

Pathways to Food Security: The Influence of Livelihood Assets and Shocks among Farming Households

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Abstract

Food security remains a major challenge for farming households in low- and middle-income countries, where agricultural livelihoods are highly affected by economic, climatic, and social shocks. This study examines how livelihood assets, income-generating activities, exposure to shocks, and access to safety nets were associated with household food security among farming households in North Central Nigeria, a primary food production zone. Mixed-methods were used. Quantitative data were obtained from 615 farming, North Central households in the Nigeria General Household Survey Panel (2023/2024). Food security was measured using Food Insecurity Experience Scale (FIES). Logistic regressions were used to assess factors associated with food security. Qualitative data were collected through interviews and focus group discussions with farmers, community members, and local officials, focusing on perceptions of food access, livelihood strategies, and shock. Quantitative results showed that 56% of households were food secure. Higher levels of physical and financial capital were associated with higher odds of food security. Exposure to economic and consumption-related shocks was strongly associated with lower odds of food security. Female-headed households and larger households were less likely to be food secure. Qualitative findings highlighted that food security was affected by seasonal variations in agricultural production, and financial capacity. Participants reported that market price fluctuations and climatic events disrupted food access. Farming households in North Central Nigeria experience substantial food insecurity, associated with exposure to shocks and limited livelihood assets. Strengthening productive and financial assets and reducing vulnerability to shocks are critical for improving food security. These findings provide evidence to inform policies and interventions aimed at building resilience among farming households in rural agricultural communities.

Keywords: *Food Security, Farming Households, Food Insecurity Experience, Livelihood Assets, Shocks, Sustainable Livelihoods Framework.*

Introduction

Food insecurity remains one of the most significant and persistent challenges faced by farming households in low- and middle-income countries, especially in sub-Saharan Africa. In Nigeria, agricultural households are particularly vulnerable due to the complex

interplay of economic, climatic, and social factors. These households operate in volatile environments marked by unpredictable weather patterns, market fluctuations, health risks, and limited access to formal safety nets, further exacerbating their vulnerability to food insecurity [1].

Despite various approaches to mitigate food insecurity, existing solutions such as market access improvements and agricultural interventions have been insufficient to ensure long-term food security for many households. The Sustainable Livelihoods Framework (SLF) provides a comprehensive model for understanding food security, but few studies have examined how different forms of capital (human, physical, financial, natural, and social) interact to influence food security outcomes in the Nigerian context. This study aims to fill that gap by analyzing the role of livelihood assets and shocks in shaping food security, specifically in North Central Nigeria [2].

The problem this research addresses is the lack of a detailed understanding of how farming households in the North Central zone achieve food security. Existing interventions have not been tailored specifically to the diverse needs of households in this zone, where climatic and economic conditions differ significantly from other parts of the country. Therefore, this study aims to identify and assess likely effective strategies to improve food security in this area [3], using an experience-based indicator of food security that captures the multidimensional nature of food insecurity [4].

Furthermore, the study will examine the pathways through which livelihood assets and shocks influence food security outcomes [5].

Food insecurity is a significant global issue, with approximately 11.3% of the world's population experiencing severe food insecurity as of 2022, while over 2.4 billion people face some form of food insecurity. Sub-Saharan Africa, in particular, is most affected, with food insecurity rates often exceeding 60% in many regions. Nigeria, despite its agricultural potential, continues to struggle with food security. Rural areas, home to most of the country's food producers, experience significant levels of food insecurity due to a combination of factors such as climate variability, market inefficiencies, and insecurity [6].

In the North Central zone of Nigeria, the prevalence of food insecurity is particularly high. Despite the area's favourable agricultural conditions, studies have reported that over 70% of households face some form of food insecurity. The North Central zone is highly dependent on agriculture for its livelihoods, but households remain vulnerable due to factors such as inconsistent rainfall patterns, fluctuating commodity prices, and limited access to credit and extension services [7].

Our study bridges the gap in existing literature regarding the relationship between livelihood assets, shocks, and food security outcomes in the North Central zone. By examining both direct and indirect factors influencing food security, this research aims to contribute to more nuanced policy frameworks that account for the complex realities faced by farming households. The findings will help design strategies that not only address immediate food security concerns but also build long-term resilience by strengthening livelihood assets and improving access to diversified coping mechanisms [8].

Literature Review

Food security in sub-Saharan Africa remains a multifaceted challenge, driven by a wide range of economic, environmental, and social factors. The role of livelihood assets in influencing food security outcomes has been recognized in the literature. In their study [2], argue that livelihood strategies are closely linked to food security, with assets such as land, labor, and capital playing pivotal roles in coping with shocks [9]. In a similar vein, [3] emphasizes the importance of access to physical assets, including land and livestock, as critical to ensuring food security in rural households [10].

