DETERMINANTS OF FARM HOUSEHOLDS' RESILIENCE TO FOOD INSECURITY IN ABEOKUTA, OGUN STATE, NIGERIA

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Abstract
Food insecurity remains a major challenge confronting farm household, particularly in rural areas where livelihoods depend heavily on agriculture. This study examined the determinants of farm households' resilience to food insecurity, emphasizing that resilience involves not only coping with shocks but also the ability to recover and adapt sustainably. Primary data were collected from a cross-section of 120 farm households, and the analysis explored how socioeconomic, institutional, and livelihood factors influence resilience outcomes. A Tobit regression model was employed to identify the key determinants of resilience. The findings revealed that households adopt various food-based coping strategies, including dietary adjustments and meal reduction, depending on the severity of food insecurity. Several factors were found to significantly enhance resilience. Access to productive assets ($\beta = 0.009$, $p < 0.01$) and social safety nets ($\beta = 0.012$, $p < 0.05$) had strong positive effects, indicating that asset ownership and participation in social protection programs improve households' ability to absorb and recover from shocks. Education level and income diversification were also positively associated with resilience, suggesting that more educated and economically diversified households are better equipped to manage risks and maintain food security. The constant term ($\beta = 9.371$, $p < 0.01$) reflects a baseline level of resilience among households. Results show that resilience to food insecurity is multidimensional, shaped by material, human, and social capital. The study concludes that strengthening asset ownership, expanding social protection, and promoting education and livelihood diversification are critical for building resilient farm households capable of sustaining food security amid uncertainty.

Keywords: Capacity, Diversification; Multidimensional; Safety nets; Stress

Introduction
In Sub-Saharan Africa, and particularly in Nigeria, food insecurity remains a significant development concern despite decades of agricultural interventions. Many rural households continue to experience cyclical hunger, low productivity, and high vulnerability to climate and market shocks (Adebayo *et al.*, 2020; Olayemi *et al.*, 2022).

Despite numerous efforts to improve agricultural productivity and food access in Nigeria, food insecurity persists among farm households, especially in rural areas. Households experience recurrent exposure to shocks ranging from erratic rainfall patterns, pest outbreaks, and land degradation to market volatility and inadequate access to productive resources. These shocks not only disrupt food availability and income stability but also erode the coping capacities of households over time (Barrett and Constas, 2014).

While some studies have focused primarily on the causes and extent of food insecurity, limited attention has been given to the

underlying factors that determine the *resilience* of farm households, their ability to recover and adapt sustainably in the face of adversity. Factors such as asset ownership, access to credit, education, social networks, and livelihood diversification may significantly shape resilience levels, yet the specific contributions of these determinants vary across contexts (Deressa *et al.,* 2019; Darnhofer, 2021).

The absence of comprehensive, empirical evidence on what drives resilience among farm households in Nigeria presents a major gap in both research and policy. Without such understanding, interventions risk remaining reactive rather than proactive, focusing on short-term relief rather than building lasting capacity to withstand future shocks.

The measurement of resilience to food insecurity is guided by the FAO Resilience Framework, which conceptualizes resilience as households' capacity to absorb, adapt to, and transform in the face of shocks while maintaining acceptable food security outcomes. The framework integrates livelihood assets, exposure to shocks, response strategies, and food security outcomes into a unified analytical structure (FAO, 2016; Constas *et al*., 2014). Hence, this study examined the socioeconomic determinants of farm households' resilience to food insecurity, providing insights that can inform targeted, context-specific strategies for strengthening rural livelihoods. Specifically, this study:

1. Assess the food insecurity status of the farm households.
2. Assess the level of resilience of farm households to food insecurity.
3. Examine the socioeconomic, institutional, and environmental factors influencing the resilience of farm households to food insecurity.

