

Credit constraints and food insecurity: A study of smallholder farmers in Southwest Nigeria

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Paper history:

Received 22 October 2025

Accepted in revised form 17 December 2025

Keywords

Food insecurity; credit constraints; smallholder farmers; FGT index; logit model; Southwest Nigeria.

Abstract

Access to credit plays a critical role in improving agricultural productivity and household welfare, yet many smallholder farmers in Nigeria remain credit constrained. This study examines the effect of credit constraints on household food insecurity and coping strategies among smallholder farming households in Southwest Nigeria. Primary data were collected from 240 farming households using a structured questionnaire. Household food security status was assessed using the Foster–Greer–Thorbecke (FGT) index, while a logit regression model was employed to identify the determinants of food security. The results show that 56% of the sampled households were food insecure, indicating a high prevalence of food insecurity among smallholder farmers. Income and landholding size had positive and significant effects on food security, while household size negatively influenced food security. Male-headed households were more likely to be food secure than female-headed households. Credit constraints were strongly associated with higher levels of food insecurity, and severely constrained households relied more on adverse coping strategies such as skipping meals and reducing food intake. The study concludes that credit constraints significantly worsen food insecurity among smallholder farmers. Policies that promote inclusive rural finance, secure land access, and strengthen farmer organizations are essential for improving food security and reducing vulnerability in rural Nigeria.

Nomenclature and units

Income (₦)

1.0. Introduction

Smallholder agriculture remains the backbone of rural livelihoods in Sub-Saharan Africa, yet access to credit continues to be a major constraint limiting productivity and welfare outcomes. Most smallholder farmers are excluded from formal financial markets due to lack of collateral, weak institutional frameworks, high transaction costs, and the perceived risk associated with rain-fed agriculture (Feder et al., 1985). As a result, rural households often depend on informal sources of credit such as money lenders, traders, friends, and relatives. Although informal credit is more accessible, it is typically characterized by high interest rates or unfavorable repayment conditions, which reduce farmers' ability to invest in improved seeds, fertilizers, and modern technologies necessary for agricultural transformation (Akudugu et al., 2011).

Access to rural finance plays a critical role in enhancing agricultural productivity and improving household welfare. Credit enables farmers to smooth consumption, manage production risks, and increase farm output, thereby strengthening income stability (FAO, 2010). In agrarian economies where food access is closely linked to income, improved financial access directly influences household food security. Empirical evidence shows that households with access to credit are more likely to be food secure than credit-constrained households, as income gains from productive investments improve purchasing power and resilience against seasonal shocks (Ahmed et al., 2017). Conversely, credit constraints limit households' ability to respond to price volatility, crop failure, and unexpected expenditures, increasing their vulnerability to food insecurity.

The linkage between rural finance and food security is particularly strong among smallholder farmers whose livelihoods depend heavily on agriculture. Financial exclusion often reinforces existing poverty traps, as low income restricts access to credit, while limited credit access further suppresses productivity and income growth. This cycle contributes to persistent food insecurity, especially during lean seasons when food prices rise and household stocks are depleted (World Bank, 2017). Studies across developing countries have shown that improving access to financial services can significantly reduce food insecurity by enabling households to invest in both production and consumption-smoothing strategies.

In response to food shortages, households adopt various coping strategies to manage consumption gaps. Common strategies include skipping meals, reducing meal size or frequency, purchasing food on credit, and selling assets (Maxwell et al., 2008). While these strategies provide short-term relief, repeated reliance on adverse coping mechanisms can undermine nutritional status, reduce productive capacity, and increase long-term vulnerability. Credit-constrained households are more likely to adopt severe coping strategies, as they lack access to formal financial buffers that could help stabilize consumption during periods of stress.

Despite the extensive literature on agricultural credit and food security, important empirical gaps remain. Many studies focus either on access to credit or food security outcomes without explicitly examining how credit constraints influence food insecurity and coping behavior simultaneously. In addition, limited attention has been given to combining expenditure-based food security measures with econometric models that identify key

socioeconomic determinants among smallholder farmers. In the Nigerian context, particularly in Southwest Nigeria, empirical evidence linking credit constraints, food security status, and household coping strategies remains scarce. This study contributes to the literature by integrating these dimensions within a single analytical framework, thereby providing policy-relevant insights into how easing credit constraints can improve food security outcomes among smallholder farming households.