Shocks, both economic and environmental, can disrupt the ability of farming households to meet their food needs. The impact of these shocks has been studied in parts of sub-Saharan Africa, where climate change and market

volatility exacerbate food insecurity. Recent studies by [4, 5] show that climatic shocks, including droughts and floods, disproportionately affect food production and access in vulnerable regions [11, 12]. Additionally, economic shocks such as fluctuating market prices and inflation have been found to undermine household purchasing power, further exacerbating food insecurity in rural areas [13].

The significance of non-farm employment and diversification strategies in improving food security has further been highlighted in recent research. Studies by [6] demonstrate that households that engage in non-farm income-generating activities are more likely to maintain food security during times of agricultural stress [14]. Similarly, diversification of agricultural production has been shown to enhance resilience to environmental and market shocks, enabling households to mitigate the risk of food insecurity [15].

In the Nigerian context, study by [7] provide insight into the coping strategies of rural households. These studies emphasize the role of community-based interventions, such as village savings and loan schemes, in enhancing household resilience to food insecurity [16, 17]. Similarly, it is emphasized that social capital and community solidarity play a crucial role in alleviating the effects of shocks on food security in rural Nigeria [18].

The role of government policies and institutional support in addressing food insecurity has also received attention in the literature. In Nigeria, the provision of agricultural extension services, access to credit, and investments in rural infrastructure have been identified as critical factors in enhancing food security outcomes. According to [9], extension services that improve agricultural practices and access to resources are essential for enhancing productivity and food security in rural areas [19]. Furthermore, policies that facilitate access to affordable and stable

markets can help mitigate the effects of price volatility on food security [20].

Recent studies on food security in North Central Nigeria have highlighted the zone's unique challenges, including the persistent insecurity in rural areas and the effects of fluctuating commodity prices. [8, 10] found that while the zone has favorable agricultural conditions, high levels of poverty and limited access to markets and resources have contributed to widespread food insecurity [21, 22].

Materials and Methods

Description of the Site

The study was carried out in Nigeria's North-Central zone, which includes the states of Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and the Federal Capital Territory (FCT) in Abuja. Home to over 20 million people, this zone relies heavily on agriculture, with farming being the primary economic activity. The area boasts favorable conditions for agricultural production, yielding a wide range of crops such as yam, rice, sorghum, maize, and various vegetables. Its climate, categorized as Guinea Savannah, experiences a single rainy season, which supports the cultivation of diverse crops. The presence of two major rivers, the Benue and Niger, provides vital water resources throughout the year [2, 3], further supporting agricultural endeavors. However, the zone's reliance on rain-fed farming makes it vulnerable to climate-induced shocks, which can negatively impact crop production and food security for local households.

Description of Data Collection

This study employs a mixed-methods design, combining both quantitative and qualitative approaches. The quantitative data was obtained from the 2023/2024 wave of the Nigeria General Household Survey-Panel (GHS-Panel), a nationally representative survey implemented by the National Bureau of Statistics (NBS). Two rounds of data collection

were conducted: post-planting (July to September 2023) and post-harvest (January to March 2024). Variables from both rounds of the survey were used. Food security indicators, livelihood activities, experience of shocks, education, and access to land were drawn from the post-harvest round, which captures recent food access, consumption, and economic engagement. Information on health, extension services, financial access, remittances, insurance, and assets was drawn from the post-planting round. Variables were considered to reflect household conditions within the same agricultural year, and within-year temporal variation was assumed to be minimal.

The analysis was restricted to farming households, defined as households that reported cultivating crops during the survey year. A total of 615 households, out of 809 households in the North Central zone in the survey, were included in the analysis. Qualitative data were collected through in-depth interviews with key informants, including agricultural extension

officers, local government staff, and heads of farming households. The qualitative data provided contextual insights into the challenges faced by farming households, and the role of social structures in food security decisions.

Conceptual Framework and Analytical Approach

The conceptual framework for this study is based on the Sustainable Livelihoods Framework (SLF), which views food security as a livelihood outcome influenced by various forms of capital, livelihood activities, and shocks. Livelihood assets, such as human, physical, financial, and social capital, are key determinants of a household's ability to manage risks and engage in income generating activities. Shocks, such as economic disruptions or climate-related events, can undermine food access, while livelihood activities are expected to reflect responses to these challenges in Figure 1.

