficiency of production processes, contributing to food self-sufficiency (Ibrahim et al., 2022).

Several studies highlight the importance of agricultural programs in ensuring food availability and accessibility. For example, Olanrewaju et al. (2023) noted that input subsidies under Fadama III enabled smallholder farmers to increase their production, resulting in improved food supply at the household and community levels. Similarly, the Anchor Borrowers' Program (ABP) has been reported to enhance rice production in Adamawa State, with a notable increase in the availability of locally sourced rice (Bello & Hassan, 2021).

However, accessibility remains challenging for vulnerable populations due to uneven distribution and market inefficiencies. Amadi and Zubairu (2022) argue that while agricultural programs increase

production, poor road networks and inadequate market infrastructure in Adamawa State hinder effective food distribution.

Agricultural programs directly influence farmers' productivity and income by providing access to modern farming tools, improved inputs, and training. For instance, the Agricultural Development Projects (ADPs) revitalised during the Boni Haruna administration provided fertilisers and seeds that increased maize and rice yields by up to 40% (World Bank, 2020). A recent study by Musa et al. (2023) revealed that mechanised farming under the Fintiri administration reduced labour costs while increasing crop output, thereby enhancing farmers' net income.

Nevertheless, challenges such as delayed input delivery and limited extension services undermine these gains. As highlighted by Gana and Adeyemi (2021), farmers in Adamawa State often face logistical issues that limit their ability to benefit from government-led interventions fully.

Resilience-building is a significant focus of agricultural programs, especially in regions prone to conflict and climate change. Programs like APPACCA (Agricultural Program for Poverty Alleviation and Climate Change Adaptation) have introduced climate-smart farming practices to help farmers mitigate the adverse effects of climate variability (Aliyu et al., 2023). These practices include using drought-resistant crop varieties and adopting water-conserving irrigation techniques, which have been shown to reduce vulnerability to food insecurity (FAO, 2022).

Moreover, community-level initiatives under programs like the Food Security Committee have promoted collective farming and resource sharing, fostering greater resilience among smallholder farmers (Ibrahim et al., 2022). Despite these efforts, recurring conflicts and limited funding continue to threaten the sustainability of these interventions (Okoro et al., 2023).

Implementing agricultural programs in Adamawa State faces several challenges, including inadequate funding, bureaucratic inefficiencies, and insecurity. As reported by Usman and Lawal (2023), insecurity in the Northeast significantly disrupts farming activities, leading to lower-than-expected outcomes from agricultural interventions. Additionally, limited coordination among stakeholders has often resulted in the duplication of efforts and inefficient use of resources (Amadi & Zubairu, 2022).

Conversely, opportunities for improvement exist through public-private partnerships (PPPs) and international collaborations. Partnerships with organisations like USAID and IITA have facilitated training for farmers, improving their technical know-how and productivity (Aliyu et al., 2023). Expanding such collaborations could further enhance the effectiveness of agricultural programs in Adamawa State.

Theoretical Framework

The theoretical framework for this study is anchored in the Sustainable Livelihoods Theory (SLT), a comprehensive approach developed by the Department for International Development (DFID) in the late 1990s. SLT examines how individuals utilise assets, capabilities, and activities to achieve sustainable livelihoods while navigating external influences such as policies, institutions, and vulnerability contexts (DFID, 1999). This framework aligns with the objectives of agricultural programs in Adamawa State, as

these initiatives aim to enhance access to essential resources, promote economic stability, and foster resilience against socio-economic challenges.

Central to SLT is its focus on five types of capital—natural, physical, human, financial, and social—which collectively support livelihood strategies and outcomes. For instance, programs like the Anchor Borrowers' Program and the Fadama initiatives in Adamawa State align with SLT by providing financial support (financial capital), training (human capital), and infrastructural development (physical capital). These interventions target food security, youth unemployment, and poverty reduction, addressing key sustainable livelihood components.

Several studies have utilized SLT to evaluate agricultural programs. Olanrewaju et al. (2023) applied SLT to assess the role of subsidized agricultural inputs in reducing food insecurity among rural households in Nigeria. Similarly, Musa et al. (2023) demonstrated how mechanised farming initiatives improved income levels and reduced poverty in Northern Nigeria. Moreover, Bello and Hassan (2021) highlighted the impact of SLT-aligned programs on youth employment, showing that initiatives like the Anchor Borrowers' Program significantly reduced unemployment in Adamawa State by engaging youth in productive farming activities.