2.0 Methodology

2.1 Area of Study

This study was conducted in Southwest Nigeria, comprising Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti States. The region lies between latitudes 4°–14°N and longitudes 3°–14°E and is characterized by a tropical climate with distinct rainy and dry seasons. Agriculture remains the dominant livelihood activity, with food crop production forming the backbone of rural economies. Based on agrarian intensity and food crop dominance, Ogun, Oyo, and Osun States were selected for detailed analysis.

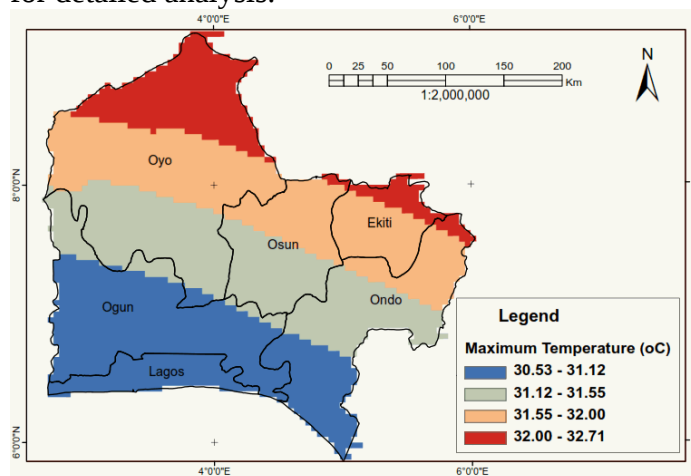


Figure 1: Map of South-west Nigeria

2.2 Study Design, Sampling Procedure, and Sample Size Determination

2.2.1 Sampling Procedure

A cross-sectional research design was adopted. A multistage sampling technique was employed as follows:

Stage I: Three states (Ogun, Oyo, and Osun) were randomly selected from the six states in Southwest Nigeria.

Stage II: Five Local Government Areas (LGAs) were purposively selected from each state based on their prominence in maize and bean production, resulting in fifteen (15) LGAs.

Stage III: One agrarian village was randomly selected from each LGA, giving a total of fifteen (15) villages. The villages exhibited relatively homogeneous farming systems, making them suitable for comparative analysis.

Stage IV: From each village, sixteen (16) smallholder farmers were randomly selected using farmer association registers, yielding a total sample size of 240 respondents.

2.2.2 Sample Size Justification

The sample size was justified using Yamane's (1967) formula:

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

where:

n = required sample size,

N = total population of smallholder farmers in the study area,

e = margin of error (precision level).

Assuming a 95% confidence level and a 5% margin of error (), the formula was applied to the total population of registered smallholder farmers in Southwest Nigeria. Substituting the relevant values into the equation yielded a minimum sample size of 240 households, which was subsequently used for the survey. This sample size is considered adequate to ensure representativeness and statistical reliability of the findings.

2.3 Data Collection Techniques

Primary data were collected using structured questionnaires complemented by Focus Group Discussions (FGDs). The questionnaire captured information on socioeconomic characteristics, farm attributes, credit access, food consumption patterns, and coping strategies.

FGDs were conducted to:

- validate questionnaire items,
- identify locally relevant food insecurity indicators,
- guide variable selection for econometric analysis.

Qualitative insights were used for contextual interpretation but were not pooled with quantitative regression analysis. Data collection was conducted between January 2023 and November 2024.

2.4 Analytical Framework

2.4.1 Conceptual and Theoretical Framework

This study is anchored on established theories that explain credit access, household production decisions, and food security outcomes among smallholder farmers.