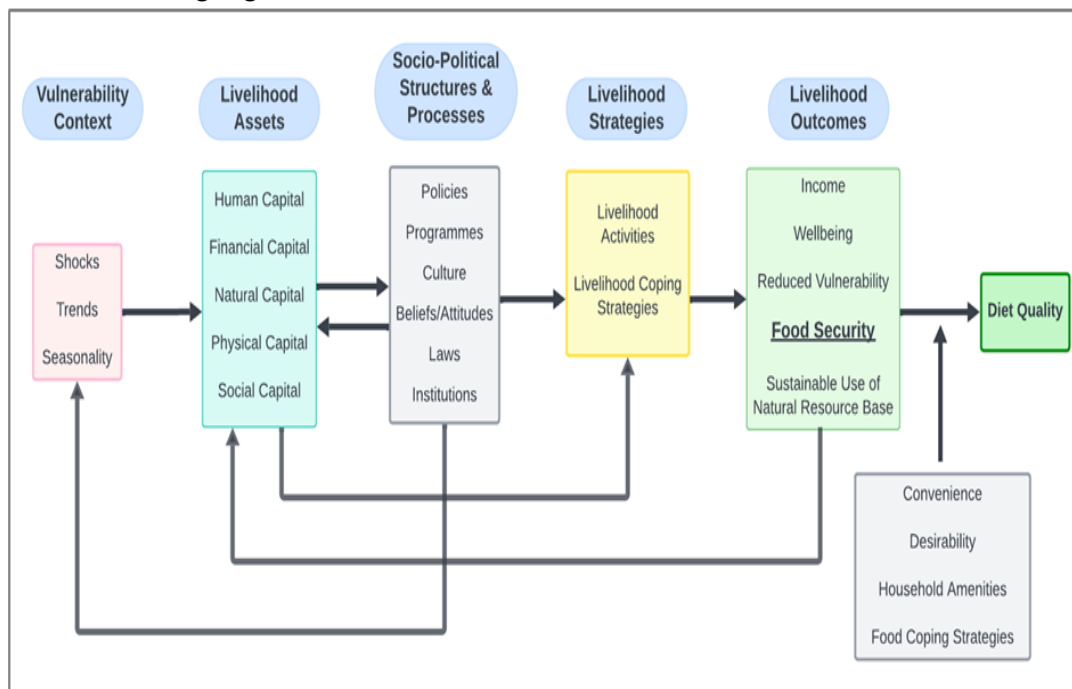


Figure 1. Conceptual Framework for the Study

Source: Adapted by authors from Løvendal et al., 2004; Turner et al., 2018; Fanzo et al., 2020; Bekele et al., 2021; Natarajan et al., 2022 [23-27].

Description of Key Indicators

Indicators used in the quantitative analysis were derived from the survey data using standard methods. Food security was measured using the Food Insecurity Experience Scale (FIES). The raw FIES data of eight questions was analyzed using the Rasch model, through an online app provided by the Food and Agriculture Organization of the United Nations for FIES data analysis (<https://foodandagricultureorganization.shinyapps.io/fies/>) [4]. Food secure households were coded 1, and food insecure households were coded 0.

Indicators for livelihood assets were developed based on the Sustainable Livelihoods Framework and grouped into four asset categories: human, physical, financial, and social capital see figure 1. For each asset category, indicators capturing access to key resources and services were combined to construct composite indices. Higher values of each index indicated greater asset endowment. Human capital captured characteristics related to education, skills, and labour capacity within the household. Physical capital reflected ownership of productive and household assets. Financial capital captured access to financial resources, including savings and credit. Social capital reflected access to social networks and support mechanisms, including access to extension services and network-based financial access. Natural capital was not included in the analysis because it was defined as access to land and was universal among the sampled farming households and therefore showed no variation.

Livelihood activities were measured based on households' engagement in income-generating activities. A categorical indicator captured the number of types of livelihood activities undertaken by each household. Categories were no reported type of livelihood activity, one type of activity (e.g., agricultural activities), two activity types, or three or more activity types.

Exposure to shocks was measured using indices capturing households' experience of economic shocks and food consumption-related shocks. Higher values of the shock indices indicated greater exposure to shocks. Access to safety nets was measured using a binary indicator capturing whether the household reported receiving any form of social assistance or support.

Description of Statistical Methods and Data Analyses Used

The analysis followed the Sustainable Livelihoods Framework (SLF) to examine factors associated with household food security among farming households. Quantitative and qualitative data were analysed in a complementary manner, with quantitative analysis providing estimates of associations and qualitative data used to contextualise and interpret these findings.

All analyses were conducted at the household level, with individual-level information aggregated to the household level. Complex survey design was used to ensure representativeness. Descriptive statistics were first used to summarize key household characteristics, including food security indicators, assets, livelihood activities, and socio-economic variables. Multivariable logistic regression analyses were then used to examine the relationship between livelihood assets, livelihood activities, shocks, safety nets, and food security. Models were specified sequentially to assess the contribution of different livelihood components to food security. The first model included the livelihood assets (human, physical, financial, and social capital) indices. The second model incorporated the economic and food consumption shocks, while the third added access to safety nets. The final model included livelihood activities. All models controlled for sex, age, and education of the household head, as well as household size and rural or urban residence.

The probability of decision error was set at 5%, and variables with p-values less than 0.05 were considered statistically significant. Variables with p-values between 0.05 and 0.10 were considered marginally significant and identified for further investigation.