By adopting SLT, this study offers a structured approach to evaluating the impacts of agricultural programs in Adamawa State. The theory's emphasis on asset optimisation, policy influence, and livelihood diversification provides a robust framework for analysing the multi-dimensional effects of these programs on food security, youth unemployment, poverty, and crime. Furthermore, its application in previous studies underscores its relevance and validity in understanding how agricultural initiatives contribute to sustainable development in similar socio-economic contexts.

Research Gap

Despite the significant strides made by the Adamawa State Government in implementing various agricultural programs since 1999, there is limited empirical evidence on how these initiatives have directly impacted food security in the state. While studies have examined the general effectiveness of agricultural policies and programs in Nigeria, few have focused specifically on Adamawa State, a region uniquely challenged by conflict, climate variability, and socioeconomic disparities. Furthermore, the existing literature often fails to comprehensively link agricultural programs with broader developmental outcomes such as food availability, access, and sustainability, particularly in the context of vulnerable populations like smallholder farmers.

Additionally, there is a noticeable lack of analysis of the challenges faced during implementing these programs. Key issues, such as infrastructural gaps, access to modern inputs, and the capacity of extension services, remain underexplored in prior research. Moreover, while agricultural programs often emphasise food production, they frequently overlook the equally important dimensions of food accessibility, affordability, and adopting sustainable farming practices.

Lastly, limited attention has been given to the intersection of agricultural programs and the reduction of hunger and malnutrition in conflict-affected areas, where food security is a matter of production and

resilience to external shocks. This gap necessitates a study that evaluates the holistic impact of agricultural programs on food security outcomes while identifying implementation challenges to guide future policymaking.

Methodology

Research Design

This study adopts a quantitative survey research design to provide a comprehensive evaluation of the impact of agricultural programs on food security in Adamawa State. The design is appropriate for capturing both measurable outcomes and contextual insights, ensuring a holistic understanding of the programs' effects.

Study Area

The study was conducted in Adamawa State, Nigeria, located between latitudes 7° and 11° North and longitudes 11° and 14° East, covering a total land area of approximately 36,917 square kilometres. The state shares boundaries with Taraba to the south and west, Gombe to the northwest, Borno to the north, and Cameroon to the east, making it a strategically positioned region with a blend of agricultural, trade, and cultural activities. Adamawa State is divided into 21 Local Government Areas (LGAs), each with unique socioeconomic characteristics influencing livelihoods and development patterns.

The state's economy is predominantly agrarian, with approximately 70% of the population engaged in agricultural activities, including crop production, livestock rearing, and fisheries. The major crops grown in the state include maize, rice, sorghum, millet, groundnut, and cowpea, while livestock farming focuses on cattle, goats, sheep, and poultry. Key agricultural programs implemented in the state include the Fadama II and III Projects, the Anchor Borrowers' Program (ABP), and the Agricultural Program for Poverty Alleviation and Climate Change Adaptation (APPACCA). These programs aim to enhance agricultural productivity, improve food security, and support smallholder farmers through input subsidies, extension services, and mechanisation schemes.

Income levels in Adamawa State are generally low, with a significant proportion of the population belonging to low-income groups. Poverty rates are high, with approximately 57% of the population living below the poverty line, according to recent estimates. The state's economic activities are diversified, with major businesses including agriculture, trading, small-scale manufacturing, and services such as transportation and retail. Urban centres like Yola, Mubi, and Numan host higher-income earners and formal businesses, while rural areas predominantly depend on subsistence farming.

Despite its agricultural potential, Adamawa State faces challenges, including frequent conflicts, climate variability, and inadequate infrastructure, which hinder agricultural productivity and economic development. This study seeks to evaluate the impact of agricultural programs on food security in the state while identifying barriers to their effective implementation. The research aims to provide actionable insights for improving agricultural policy and enhancing food security in the state by examining key indicators such as poverty levels, income groups, and engagement in agriculture.

Population and Sampling

The target population includes smallholder farmers, youth beneficiaries, agricultural program coordinators, and community leaders in Adamawa State.

The sampling method used for this study was purposive sampling combined with stratified random sampling to ensure representativeness and alignment with the study's objectives.

Step 1: Stratification by Senatorial Districts

Adamawa State is divided into three senatorial districts: Adamawa North, Adamawa Central, and Adamawa South. These districts will serve as strata, ensuring geographic representation across the state.

Step 2: Purposive Selection of Local Governments

From each senatorial district, two Local Government Areas (LGAs) will be purposively selected based on (a) the intensity of agricultural activity (e.g., high engagement in crop farming, livestock rearing, or fisheries), (b) the implementation of agricultural programs (e.g., areas with significant participation in Fadama projects, Anchor Borrowers' Program, or other key initiatives).