First, the Credit Rationing Theory proposed by Stiglitz and Weiss (1981) provides a core theoretical foundation. The theory posits that due to information asymmetry and risk, financial institutions may limit loan supply or impose stringent conditions even when borrowers are willing to pay higher interest rates. In the context of smallholder farmers, this results in exclusion from formal credit markets, compelling farmers to rely on informal lenders with high interest rates. This theory explains the observed relationship between credit constraints and food insecurity in the study area.

Second, the Agricultural Household Model links production, consumption, and labor decisions within the household. According to this model, farm households simultaneously make decisions about resource allocation, production, income generation, and food consumption. Credit constraints disrupt these decisions by limiting farmers' ability to invest in productive inputs, thereby reducing output, income, and ultimately household food security.

Third, the Sustainable Livelihoods Framework emphasizes the role of access to assets—human, financial, physical, social, and

natural capital—in shaping livelihood outcomes. Credit access constitutes a key component of financial capital that enhances households' capacity to withstand shocks, smooth consumption, and adopt improved farming practices. Limited access to credit weakens livelihood resilience and increases vulnerability to food insecurity.

Finally, the Financing Gap Theory highlights the mismatch between the financial needs of smallholder farmers and the credit supplied by formal financial institutions. This gap explains persistent reliance on informal credit sources and underscores the structural barriers preventing adequate financing of small-scale agriculture.

Based on these theoretical perspectives, the study conceptualizes food security as an outcome influenced by credit access, household socio-demographic characteristics, and farm-related factors. Credit constraints affect food security both directly—by limiting households' ability to purchase food—and indirectly—by reducing agricultural productivity and income. Household characteristics such as sex of household head, family size, income, and land ownership further mediate this relationship.

2.4.2 Foster–Greer–Thorbecke (FGT) Food Insecurity Index

Food insecurity was measured using the Foster–Greer–Thorbecke (1984) index:

$$P\alpha = 1/n \sum_{i=1}^q \left(\frac{z-y_i}{z}\right)^\alpha \text{-----ii}$$

where:

N = total population size

Q = number of individuals with income (or consumption) $y_i < z$

y_i = income (or consumption) of the i-th poor individual

z = poverty line

$\alpha \geq 0$ = poverty aversion parameter

$\alpha=0 \rightarrow$ Headcount Ratio

$$P_0 = \frac{q}{N} \text{-----iii}$$

$\alpha=1 \rightarrow$ Poverty Gap Index

$$P_1 = \frac{1}{N} \sum_{i=1}^q \frac{z-y_i}{z} \text{-----iv}$$

$\alpha=2 \rightarrow$ Squared Poverty Gap Index

(gives more weight to the poorest)

$$P_2 = \frac{1}{N} \sum_{i=1}^q \left(\frac{z-y_i}{z}\right)^2 \text{-----v}$$

2.4.3 Logit Regression Model

The logit model assumes that a household's likelihood of achieving food security is determined by an underlying index, which is connected to the probability through a logistic distribution function.

$$P_i(y) = f(Z_i) P_i = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}} \text{-----vi}$$

$$1 - P_i = \frac{1}{1 + e^{-Z_i}} \text{-----vii}$$

The equation can be written as:

$$\frac{P_i}{1-P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} \text{-----viii}$$

Taking the natural logarithm of both sides of the equation yields:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_1 + \beta_2 X_1 \dots \dots \dots \beta_k X_k + U_i - \dots \dots \dots ix$$

Let Z denote a vector of factors affecting household food security, beta (β) represents the corresponding regression coefficients, and U signify the error term.

The equation is written in an explicit form as

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \dots + \alpha_n X_n + \varepsilon \dots \dots \dots x$$

2.4.4 Definition of Variables

Food Security (Y): 1 = food secure, 0 = food insecure

X₁ = Age of household head - Years of household head

X₂ = Sex of household head - 1 = male, 0 = female

X₃ = Household size - Number of household members

X₄ = Marital status

X₅ = Land ownership - 1 = owns land, 0 = rents/leases

X₆ = Educational level - Years of formal schooling

X₇ = Income - Annual household farm income (₦)