Qualitative data from interviews were analysed thematically to identify recurring patterns related to food access, livelihood strategies, and exposure to shocks. Rather than being analysed as stand-alone outcomes, qualitative findings were used to complement the quantitative analysis by providing contextual explanations for observed statistical associations, particularly with respect to seasonal food access, financial constraints, and the ways households manage livelihood risks.

Results

Quantitative Findings

Socio-Demographic Characteristics

Household Head Information

Among the household heads, 82.89% were male, while 17.11% were female. The average age of household heads was 49.62 years (95% CI 47.74 – 51.50), with a wide range of ages from 19 to 100 years. In terms of education, 32.93% of household heads had no formal education, while 22.10%, 25.73%, and 19.23% had primary, secondary, and tertiary education,

respectively. A significant majority (78.70%) of household heads were married or in an informal union (monogamous or polygamous), while 20.48% were unmarried, divorced, separated, or widowed.

Household Information

The average household size was 5.96 members (95% CI 5.57 – 6.34), with a range from 1 to 25 members. The dependency ratio was 1.09 (95% CI 0.98 – 1.20), indicating that for every working adult, there was an average of just over one dependent individual. A large proportion (84.94%) of households resided in rural areas, while 15.06% resided in urban areas. Household samples were drawn from the FCT and all states in North Central Nigeria, with the following distribution: Benue (26.33%), Kogi (16.48%), Kwara (8.54%), Nasarawa (8.80%), Niger (19.18%), Plateau (17.70%), and FCT (2.97%).

Livelihood Assets

Households in the region rely on a variety of livelihood assets to support their food security. These include human, physical, financial, and social capital. The mean values for each asset category and their associated 95% confidence intervals (CI) are summarized in Table 1 below.

The following table summarizes the mean values and confidence intervals for each asset:

Table 1. Mean Value and Confidence Intervals

Livelihood Asset	Mean	95% CI Lower	95% CI Upper
Human Capital	0.71	0.68	0.74
Physical Capital	0.41	0.38	0.44
Financial Capital	0.32	0.29	0.35
Social Capital	0.34	0.29	0.39

Source: Authors, based on data from the 2023/2024 round of the Nigeria General Household Survey-Panel. National Bureau of Statistics. 2024 [28]

Shocks

Food Consumption Shocks

A total of 74.43% of households experienced food consumption shocks in the 12 months preceding the survey, with the average number

of shocks being 3 (95% CI 2.83 – 4.06). Increased prices were therefore the biggest food consumption shocks experienced by households, followed by shocks that affected agricultural productivity, and climatic shocks. In aggregate, 25.29% of households

experienced climatic shocks (floods, drought, hail, and/or erosion); 18.15% of households experienced security threats (theft of livestock and/or assets); 36.00% of households experienced agricultural productivity shocks (pests, weeds, and/or crop/livestock diseases); 67.89% experienced increased food prices and 46.74% experienced increased prices of agricultural inputs (71.31% of households experienced at least one of these price shocks).

Economic Shocks

63.60% of households reported experiencing economic shocks related to income or asset loss since 2022, with an average of 2 economic shocks per household (95% CI 1.52 – 2.24). The economic shocks primarily involved price (inputs/food/fuel price) increases (56.91%), followed by climatic (floods, irregular rains, droughts, or high temperatures) shocks (15.35%) and security (theft, robbery, assault and/or kidnapping) issues (6.70%).

Safety Nets

Just 2.71% of households received any safety net support in the 12 months preceding the survey, highlighting a significant gap in external assistance during times of vulnerability.

Livelihood Activities

Ninety percent (90%) of households were engaged in at least one type of livelihood activity in the 7 days preceding the survey; 5% of households were engaged in up to three types of livelihood activities. Households that had not engaged in any type of livelihood activity in the 7 days preceding the survey most commonly reported seasonal inactivity, temporary job transitions, short-term illness, or personal leave/vacation. Table 2 below provides a detailed breakdown of the prevalence of household involvement in various livelihood activities. It highlights the percentage of households engaged in different livelihood activities, with agricultural activities being the most common, and includes the corresponding 95% confidence intervals for each estimate.

Table 2. Prevalence of Household Involvement in Various Livelihood Activities and Their Confidence Intervals

Percent of households that engage in different types of livelihood activities and average number of total livelihood activities engaged in	Percent/mean	95% CI Lower	95% CI Upper
At least one household member engaged in wage-earning activities	19.98%	13.55%	26.41%
At least one household member was involved in a non-farm household enterprise	27.10%	18.89%	35.31%
At least one household member was involved in agricultural livelihood activity (farm, livestock, fishing, forestry)	75.68%	70.28%	81.08%
At least one household member was involved in any of the three types of livelihood activities	89.99%	86.47%	93.51%

Source: Authors, based on data from the 2023/2024 round of the Nigeria General Household Survey-Panel. National Bureau of Statistics. 2024.[28]

Food Security

Fifty-six percent (55.5%) of households reported no moderate or severe food insecurity in the one month preceding the survey. Table 3 below presents the model results on factors

influencing food security, examining the role of livelihood assets (human, physical, financial, and social capital), shocks (food consumption and economic), safety nets, and livelihood activities. The odds ratios, p-values, and 95%

confidence intervals for each factor are provided, highlighting how these variables are associated with food security outcomes.