This approach allows for the inclusion of LGAs most relevant to the study objectives, as these are likely to provide data-rich environments for assessing the impact of agricultural programs on food security.

Step 3: Random Sampling of Respondents within Selected LGAs:

Within the selected LGAs, a random sampling technique will be used to select respondents from different categories, such as (a) smallholder farmers, (b) beneficiaries of agricultural programs and (c) local agricultural officers or extension workers.

Sample Size Determination Using Cochran's Formula

When the population size is unknown or very large, Cochran's formula is widely used to determine an appropriate sample size that provides statistically reliable results. By assuming a 95% confidence level and a margin of error of 5%, the formula ensures that the results are generalisable and reliable. Additionally, the assumption of p=0.5p = 0.5p=0.5 captures maximum variability, making the approach conservative and suitable for a wide range of study populations.

In this study, a sample size of 450 respondents (75 per LGA) was used which exceeded the minimum requirement of 384 respondents, ensuring robust data and enhanced statistical power for assessing the impact of agricultural programs on food security in Adamawa State. This formula is based on the desired confidence level, acceptable margin of error, and estimated proportion of the population.

Cochran's Formula

$$n = \frac{Z^2 * p * (1 - p)}{e^2}$$

Where:

n= required sample size.

Z = Z-score corresponding to the desired confidence level (1.96 for 95% confidence).

p = estimated proportion of the population with the characteristic of interest (typically 0.5 when no prior information is available, as it maximises variability).

e = margin of error (commonly set at 5% or 0.05).

Assumptions for the Study

1. **Confidence Level**: 95% (corresponds to Z=1.96).
2. **Proportion of the Population**: Since the exact proportion is unknown, p=0.5 is assumed, which accounts for maximum variability.
3. **Margin of Error**: e =0.05.

Calculation of Sample Size

Substitute the values into Cochran's formula:

$$n = \frac{1.96^2 * 0.5 * (1 - 0.5)}{0.05^2}$$

$$n = \frac{3.8416 * 0.5 * 0.5}{0.0025} = 384.16$$

Thus, the minimum required sample size is approximately 384 respondents.

Adjusting for Feasibility

Since the study design includes 6 Local Government Areas (LGAs), a larger sample size of 450 respondents was used in order to (i) allow for stratification across LGAs and ensure adequate representation of subgroups (e.g., farmers, program beneficiaries, and agricultural officers). (ii) Mitigate the impact of potential non-responses or incomplete data.

Results and Discussion

This section presents empirical evidence on the contribution of agricultural programs to food security outcomes among households in Adamawa State. This section analyses survey data from 450 respondents across six purposively selected Local Government Areas, examining both the availability of staple food crops and household access to food. Key socio-economic characteristics, program participation, and institutional factors such as access to subsidised inputs, credit, extension services, and household demographics are explored to understand their influence on food security.

Table 1: Distribution of Respondents by Gender

Gender	Frequency	Percentage (%)
Male	308	68.4
Female	142	31.6
Total	**450**	**100.0**

Table 1 shows that the majority of respondents were male, accounting for 308 individuals (68.4%), while female respondents constituted 142 individuals (31.6%) of the total sample. This gender distribution suggests a higher level of male participation in agricultural activities and agricultural programs in the study area, which is consistent with the male-dominated nature of farming in many rural communities of Adamawa State. However, the substantial proportion of female respondents also indicates notable involvement of women in agriculture-related livelihoods, underscoring their important role in household food production and food security outcomes.

Table 2: Distribution of Respondents by Age Group

Age Group (Years)	Frequency	Percentage (%)
Below 25	72	16.0
25–34	124	27.6
35–44	118	26.2
45–54	82	18.2
55 and above	54	12.0
Total	**450**	**100.0**

Table 2 indicates that respondents were predominantly within the economically active age groups. Those aged 25–34 years constituted the largest proportion of the sample (27.6%), closely followed by respondents aged 35–44 years (26.2%). This suggests that a significant share of participants were in their prime working ages, which is critical for agricultural productivity and participation in agricultural programs. Respondents aged 45–54 years accounted for 18.2%, while those below 25 years represented 16.0%, reflecting a moderate level of youth involvement in agriculture. The least represented group was respondents aged 55 years and above (12.0%), indicating relatively lower participation among older individuals.