X₈ = Group membership - 1 = member of farmer group, 0 = otherwise

X₉ = Farm size - Hectares cultivated

X₁₀ = Credit constraint - 1 = constrained, 0 = unconstrained

X₁₁ = Preferred Credit Source: 1 = formal (commercial banks, microfinance banks, agricultural development banks), 0 = informal (money lenders, friends, cooperatives)

3.0. Results and Discussion

3.1. Demographic Features of the Respondents

The survey revealed that smallholder food crop farming is predominantly male-dominated, with 77.1% of households headed by men and 22.9% by women, consistent with previous research (Jimoh & Haruna, 2007). The age profile revealed that 38.3% of farmers fell within the 21-40 age range, while 16.3% were over 60, with an average age of around 42 years indicating that most farmers are in their active age and likely to engage in farming activities. (see Table 1).

Table 1: Demographic Features of the Respondents

Feature	Frequency	Percentage
Age group		
<20	41	17.1
20 – 39	92	38.3
40 – 59	68	28.3
60 – 79	30	12.5
> 80	9	3.8
Gender		
Male	180	75.0
Female	60	25.0
Marital status		
Not married	19	7.9
Married	147	61.3
Formerly married	25	10.4
Widowed	49	20.4
Education		
Without schooling	81	33.8

Elementary education	99	41.2
High school	40	16.7
Higher education	20	8.3
Main job		
Agriculture	135	56.3
Commerce	62	25.8
Government work	43	17.9

Source: Field survey, 2024

The study's outcomes corroborate Famuyide et al.'s (2013) findings, which indicated that 67% of respondents were aged 31-50. In terms of marital status, the majority (60%) were married, and a minority (5%) were unmarried. Married farming households may have an advantage in terms of family labor, potentially enhancing productivity compared to single households that rely on hired labor (Amusa & Jimoh, 2012).

The education level of household heads was relatively low, with 33% without formal schooling, 43% primary education, 17.5% secondary education, and 4% tertiary education. This suggests that most farmers were semi-literate, unable to read or write with ease. This finding contrasts with Ayanwuyi (2013), who reported that rural farmers in Surulere Local Government area of Oyo State were well-educated.

In terms of primary occupation, 56.3% of farmers identified farming as their main source of livelihood, while 25.8% and 17.9% combined farming with trading and civil service, respectively. All respondents engaged in small-scale food crop production to supplement their household food needs.

3.2 Food Security Status

This study employed the Foster–Greer–Thorbecke (FGT) index to assess the incidence, depth, and severity of food insecurity among smallholder farming households in Southwest Nigeria. The total per capita household expenditure was ₦1,898,219.80, with a mean per capita household expenditure of ₦9,149.13. The food insecurity line was defined as two-thirds of the mean per capita household expenditure, yielding a threshold of ₦6,099.42. Households with per capita expenditure below ₦6,099.42 were classified as food insecure, while those with expenditure equal to or above this threshold were considered food secure.

Table 2: Level of Food Insecurity

FGT Index	Estimate
Headcount ratio (F ₀)	0.56
Food insecurity gap (F ₁)	0.07
Severity of food insecurity (F ₂)	0.05

Source: Field survey, 2024

The findings from the Foster–Greer–Thorbecke (FGT) index indicate that food insecurity remains a critical challenge among smallholder farming households in Southwest Nigeria. With 56% of households classified as food insecure, the results suggest that more than half of the sampled farmers are unable to meet minimum dietary requirements. The observed food insecurity gap (0.07) implies that food-insecure households would require an average increase of 7% in per capita expenditure to reach the food

security threshold, while the severity index (0.05) reflects the presence of extreme deprivation among the most vulnerable households. These findings are consistent with earlier studies in developing-country contexts where smallholder farmers face chronic income and consumption constraints (Mequanent et al., 2014; Tantu et al., 2017).

3.3 Household Food Security Characteristics

Although all sampled households engaged in agricultural activities, farming was not the sole source of livelihood for many respondents. As shown in Table 3, about 75% of households relied primarily on farming, while 20.8% depended on trade and 4.2% on remittances or transfers.