Logistic Regressions

In model 1 (livelihood assets and control variables only), physical capital and financial capital significantly increased the odds of being food secure, while social capital reduced the odds of food security and human capital did not have a statistically significant relationship. Households in the rural area had significantly higher odds of being food secure, while female-headed households had significantly lower odds. Household was negatively associated with food security, with a marginal significance level.

In model 2, after including food consumption and economic shock indices, physical capital and financial capital remained positively and significantly associated with food security. Social capital remained negatively associated, but now with marginal statistical significance. Both the food consumption shock index and the economic shock index were strongly and negatively associated with food security. Female headed households still had significantly lower odds of food security and the positive relationship with rural residence persisted. Household size remains negatively associated, becoming statistically significant at the 5% level (larger households have lower odds of food security).

With the further inclusion of safety nets, the magnitude and significance of physical and financial capital remained largely unchanged. Social capital continued to show an odds ratio

below one, with marginal statistical significance, while shock indices remained strongly and negatively associated with food security. Receipt of safety net(s) was negatively associated with food security, but this association was not statistically significant. Female headship, household size, and rural residence retained similar directions and levels of significance as in Model 2.

In the fully specified model including livelihood activities, physical capital and financial capital remained positively and significantly associated with food security and human capital became marginally significantly associated with food security. Social capital, food consumption shock index, and economic shock index remained negatively associated with food security and statistically significant. Receipt of safety net(s) remained negatively associated with food security, and this became marginally significant. None of the livelihood activity categories (one, two, or three types of activities) were statistically significant at the 5% level compared to no livelihood activity. Female headship and household size remained negatively and significantly associated with food security, while rural residence remained positively and significantly associated with food security.

Age and education of the household head were not statistically significant in any of the models.

Overall, across models, the direction of associations was largely stable, with minimal changes observed in the magnitude and statistical significance of key variables as additional covariates were introduced.

Table 3. Model Results on Factors Influencing Food Security: Livelihood Assets, Shocks, Safety Nets, and Activities

MODEL 1: Establish whether livelihood assets are associated with food security				
Food Secure	Odds ratio	p-value	95% CI Lower	95% CI Upper
Human capital	4.21	0.111	0.72	24.68
Physical capital	19.88	0.000	4.82	82.07
Financial capital	9.78	0.000	3.35	28.56

Social capital	0.36	0.000	0.21	0.64
Female household head	0.44	0.011	0.23	0.83
Age of household head	1.00	0.767	0.98	1.02
Household head has no formal education	0.00			
Household head has primary education	1.02	0.948	0.52	2.03
Household head has secondary education	1.19	0.699	0.50	2.82
Household head has tertiary education	0.93	0.885	0.36	2.43
Household size	0.94	0.096	0.88	1.01
Household is in rural area	4.77	0.006	1.58	14.40
MODEL 2: Added vulnerability context (shocks): Test whether shocks reduce the odds of food security beyond asset endowments				
Food Secure Based on FIES	Odds ratio	p-value	95% CI Lower	95% CI Upper
Human capital	5.52	0.078	0.83	36.80
Physical capital	10.27	0.007	1.89	55.91
Financial capital	6.36	0.003	1.87	21.59
Social capital	0.56	0.063	0.31	1.03
Food consumption shocks index	0.02	0.000	0.00	0.06
Economic shocks index	0.00	0.001	0.00	0.04
Female household head	0.35	0.002	0.18	0.68
Age of household head	1.00	0.832	0.99	1.02
Household head has no formal education	0.00			
Household head has primary education	0.97	0.930	0.51	1.87
Household head has secondary education	1.23	0.679	0.46	3.25
Household head has tertiary education	0.87	0.781	0.33	2.32
Household size	0.92	0.050	0.85	1.00
Household is in rural area	3.94	0.007	1.45	10.72
MODEL 3: Add safety nets: Assess whether safety nets buffer food insecurity				
Food Secure Based on FIES	Odds ratio	p-value	95% CI Lower	95% CI Upper
Human capital	5.31	0.085	0.79	35.47
Physical capital	10.05	0.008	1.83	55.06
Financial capital	6.19	0.004	1.81	21.09
Social capital	0.55	0.052	0.30	1.00
Food consumption shocks index	0.02	0.000	0.00	0.06
Economic shocks index	0.00	0.002	0.00	0.06
Household received safety net	0.42	0.118	0.14	1.25
Female household head	0.34	0.002	0.17	0.68
Age of household head	1.00	0.721	0.99	1.02
Household head has no formal education	0.00			
Household head has primary education	1.00	0.995	0.52	1.93
Household head has secondary education	1.27	0.624	0.48	3.34
Household head has tertiary education	0.92	0.866	0.34	2.47
Household size	0.92	0.050	0.86	1.00
Household is in rural area	3.91	0.007	1.46	10.50