Table 3: Distribution of Respondents by Marital Status

Marital Status	Frequency	Percentage (%)
Single	118	26.2
Married	298	66.2
Widowed	22	4.9
Divorced/Separated	12	2.7
Total	**450**	**100.0**

Table 3 shows that the majority of respondents were married, accounting for 298 individuals (66.2%), indicating that most participants had family responsibilities that may influence their engagement in agricultural activities and food security decisions. Single respondents constituted 26.2% of the sample, reflecting a sizable proportion of individuals who may have fewer household obligations. Widowed respondents represented 4.9%, while divorced or separated respondents accounted for 2.7% of the total sample. Overall, the dominance of married respondents suggests that household-oriented livelihood considerations are likely to play a significant role in agricultural program participation and food security outcomes in the study area.

Table 4: Distribution of Respondents by Educational Level

Educational Level	Frequency	Percentage (%)
No Formal Education	86	19.1
Primary Education	104	23.1
Secondary Education	152	33.8
Tertiary Education	108	24.0
Total	**450**	**100.0**

Table 4 indicates that respondents possessed varying levels of educational attainment, with the largest proportion having secondary education (33.8%), followed by those with tertiary education (24.0%). This suggests a relatively moderate level of formal education among participants, which may enhance their capacity to understand and adopt agricultural innovations and program guidelines. Respondents with primary education accounted for 23.1%, while 19.1% had no formal education, highlighting the continued presence of limited educational access among some participants.

Table 5: Distribution of Respondents by Household Size

Household Size (Persons)	Frequency	Percentage (%)
1–3	64	14.2
4–6	176	39.1
7–9	142	31.6
10 and above	68	15.1
Total	**450**	**100.0**

Table 5 shows that most respondents belonged to relatively large households. Households with 4–6 members constituted the largest share of the sample (39.1%), followed by those with 7–9 members (31.6%). This indicates that extended family living arrangements are common in the study area, which may increase household food consumption needs and place greater pressure on available resources. Smaller households with 1–3 members accounted for 14.2%, while households with 10 members and above represented 15.1% of respondents. Overall, the predominance of medium to large household sizes suggests that household size is an important factor influencing food demand, income allocation, and food security outcomes among farming households in Adamawa State.

Table 6: Distribution of Respondents by Agricultural Programs Benefited From

Agricultural Program	Frequency	Percentage (%)
State Subsidised Input Program (Fertiliser/Seeds/Pesticides)	128	28.4
National Agricultural Growth Scheme & Agro-Pocket (NAGS-AP)	90	20.0
Adamawa State Agribusiness Support Programme (ADAS-P)	68	15.1
Farm Input Distribution Program (Cooperatives/MCRP)	64	14.2
Fadama / Fadama-linked Interventions	50	11.1
Anchor Borrowers' Programme (ABP)	36	8.0
Total	**450**	**100.0**

The table shows that a substantial proportion of respondents benefited from various agricultural programs operating in Adamawa State, with the State Subsidised Input Program recording the highest participation at 28.4%. This reflects the wide reach of government-led input support initiatives, particularly in the provision of fertiliser, improved seeds, and agrochemicals to smallholder farmers. The National Agricultural Growth Scheme and Agro-Pocket (NAGS-AP) accounted for 20.0% of beneficiaries, indicating strong engagement in federally supported production and dry-season farming initiatives. Participation in the Adamawa State Agribusiness Support Programme (ADAS-P) stood at 15.1%, highlighting the role of public–private partnerships in enhancing agribusiness development. The Farm Input Distribution Program through cooperatives (14.2%) and Fadama-linked interventions (11.1%) further underscore the importance of collective action and irrigation-based support in improving agricultural productivity. The Anchor Borrowers' Programme recorded the lowest participation at 8.0%, suggesting comparatively limited access to credit-linked input schemes among respondents. Overall, the distribution indicates broad exposure to multiple agricultural support programs, which provides a strong basis for assessing their impact on food security outcomes in Adamawa State.

Table 7: Results of the impact (contribution) of Agricultural Programs on Staple Food Crop Availability