Meal frequency further reflects household food security conditions. About 52.1% of respondents consumed two meals per day, 32.1% consumed three meals, while 15.8% survived on one meal daily, indicating constrained access to adequate food.

Table 3: Household Food Security Indicators

Variable	Frequency	Percentage
Primary source of livelihood		
Farming	180	75.0
Trade	50	20.8
Remittances	10	4.2
Daily meal frequency		
One meal	38	15.8
Two meals	125	52.1
Three meals	77	32.1
Food crisis period		
Jan–Mar (Q1)	60	25.0
Apr–Jun (Q2)	61	25.4
Jul–Sep (Q3)	14	5.8
Oct–Dec (Q4)	105	43.8
Adaptation strategies		
Food abstinence	126	52.5
Food rationing	49	20.4
Buying food on credit	65	27.1
Food availability constraints		
Poor child nutrition	67	27.9
Time constraints for cooking	17	7.2
Financial constraints	100	41.6
Meal preparation challenges	56	23.3

Source: Field survey, 2024

Household size was found to negatively and significantly influence food security, indicating that larger households are more likely to experience food insecurity. This result is expected, as increased household size raises consumption needs without a proportional increase in income or productivity, especially where dependency ratios are high. Conversely, male-headed households were more likely to be food secure than female-headed households, reflecting gender-based disparities in access to productive resources, credit, and income-generating

opportunities. Similar findings have been reported in previous studies across sub-Saharan Africa (Twaha, 2015).

Income and land ownership exerted positive and significant effects on food security. Higher income enhances households' ability to purchase food and absorb shocks, while land ownership provides a stable production base and strengthens farmers' asset portfolios. These results reinforce the relevance of the Sustainable Livelihoods Framework, which highlights the importance of asset accumulation in reducing vulnerability and improving welfare outcomes.

3.4 Food Shortage and Coping Strategies

Food shortages were most prevalent during the dry season (October–March), with 68.8% of households reporting food deficits during this period. Other households experienced shortages between April and June (25.4%) and July to September (5.8%), depending on cropping patterns and production cycles.

Food insecurity significantly affected household welfare, resulting in financial stress (41.6%), poor child nutrition (27.9%), meal preparation challenges (23.3%), and limited time for cooking (7.2%). To cope with food shortages, households adopted strategies such as skipping meals (52.5%), purchasing food on credit (27.1%), and reducing portion sizes (20.4%), consistent with earlier findings (Abur, 2014).

3.5 Relationship between Credit Constraints and Food Insecurity

Table 4 shows an inverse relationship between credit constraints and food security among smallholder farmers. As credit constraints intensify, the proportion of food-secure households declines, while food insecurity increases.

Table 4: Relationship between Credit Constraints and Food Insecurity

Credit constraint level	Food security status	Frequency	Percentage
No constraint	Food secure	179	74.58
	Food insecure	61	25.42
Mild constraint	Food secure	135	56.25
	Food insecure	105	43.75
Severe constraint	Food secure	31	12.92
	Food insecure	209	87.08

Source: Field survey, 2024

Households facing severe credit constraints recorded the highest food insecurity rate (87.08%), compared to mildly constrained (43.75%) and unconstrained households (25.42%). This pattern underscores the central role of credit in smoothing consumption, financing agricultural inputs, and mitigating seasonal food shortages. Credit-constrained households are less able to invest in improved seeds, fertilizers, and technologies, leading to lower productivity and income, which ultimately translates into reduced food availability and access.

Despite the high interest rates charged by informal money lenders, many farmers continue to patronize them. This seemingly irrational behavior can be explained by urgency of need, ease of access, absence of collateral requirements, and delays associated with formal lending institutions. For many smallholder farmers, informal credit serves as a last resort during periods of acute food

shortages or production shocks, even though it exacerbates long-term vulnerability.

3.6 Coping Strategies by Credit Constraint Level

Table 5 presents coping strategies adopted by households across different levels of credit constraints. Households with severe credit constraints predominantly relied on skipping meals (50.2%) as a coping strategy, while reducing meal quantity or frequency was more common among mildly constrained (27.2%) and severely constrained (23.4%) households compared to unconstrained households (7.5%).