MODEL 4: Add livelihood activities				
Food Secure Based on FIES	Odds ratio	p-value	95% CI Lower	95% CI Upper
Human capital	6.20	0.076	0.83	46.46
Physical capital	14.26	0.006	2.17	93.94
Financial capital	6.30	0.006	1.69	23.53
Social capital	0.52	0.031	0.28	0.94
Food consumption shocks index	0.02	0.000	0.00	0.07
Economic shocks index	0.00	0.001	0.00	0.05
Household received safety net	0.36	0.063	0.12	1.06
Household had no type of livelihood activity	0.00			
Household had one type of livelihood activity	1.04	0.937	0.42	2.58
Household had two types of livelihood activity	0.38	0.071	0.13	1.09
Household had three types of livelihood activity	1.11	0.892	0.24	5.07
Female household head	0.33	0.002	0.16	0.66
Age of household head	1.00	0.575	0.99	1.02
Household head has no formal education	0.00			
Household head has primary education	1.14	0.713	0.57	2.29
Household head has secondary education	1.52	0.348	0.63	3.67
Household head has tertiary education	1.26	0.625	0.50	3.20
Household size	0.93	0.082	0.86	1.01
Household is in rural area	4.17	0.004	1.59	10.96

Source: Authors, based on data from the 2023/2024 round of the Nigeria General Household Survey-Panel. National Bureau of Statistics. 2024.[28]

Qualitative Results

This section presents the qualitative findings from the study, which explore the perceived pathways to food security among farming households in North Central Nigeria. The analysis focuses on the influence of livelihood assets, livelihood activities, and the impact of various shocks on food insecurity.

In-depth interviews were conducted with key informants across all states in the North Central zone and the Federal Capital Territory (FCT). A purposive sampling technique, supplemented by snowball sampling, was employed to ensure diverse representation from essential stakeholder groups involved in food production, preparation, and nutrition-related decision-making. The selection process

continued until data saturation was achieved. Interviews took place at four distinct levels: state, local government area (LGA), community, and household. At the state level, agricultural extension officers and personnel from the Women-in-Agriculture Unit within the State Ministry of Agriculture were interviewed. At the LGA level, interviews involved agricultural officers and women-in-agriculture staff working within the local agricultural departments. At the community and household levels, interviews were conducted with community leaders, heads of farming households, and primary food preparers in the households.

The interviews were guided by a semi-structured interview guide, allowing for

flexibility to probe emerging topics. The questions aimed to explore the factors impacting food security, Livelihood Assets, Shocks and coping mechanisms during food scarcity, and the challenges faced by farming households. The interviews were conducted by local research assistants, in either English or local languages, with all interviews being audio-recorded after obtaining consent. Ethical approval for the study was obtained from the research and ethics committees of the respective State Ministries of Health, as well as from the FCT Health Research Ethics Committee.

The results are categorized into key themes related to livelihood strategies and common shocks.

Livelihood Strategies and Assets

The study found that farming households in North Central Nigeria employ a range of livelihood strategies that significantly affect their ability to maintain food security. These strategies are primarily dependent on the assets available to the households, including human, social, financial, and natural resources.

1. Farm Activities

Agriculture is the central livelihood activity, with all respondents reporting its significance in securing household food and income. The most common farm activities include crop farming, livestock farming, and hired labor.

- **Crop Farming:** This was identified as the most widespread farm activity, with respondents describing farming as a generational tradition and the primary means of livelihood. Many households engage in crop farming, both for household consumption and commercial purposes. A respondent from Benue State noted, "Farming is our basic necessity for more than two generations now in this village."
- **Livestock Farming:** In addition to crop farming, livestock farming, particularly poultry and small ruminants such as goats

and sheep, plays a crucial role in diversifying household income. A farmer from Niger State shared, "We rear animals like goats, chickens, and sheep, and sell them to earn income."

- **Hired Farm Labor:** Some farming households rely on hired labor, either working on other farmers' land or hiring others to work on theirs. This additional income source helps to buffer households from food insecurity during lean seasons.

2. Non-Farm Activities

Many households supplement their agricultural activities with non-farm income-generating ventures, which help reduce the financial pressures of farming. These activities include trading, crafts, transportation, and food vending.

- **Trading:** The buying and selling of agricultural produce, as well as non-farm goods, is a common strategy for increasing household income. One respondent from Nasarawa State noted, "Many women in our community sell grains like paddy rice and guinea corn. This is an important second income source."
- **Crafts and Artisanal Work:** Respondents reported that crafts such as hairdressing, blacksmithing, and tailoring are common in the zone. These activities often provide women with opportunities for income, which they use to support household food security.
- **Transportation and Food Vending:** Some households engage in transportation services, such as motorcycling ("Okada") or food selling, often by the roadside. These activities provide additional sources of income, particularly during farming off-seasons.