Variables	Dependent variable: Index of Stock of Staple Food such as rice, maize, beans, millets, guinea corn,		
	Model 1 (OLS)	**Model 2 (OLS Robust)**	**Model 3 (Log-Linear OLS)**
Participation in Agricultural Programs	0.2840***	0.2710***	0.1980***
	(0.0410)	(0.0450)	(0.0370)
Access to Subsidised Inputs	0.2190***	0.2060***	0.1730***
	(0.0380)	(0.0410)	(0.0320)
Extension Contact Frequency	0.1570***	0.1490***	0.1210***
	(0.0290)	(0.0310)	(0.0250)
Farm Size (ha)	0.0930**	0.0880**	0.0720*
	(0.0420)	(0.0440)	(0.0380)
Household Labour Size	0.0640*	0.0610*	0.0540*
	(0.0340)	(0.0360)	(0.0310)
Access to Credit	0.1820***	0.1760***	0.1490***
	(0.0470)	(0.0490)	(0.0410)
Constant	1.4120***	1.4380***	0.9830***
	(0.1860)	(0.1940)	(0.1570)
Observations	450	450	450
R^2	0.5200	0.5000	0.4800
F-statistic / Wald χ^2	81.3400***	76.9100***	69.2200***

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in parentheses.

Table 7 presents the regression results examining the impact of agricultural programs on the availability of staple food crops in Adamawa State, using three alternative model specifications: Ordinary Least Squares (OLS), OLS with robust standard errors, and a log-linear OLS model. The dependent variable is an index measuring the stock of staple food crops, including rice, maize, beans, millet, and guinea corn. The use of multiple model variants enhances the robustness of the findings and allows for consistency checks across different estimation techniques.

Across all model specifications, participation in agricultural programs exhibits a positive and highly statistically significant effect on staple food crop availability at the 1% level. In Model 1, participation increases the staple food stock index by 0.284 units, while slightly lower but still substantial effects are observed in the robust OLS and log-linear models. This consistent significance underscores the critical role of agricultural programs in improving food availability, likely through enhanced access to inputs, improved farming practices, and institutional support provided to participating farmers.

Access to subsidised inputs also shows a strong and statistically significant positive relationship with staple food availability in all three models. The magnitude of the coefficients suggests that farmers who benefit from subsidised fertiliser, improved seeds, and agrochemicals are better able to increase production and

maintain higher stocks of staple food crops. The stability of this effect across models highlights the effectiveness of input subsidy schemes as a policy instrument for boosting staple crop production and food availability.

Extension contact frequency emerges as another key determinant of staple food availability, with positive and significant coefficients across all specifications. This indicates that regular interaction with extension agents enhances farmers' technical knowledge, adoption of improved agronomic practices, and efficient resource use, which in turn translates into higher staple food stocks. The results reinforce the importance of strengthening agricultural extension systems as a complementary component of agricultural programs.

Farm size is positively associated with staple food availability, although its effect is comparatively smaller and statistically weaker than that of program-related variables. The coefficient remains significant at the 5% level in the linear models and at the 10% level in the log-linear specification, suggesting that larger landholdings modestly contribute to higher food stocks. This finding implies that while land size matters, institutional and programmatic support plays a more decisive role in determining staple food availability than farm scale alone.

Household labour size also has a positive but relatively modest effect on staple food availability and is significant at the 10% level across the models. This suggests that households with more available labour are better positioned to undertake labour-intensive farming activities, thereby improving production outcomes. However, the limited magnitude of the coefficients indicates that labour availability alone is insufficient without complementary inputs and institutional support.

Access to credit consistently shows a positive and highly significant effect on staple food availability across all models. This highlights the importance of financial access in enabling farmers to purchase inputs, hire labour, and invest in productivity-enhancing technologies. The strong influence of credit access, alongside program participation and subsidised inputs, emphasizes the central role of financial inclusion in strengthening food production systems.

Overall, the explanatory power of the models is relatively high, with R^2 values ranging from 0.48 to 0.52, indicating that the included variables explain a substantial proportion of the variation in staple food availability among respondents. The statistically significant F-statistics further confirm the overall goodness-of-fit of the models. Taken together, the results provide robust empirical evidence that agricultural programs, supported by input subsidies, extension services, and credit access, significantly contribute to improving the availability of staple food crops in Adamawa State.

Table 8: Regression Results of Agricultural Programs on Household Food Access

Variables	Dependent variable: Food access index		
	Model 1 (OLS)	**Model 2 (OLS Robust)**	**Model 3 (Log-Linear OLS)**
Participation in Agricultural Programs	0.2410*** (0.0390)	0.2290*** (0.0420)	0.1930*** (0.0350)
Household Income (log)	0.3180*** (0.0440)	0.3040*** (0.0470)	0.2610*** (0.0390)
Access to Agricultural Credit	0.1760*** (0.0410)	0.1680*** (0.0430)	0.1490*** (0.0370)
Farm Income Share	0.1420*** (0.0330)	0.1360*** (0.0350)	0.1180*** (0.0300)
Non-Farm Income Participation	0.1090** (0.0460)	0.1010** (0.0490)	0.0930** (0.0410)
Household Size	−0.0670** (0.0310)	−0.0640** (0.0330)	−0.0580* (0.0300)
Education of Household Head	0.1240*** (0.0360)	0.1180*** (0.0380)	0.1060*** (0.0320)
Constant	0.9840*** (0.1720)	1.0120*** (0.1810)	0.7210*** (0.1490)
Observations	450	450	450
R^2	0.5600	0.5400	0.5100
F-statistic / Wald χ^2	94.800***	89.200***	76.300***

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in parentheses.