Table 5: Coping Strategies by Credit Constraint Level (%)

Coping strategy	No constraint	Mild constraint	Severe constraint
Reduce meal quantity/frequency	7.5	27.2	23.4
Purchase food on credit	10.0	35.0	26.4
Skipping meals	12.0	37.8	50.2

Source: Field survey, 2024

The increasing reliance on adverse coping mechanisms as credit constraints worsen underscores the vulnerability of severely constrained households and the potential negative implications for nutrition and health outcomes.

Overall, the findings demonstrate that credit constraints are a major driver of food insecurity among smallholder farmers. Addressing these constraints through inclusive rural finance, improved land tenure systems, and strengthened farmer institutions is essential for enhancing food security and sustainable agricultural development.

3.7 Determinants of Food Insecurity

The logit regression results reveal that household food security is significantly influenced by socioeconomic and resource-related factors. The overall model is statistically significant (LR $\chi^2 = 129.02$, $p < 0.01$), indicating that the included variables jointly explain variations in household food security status. The McFadden Pseudo R^2 of 0.620 suggests a strong explanatory power of the model.

Table 6: Logit Estimates of Determinants of Food Security (Logit Model, STATA)

Variable	Coefficient (β)	Std. Error	z-value	p-value	Marginal Effect (dy/dx)
Sex	0.5942*	0.3566	1.67	0.096	0.1450* (0.0869)
Education (years)	0.3800	0.3330	1.14	0.254	0.3401 (0.2634)
Income	0.71228**	0.0206	34.58	<0.001	6.20e-07 (0.0000)

Group membershi	0.3402	0.8102	0.42	0.674	16.8310 (0.2354)
Landholdin	2.0214*	0.0580	34.8	<0.001	0.2261* (0.0527)
Family size	-0.1424*	0.0580	-2.4	0.014	-0.332* (0.0527)
Farm acreage	0.4360	0.4410	0.99	0.323	0.3830 (0.8031)
- Log likelihood = -15.981 - LR chi-square = 129.02 ($p < 0.01$) - McFadden Pseudo $R^2 = 0.620$ - Number of observations = 240					

Source: Field survey, 2024

Notes: Standard errors are in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. Marginal effects are evaluated at sample means, consistent with STATA logit margins output.

The positive and highly significant effect of household income on food security is consistent with established evidence that income enhances households' purchasing power and ability to access adequate food (FAO, 2008; Ahmed et al., 2017). This confirms that income growth remains central to improving food security outcomes in rural households.

The significant role of landholding size aligns with findings by Asfaw et al. (2012) and Kassie et al. (2015), who report that access to land and productive assets increases agricultural output, promotes crop diversification, and strengthens household resilience against food shortages.

The negative effect of family size on food security supports earlier studies indicating that larger households face increased dependency burdens, which reduce per capita food availability when resources are limited (Amaza et al., 2009).

The positive influence of sex of the household head, favoring male-headed households, is consistent with Quisumbing et al. (2014), who document persistent gender disparities in access to land, credit, and extension services that disadvantage female-headed households in achieving food security.

Although education and group membership were not statistically significant, their positive coefficients align with literature suggesting that education improves decision-making and technology adoption, while collective action enhances access to information and resources (Asfaw et al., 2012; Kassie et al., 2015). Their lack of significance may reflect contextual differences in education quality and institutional effectiveness.

4.0 Conclusion

This study examined the food security status, coping strategies, credit constraints, and determinants of food security among smallholder farming households in Southwest Nigeria. The findings reveal that food insecurity remains widespread, with more than half of the sampled households classified as food insecure. The Foster–Greer–Thorbecke indices further indicate not only a high incidence of food insecurity but also the presence of depth and severity, suggesting that a substantial proportion of households experience chronic and extreme deprivation.