3. Wage Employment

A smaller proportion of households engage in wage employment, which includes civil service jobs, teaching, construction work, and private sector employment. These sources of income help households mitigate the impact of

food insecurity during periods when agricultural income is low.

Shocks and Vulnerability

Farming households in North Central Nigeria face multiple shocks that influence their food security. These shocks include both climatic events and market fluctuations, which disrupt agricultural production and reduce income stability.

1. Climatic Shocks

Respondents cited droughts and floods as the most common climatic shocks that affect agricultural productivity. Farmers reported that these environmental challenges result in crop failure or reduced yields, leading to food insecurity.

"We face droughts sometimes, and other times the floods destroy our crops. This makes it hard to rely on farming alone," explained a respondent from Plateau State.

2. Market Shocks

Market-related shocks, such as price fluctuations and poor access to markets, were also found to affect food security. Farmers expressed concern over the volatility of crop prices, especially for grains, which often fluctuate based on supply and demand.

"The price of grains like maize and rice changes every season. Sometimes we sell for a high price, and other times, we can't even cover our costs," shared a farmer from Niger State.

3. Economic Shocks

Rising input costs, particularly for seeds, fertilizers, and agrochemicals, were also highlighted as a significant barrier to food security. Respondents noted that increasing input costs often leave farmers in debt, limiting their capacity to invest in subsequent planting seasons.

Livelihood Strategies

In response to these shocks, farming households employ various strategies,

primarily aimed at ensuring food availability and economic resilience.

Access to Resources and External Support

Households reported receiving support from government programs, NGOs, and community networks. While this support is helpful, it is often inconsistent or insufficient.

- "The government provides some inputs, but the support is not timely, and we miss out due to our location," explained a respondent from Kwara State.
- NGOs like GAIN and JICA were reported to provide farm inputs, technical assistance, and training, which enabled households to improve their agricultural practices and enhance food security.

Diversification of Livelihood Activities

One of the most common livelihood strategies employed by farming households is diversification of income sources. This includes pursuing non-farm activities or engaging in multiple agricultural activities to reduce dependency on a single crop.

"Most people here don't rely only on farming. We also engage in small businesses like trading, and this helps us avoid food shortages," shared a medium-scale farmer from Benue State.

Market Linkages and Storage

Several respondents emphasized the importance of better market access and improved transportation networks to enhance income from agricultural produce. Access to reliable storage facilities was also identified as critical to reduce post-harvest losses.

"Good roads and market access are key to ensuring we get fair prices for our produce," explained a farmer from Nasarawa State.

Discussion

The purpose of this study was to examine the pathways to food security among farming households in North Central Nigeria, with a focus on the influence of livelihood assets,

livelihood activities, and shocks. Both quantitative and qualitative findings provide a deeper understanding of the factors influencing food security among farming households.

In the quantitative analysis, livelihood activities were not significantly associated with food security. While this lack of significance might suggest that livelihood diversification did not directly contribute to food security, it does not imply that it is not a vital strategy. The results indicate that other factors, such as household assets and exposure to shocks, played a more significant role in determining food security. The importance of non-farm activities, such as trading and food vending, should not be overlooked. These activities provide critical support, especially during off-seasons or periods when agricultural income is insufficient. Indeed, participants in the interviews highlighted the crucial role of livelihood diversification in ensuring stability of food consumption. Thus, while livelihood diversification did not show a statistically significant direct relationship, it may still play an important role in enhancing household resilience to food insecurity, particularly in areas prone to agricultural stress [2, 3].

The negative impact of shocks on food security was a key finding. Food consumption shocks and economic shocks, particularly price fluctuations and climatic disruptions (such as droughts and floods), were strongly associated with lower food security. This underscores the vulnerability of farming households to both economic disruptions and climate-related shocks, which hinder their ability to access and produce food. These findings are consistent with existing literature, which emphasizes the adverse effects of economic volatility and climate change on food security, especially in rural areas [29-31]. The impact of market fluctuations, particularly price volatility, has been widely reported in literature as a major factor contributing to food insecurity in farming communities [20, 32].

While social safety nets were not significantly associated with food security in the quantitative analysis, qualitative data revealed a role for social protection and highlighted concerns about the timeliness and adequacy of external support. Respondents highlighted that while some government and NGO interventions were available, they were often inconsistent and insufficient to effectively mitigate food insecurity, particularly during critical periods. This finding aligns with previous studies highlighting the challenges of implementing effective social protection programs in rural settings, where the reach and adequacy of interventions often fall short due to logistical challenges, corruption, and inadequate funding [32, 33]. The limited effectiveness of social safety nets has also been reported in research on Nigeria's rural communities, where many households fail to benefit from formal safety net programs [34]. The finding suggests that external support programs must be timely and well-targeted to be effective in supporting vulnerable households [17, 35].