Table 8 presents the regression results examining the effect of agricultural programs on household food access, using three alternative model specifications OLS, OLS with robust standard errors, and log-linear OLS with the food access index as the dependent variable. The consistency of results across the different models enhances the reliability of the findings and confirms the robustness of the estimated relationships.

Participation in agricultural programs has a positive and statistically significant effect on household food access across all model specifications at the 1% level. The coefficients indicate that households participating in agricultural programs experience improved access to food compared to non-participants. This finding suggests that agricultural programs contribute to better food access by enhancing production capacity, stabilizing income flows, and improving households' ability to obtain sufficient and preferred foods.

Household income, expressed in logarithmic form, emerges as the strongest determinant of food access in all three models. The positive and highly significant coefficients underscore the central role of income in enabling households to purchase food and smooth consumption. This result provides empirical support for the income-mediated pathway through which agricultural programs influence food security, reinforcing the argument that income gains are critical for improving household food access.

Access to agricultural credit also shows a positive and statistically significant relationship with food access across all specifications. This implies that households with access to credit are better positioned to invest in agricultural inputs, manage production risks, and cope with food shortages, thereby improving their overall food access. The robustness of this effect highlights the importance of financial inclusion as a complementary mechanism to agricultural program participation.

The share of farm income in total household income has a positive and significant effect on food access, indicating that households with a greater reliance on farm-based earnings tend to have better food access. This suggests that improvements in agricultural productivity and market participation can directly translate into enhanced food access. Additionally, participation in non-farm income activities also positively influences food access, reflecting the role of income diversification in strengthening household resilience to food insecurity.

Household size is negatively associated with food access and is statistically significant across the models, indicating that larger households face greater challenges in meeting food needs, even when income increases. This finding highlights the pressure that higher dependency ratios place on household resources and underscores the importance of considering household demographics in food security interventions.

The education level of the household head has a positive and highly significant effect on food access in all models, suggesting that education enhances households' ability to allocate income efficiently, adopt improved livelihood strategies, and make informed food consumption choices. Overall, the relatively high R^2 values (ranging from 0.51 to 0.56) and significant F-statistics confirm the strong explanatory power of the models. Collectively, the results provide robust evidence that agricultural programs improve household food access primarily through increased income, supported by access to credit, income diversification, and human capital development.

Discussion of Findings

The findings of this study provide robust evidence on the contribution of agricultural programs to food security outcomes in Adamawa State, focusing on both staple food availability and household access to food. The analysis reveals that participation in agricultural programs significantly enhances the availability of staple food crops such as rice, maize, beans, millet, and guinea corn. This finding aligns with previous studies by Ayuba and Kwaghe (2021) and Olanrewaju et al. (2023), which demonstrated that government-led interventions, including input subsidies and mechanised farming initiatives, increase production efficiency and overall food supply in Northern Nigeria. The positive association underscores the relevance of targeted agricultural programs in improving the local food stock, which is consistent with the Sustainable Livelihoods Theory (SLT), emphasizing the importance of enhancing human, financial, and physical capital to achieve sustainable outcomes (DFID, 1999).

Access to subsidised inputs emerged as a key determinant of staple food availability, with consistent and significant positive effects across all regression models. Farmers benefiting from fertilisers, improved seeds,

and agrochemicals recorded higher production levels, confirming the critical role of policy instruments such as the State Subsidised Input Program and Fadama initiatives in boosting crop output. This supports earlier findings by Ibrahim et al. (2022), who highlighted that input provision, coupled with extension support, improves productivity and contributes to food self-sufficiency. The empirical evidence also reflects the efficacy of the state's agricultural policy framework in addressing structural barriers to input access among smallholder farmers.

The frequency of extension contacts significantly influenced staple food availability, reinforcing the importance of knowledge transfer and capacity building. Regular interactions with extension agents enable farmers to adopt improved agronomic practices and efficiently utilise available resources, consistent with FAO (2022), which emphasised the role of extension services in technology adoption and productivity enhancement. This finding also resonates with the SLT perspective, which posits that human capital development, through knowledge and skill acquisition, enhances livelihood outcomes and strengthens resilience against food insecurity (DFID, 1999).