Demographic and socioeconomic characteristics play a critical role in shaping food security outcomes. Smallholder farming in

the study area is predominantly male-dominated, with most household heads in their economically active years but possessing relatively low levels of formal education. While farming remains the primary livelihood for most households, diversification into non-farm activities is common, reflecting efforts to supplement income and manage risk.

The study demonstrates that household income and landholding size significantly enhance food security, confirming the importance of productive assets and income-generating capacity in ensuring access to adequate food. In contrast, larger household sizes reduce the likelihood of food security due to increased consumption pressure and high dependency ratios. Gender disparities persist, with male-headed households being more food secure than female-headed households, largely due to unequal access to land, credit, and other productive resources.

Food shortages were found to be highly seasonal, particularly during the dry season, compelling households to adopt negative coping strategies such as skipping meals, reducing portion sizes, and purchasing food on credit. These strategies, while necessary for short-term survival, have adverse implications for nutrition, health, and long-term welfare.

A key contribution of the study is the identification of credit constraints as a major driver of food insecurity. Severely credit-constrained households exhibit the highest levels of food insecurity and reliance on adverse coping mechanisms. Despite the high cost of informal credit, many farmers depend on it due to accessibility and urgency, highlighting significant gaps in formal rural financial systems.

Overall, the findings underscore that food insecurity among smallholder farmers is a multifaceted problem driven by limited income, inadequate access to land and credit, large household sizes, gender inequalities, and seasonal production shocks. Addressing these challenges requires integrated policy interventions that strengthen livelihoods, improve access to productive resources, and reduce vulnerability.

This study has some limitations. It uses cross-sectional data, which makes it difficult to show cause-and-effect relationships or capture changes in food security over time. In addition, food security was measured using household expenditure, which may not fully reflect nutritional quality or how food is shared within households.

Future studies should use panel or longitudinal data to better understand changes in food security across seasons and years. Including nutrition indicators such as dietary diversity or child nutrition measures would give a more complete picture of food security. Further research could also examine gender-specific challenges and assess the impact of improved credit programs on smallholder farmers.

5.0. Policy Implications and Recommendations

5.1 Inclusive rural finance reform
The strong association between credit constraints and food insecurity implies that existing rural financial systems inadequately serve smallholder farmers. Policymakers should reform agricultural credit schemes to expand coverage, reduce collateral requirements, and improve loan timeliness, particularly during lean seasons.

5.2 Land tenure security and gender equity
The positive effect of landholding on food security highlights the need for policies that strengthen land access and tenure security. Gender-sensitive land reforms are especially critical to reduce disparities faced by female-headed households.

5.3 Livelihood diversification and rural employment
Given the role of income in improving food security, policies that promote rural non-farm employment, agro-processing, and value-chain development can enhance income stability and reduce vulnerability to seasonal food shortages.

5.4 Seasonal social protection mechanisms
The seasonal nature of food insecurity underscores the importance of targeted social protection policies, such as conditional cash transfers or food assistance during periods of acute shortage.

6.0 Practical Recommendations

6.1 Farmer-friendly credit products
Financial institutions should design flexible loan products aligned with agricultural production cycles, featuring reduced collateral requirements and repayment schedules that reflect seasonal income flows.

6.2 Strengthening farmer organizations
Development agencies and NGOs should build the capacity of farmer groups to improve access to credit, extension services, and markets, thereby enhancing collective bargaining power and resilience.

6.3 Promotion of nutrition-sensitive agriculture
Programs encouraging crop diversification, home gardening, and nutrition education can improve dietary quality and reduce reliance on adverse coping strategies.

6.4 Financial literacy and household resilience
Training in savings, credit management, and household budgeting should accompany credit interventions to maximize their effectiveness and strengthen household resilience to shocks.

Declaration of Conflict of Interest

All authors were actively involved in the formulation of the research idea, study design, and implementation of the work. They also participated in writing the manuscript and conducting thorough critical revisions to ensure substantial scholarly contribution. This work has not been submitted to, nor evaluated by, any other journal or publication outlet. The authors declare that they have no personal or financial relationships with any entities that could be perceived as influencing the research presented in this manuscript.

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