The study found that livelihood assets, including physical, financial, and human capital, were significantly associated with food security. Households with greater access to productive assets (such as land, livestock, and financial resources) were more likely to be food secure. Human capital, including education and skills, also played an important role in enhancing resilience to food insecurity, as it enabled households to better adapt to shocks and engage in income-generating activities. These findings emphasize the importance of strengthening household assets to help farming households manage risks and improve their food security outcomes [3, 6, 36]. Still, the negative association between social capital and food security that was found in our study suggests a more nuanced role of community networks that should be further explored in future research. Previous studies on rural social networks highlight the potential of collective

action to reduce vulnerability to food insecurity [35, 37].

The findings from both the quantitative and qualitative analyses have important implications for policy and program design aimed at improving food security among farming households in North Central Nigeria. The following policy recommendations are based on these findings:

1. **Strengthening Livelihood Assets:** There should be an emphasis on strengthening household assets, particularly physical and financial capital. This could include improving access to credit, supporting market access, and providing training to enhance agricultural productivity. Supporting non-farm income-generating activities could also help reduce reliance on agriculture alone for food security, especially in rural areas where income from agriculture is seasonal [33, 38].
2. **Strengthening Resilience to Shocks:** In addition to strengthening livelihood assets, it is crucial to build resilience to economic and environmental shocks. This can be achieved through the diversification of income sources, promoting small-scale entrepreneurship, and enhancing access to sustainable markets for various products to buffer households against seasonal agricultural fluctuations. Strengthening disaster risk reduction measures, such as providing climate-resilient technologies, early warning systems, and training on climate-smart agricultural practices, will also help reduce vulnerability to shocks like floods and droughts [33].
3. **Improving Social Support Systems:** Government and NGO support programs should be timely, adequate, and consistent. Ensuring that support reaches vulnerable populations in remote areas is essential. Additionally, targeted interventions, such as extension services and input distribution, should be implemented to

ensure support reaches those most in need [39].

While this study provides valuable insights into the pathways to food security in North Central Nigeria, there are some methodological limitations that should be considered. The cross-sectional design of the study limits causal inference, as it provides only a snapshot of the situation at a specific point in time [35]. Future studies could adopt a longitudinal design to track changes in food security, assets, and livelihood strategies over time [40]. Although the study captured a wide range of shocks including economic, climatic, and market-related shocks, future research could examine how these shocks interact and their cumulative impact on food security [41]. Research could explore the compounded effects of multiple shocks and investigate how households prioritize different livelihood strategies in response to simultaneous challenges [42]. Future research could also explore the long-term impact of climatic shocks and market volatility on household food security, particularly in the context of climate change [43, 44]. Additionally, research could investigate the effectiveness of policy interventions aimed at enhancing livelihood diversification, market access, and climate resilience [31]. Comparative studies between different zones or farming systems in Nigeria would provide further insights into the factors that influence food security outcomes [45]. Moreover, qualitative research could explore the gendered dimensions of food security, focusing on the specific challenges faced by women and youth in accessing resources, livelihood strategies, and market opportunities. This would contribute to a more inclusive understanding of food security and inform gender-sensitive policies [46].

Conclusion

This study highlights the key role of livelihood assets in improving food security among farming households in North Central

Nigeria. Exposure to shocks, particularly economic and climatic disruptions, remains a major factor contributing to food insecurity. While livelihood activities did not show a direct statistical relationship with food security in this study, they still provide important support to households, particularly during off seasons. Policies should focus on strengthening household assets, improving market access, and ensuring effective external support to mitigate the impacts of shocks and improve food security outcomes

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Ethical Approval

Ethical approval for this study was obtained from the research and ethics committees of the respective State Ministries of Health, as well as from the FCT Health Research Ethics Committee. All participants provided informed consent before their involvement in interviews.

Data Availability

The GHS-Panel data used for the quantitative analysis is publicly available (<https://microdata.nigerianstat.gov.n>

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[g/index.php/catalog/82](http://www.texila.com/index.php/catalog/82)). Qualitative data were collected through semi-structured interviews guide across the North Central zone of Nigeria. De-identified qualitative data are available from the corresponding author upon reasonable request.

Author Contributions

Blessing Ukamaka Ugwunne conceptualized and designed the study, led the qualitative data collection process, conducted data analysis, and wrote the manuscript. Olutayo Adeyemi provided guidance on the study's conceptualization and design, contributed to the data analysis, and reviewed the manuscript. Both authors approved the final manuscript for submission.

Funding

This study was supported by the Global Alliance for Improved Nutrition (GAIN). The funder had no role in the study design, data collection, analysis, or manuscript preparation.

Acknowledgements

The authors gratefully acknowledge the Global Alliance for Improved Nutrition (GAIN) for supporting this study.

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