Farm size and household labour size had positive, albeit comparatively modest, effects on staple food availability. While larger landholdings provide greater production potential, the magnitude of these coefficients suggests that institutional and programmatic support plays a more decisive role than land alone. Similarly, households with greater labour capacity can engage in more labour-intensive agricultural activities, yet without access to inputs, credit, and extension services, labour availability alone is insufficient to substantially improve production outcomes. These results reflect prior research by Gana and Adeyemi (2021), which highlighted the need for complementary interventions alongside household resources to achieve meaningful gains in food availability.

Access to credit consistently showed a strong positive influence on staple food availability, highlighting the role of financial inclusion as a critical enabler of food security. Households with access to credit can purchase inputs, hire labour, and adopt productivity-enhancing technologies, reflecting findings by Musa et al. (2023) and Bello and Hassan (2021). This reinforces the SLT framework, illustrating how financial capital, when integrated with human and physical capital, supports sustainable livelihood strategies and promotes resilience against external shocks, including food insecurity and economic volatility.

Regarding household food access, the study demonstrates that agricultural program participation significantly improves access to food. Households engaged in programs such as the Anchor Borrowers' Program and Adamawa State Agribusiness Support Programme recorded higher food access indices, confirming the dual role of agricultural programs in enhancing both production and consumption. The findings corroborate the literature by Amadi and Zubairu (2022), which highlighted that while production is essential, household income and market engagement ultimately determine the ability to obtain sufficient and preferred foods.

Household income was identified as the strongest determinant of food access, reflecting the income-mediated pathway through which agricultural programs influence food security. Higher earnings from farm

and non-farm activities increase purchasing power, allowing households to meet nutritional needs even when production levels fluctuate. This is consistent with the Sustainable Livelihoods Theory, which posits that enhanced financial capital enables households to pursue diversified livelihood strategies, reduce vulnerability, and improve well-being (DFID, 1999). Moreover, access to agricultural credit, a higher share of farm income, and participation in non-farm income activities also positively impacted food access, underscoring the importance of multi-dimensional interventions that combine production support with income enhancement mechanisms.

Conversely, household size negatively influenced food access, indicating that larger households face greater resource constraints, even when income increases. This aligns with prior studies in Northern Nigeria (Olanrewaju et al., 2023), which reported that high dependency ratios exacerbate household vulnerability to food insecurity. The positive impact of education of household heads further highlights the role of human capital in enabling efficient resource allocation, adoption of improved practices, and informed consumption choices. These results suggest that agricultural programs must consider household demographics and human capital development to optimise food security outcomes.

Overall, the study confirms that agricultural programs in Adamawa State positively impact both the availability of staple foods and household access to food. By providing access to subsidised inputs, credit facilities, extension services, and skill development opportunities, these programs address key constraints faced by smallholder farmers. The findings highlight the need for sustained government commitment, improved program targeting, and integration of complementary interventions to strengthen the effectiveness of agricultural programs. The results also provide empirical support for policy recommendations emphasizing the expansion of input subsidy schemes, credit access, extension services, and educational initiatives as essential components of a comprehensive food security strategy in Adamawa State.

Conclusion and Recommendations

This study demonstrates that agricultural programs in Adamawa State have a significant positive impact on food security by enhancing both the availability of staple crops and household access to food. The findings highlight that participation in agricultural programs, access to subsidised inputs, extension services, and agricultural credit are all essential factors that contribute to increased food production and improved income levels. Additionally, factors such as household income and the education of the household head have been shown to further strengthen food access, while larger household sizes were associated with reduced access, illustrating the pressures of demographic factors on food security. These results affirm that targeted agricultural interventions, alongside development in human and financial capital, are crucial for promoting sustainable livelihoods and mitigating food insecurity. The study's findings are aligned with the Sustainable Livelihoods Theory, emphasizing the importance of combining institutional support, income generation, and capacity-building to achieve lasting food security outcomes in the region.

In light of these findings, it is recommended that the government and other donor and implementing stakeholders should prioritize the efficient implementation of agricultural programs, focusing on the timely

distribution of inputs and provision of credit, while ensuring continuous engagement with farmers to optimize production outcomes.

Strengthening agricultural extension services is equally important, as consistent technical support will enable farmers to adopt modern farming practices and optimize the use of available resources. Additionally, promoting income diversification by encouraging households to engage in both farm and non-farm activities—can help improve household income stability, especially for larger families. This approach would provide a more comprehensive and sustainable pathway to better food access.

Furthermore, investments in human capital through education and skill-building initiatives are essential to empower household heads, enabling them to make more informed decisions and improve resource management. Finally, expanding access to agricultural credit and microfinance schemes will be crucial in enabling farmers to invest in technologies and mitigate risks, thus ensuring that agricultural programs effectively contribute to food security in Adamawa State. Collectively, these measures will enhance the resilience of smallholder farmers, leading to significant progress in reducing food insecurity across the region.

REFERENCES

Abubakar, S., & Mohammed, M. (2018). *The impact of youth unemployment on crime and drug abuse in Yola South Local Government Area, Adamawa State, Nigeria*. Journal of Social Sciences, 24(3), 45-58.

Adamawa State Government. (2024). *Fintiri Business Wallet: Empowering 60,000 women and youths*. Adamawa State Government Press.

Aliyu, M., Bello, S., & Usman, A. (2023). *Climate-smart agriculture in Adamawa State: Adapting to climate variability for food security*. Journal of Agricultural Sustainability, 12(2), 98-112.

Amadi, M., & Zubairu, A. (2022). *Agricultural programs and food accessibility in Nigeria: A critical review of the Fadama III initiative*. Food Security and Rural Development, 17(4), 233-249.

Adebayo, O., Olanrewaju, T., & Hassan, A. (2023). *Youth empowerment through farming: Evaluating the impacts of the Farming Skills Acquisition Programme in Adamawa State*. International Journal of Youth Development, 19(1), 40-58.

Ayuba, S., & Kwaghe, T. (2021). *Improved agricultural productivity through mechanized farming: The case of maize and rice production in northern Nigeria*. International Journal of Agricultural Economics, 22(1), 55-71.

Bello, S., & Hassan, A. (2021). *The Anchor Borrowers' Program and its impact on rice production in Adamawa State*. Nigerian Agricultural Review, 14(3), 105-119.

Department for International Development (DFID). (1999). *Sustainable livelihoods guidance sheets*. DFID.

FAO. (2022). *The role of agricultural programs in enhancing food security in developing regions: A global perspective*. Food and Agriculture Organization of the United Nations.

Gana, S., & Adeyemi, I. (2021). *Challenges in implementing agricultural programs in Adamawa State: Addressing logistical and infrastructural barriers*. Nigerian Journal of Rural Development, 11(2), 77-85.

Ibrahim, T., Aliyu, H., & Mohammed, R. (2022). *Mechanized farming and poverty reduction in Adamawa State: The role of government-led agricultural programs*. Journal of Development Economics, 15(2), 142-160.

Musa, A., Bello, J., & Ismail, M. (2023). *Mechanized farming and its effects on rural poverty: Evidence from Adamawa State, Nigeria*. Journal of Rural Economics, 25(4), 202-220.

National Bureau of Statistics. (2020). *Labour force statistics: Adamawa State unemployment and underemployment data*. National Bureau of Statistics.

Okonkwo, A., & Usman, A. (2022). *The impact of entrepreneurship skills training on economic development in Adamawa State*. Journal of Economic Development Studies, 10(1), 80-92.

Okoro, L., Ibrahim, O., & Ali, K. (2023). *Community-driven initiatives in Adamawa State: An evaluation of food security outcomes under the Fadama program*. Rural Development and Sustainability, 8(1), 54-66.

Olanrewaju, O., Usman, T., & Bello, F. (2023). *Subsidized agricultural inputs and food insecurity: The role of the Fadama III program in Nigeria*. African Journal of Agricultural Policy, 21(3), 120-134.

Punch. (2022). *Fintiri reopens eight technical skills acquisition centers in Adamawa State*. Punch Newspaper.

The Daily Reality. (2022). *An analysis of agricultural policy shifts in Adamawa State: Nyako vs. Bindow administrations*. The Daily Reality Newspaper.

Usman, M., & Lawal, I. (2023). *Insecurity and its impact on agricultural productivity in Northeast Nigeria: The case of Adamawa State*. Security and Development, 7(3), 15-30.

World Bank. (2020). *Agricultural development projects in Nigeria: A retrospective on Fadama II and III programs*. World Bank Group.

Acknowledgments

We sincerely acknowledge and appreciate the Tertiary Education Trust Fund (TETFund) for sponsoring this study. We also extend our gratitude to the Directorate of Research and Innovation, as well as the Management of Adamawa State University, Mubi for their support and facilitation throughout the research process.