Materials and methods

Study area: This study was carried out in Abeokuta, Ogun State. Abeokuta is the capital city of Ogun State in southwestern Nigeria, located in the tropical zone of West Africa. It lies in a transitional ecological zone between forest and savanna. Latitude is approximately 7°09′ N to 7°14′ N, and Longitude is approximately 3°15′ E to 3°26′ E. The city is situated on the east bank of the Ogun River, about 80 km north of Lagos, with an undulating terrain punctuated by granite outcrops and knolls typical of the Nigerian basement complex. Abeokuta's climate is tropical wet and dry (savanna), characterized by alternating rainy and dry seasons. Abeokuta lies in a forest–savanna transition zone, which supports significant agricultural activity. Abeokuta's environment, with water sources like the Ogun and Oyan rivers and a moderate tropical climate, supports livestock rearing as well as crop farming, making the area important for food production and rural livelihoods.

Study Data: Primary data was used for this study, collected through the administration of a questionnaire to household heads in the communities of Abeokuta ADP, Zone.

Sampling Techniques: A Multistage sampling procedure was used to collect a cross-section of 120 farm households in the study area.

i. Stage One: Random selection of the Abeokuta Agriculture Development Program zone out of the four (4) Agricultural zones in Ogun State.
ii. Stage Two: Random selection of two (2) blocks from the zone.

iii. Stage Three: Random selection of 6 cells in each of the blocks, making a total of 12 cells.
iv. Stage Four: Random selection of 1 farming community in each of the selected cells, making a total of 12 farming communities.
v. Stage Five: Random selection of ten (10) farm households in each of the selected farming communities, making a total of 120 farm households. (1*2*6*1*10=120 farm households).

Analytical Techniques: Both descriptive and inferential statistics were used to analyze the data for this study.

Descriptive statistics were used to describe the socioeconomic characteristics of the respondents. The Coping Strategy Index (CSI) was used to assess the food insecurity status of farm households. The Coping Strategy Index (CSI) is a behaviour-based analytical tool used to assess the severity of food insecurity at the household level. It is based on the frequency and perceived severity of the strategies households adopt when faced with food shortages. The CSI translates qualitative coping behaviors into a quantitative index, allowing for statistical comparison and analysis.

A list of common food-related coping behaviours is generated through household surveys or focus group discussions (e.g., eating less preferred food, reducing meal size, borrowing food, or skipping meals). Respondents indicate how often each strategy was used over a recall period (usually 7 days). Frequencies are coded as:

i. 0 = Never
ii. 1 = Rarely (1–2 times per week)
iii. 2 = Sometimes (3–6 times per week)
iv. 3 = Often (daily)

Each coping strategy is assigned a severity weight (ranging from 1 to 4) based on its seriousness, usually determined through expert judgment or participatory ranking. The CSI score for each household is calculated as:

$$CSI = \sum_{i=1}^{n} (F_i - W_i) \qquad (1)$$

Where:

F_i = frequency of coping strategy i

W_i = severity weight of coping strategy i

n = total number of coping strategies

Table 1 presents the most widely used standard coping strategies indicators developed by the Food and Agriculture Organization (FAO, 2008) for assessing household responses to food insecurity. These indicators are commonly applied in the construction of the Coping Strategies Index (CSI), with each strategy assigned a severity weight based on its relative impact on household welfare.

Table 1: Standard Coping Strategies Indicators and Severity Weights

Coping Strategy	Description	Severity Weight
Relying on less preferred and less expensive foods	Diet quality reduction	**1**
Borrowing food or relying on help from friends/relatives	Social coping	**2**
Limiting portion sizes at mealtimes	Intake reduction	**1**
Restricting consumption by adults so that children can eat	Protective but erosive	**3**
Reducing the number of meals eaten in a day	Quantity reduction	**2**

FAO (2008)

These coping strategies reflect a progression in the severity of food insecurity, ranging from dietary compromise to more severe consumption adjustments. Lower-weight strategies (e.g., reliance on less preferred foods) indicate mild food stress, while higher-weight strategies (e.g., restricting adult consumption) signal more severe household vulnerability.

The resulting CSI score reflects the extent of food insecurity, where low CSI implies more food-secure households, and High CSI implies more food-insecure households. Descriptive statistics (mean, range, standard deviation) are used to summarize CSI values. Higher CSI values indicate greater reliance on distress coping behaviors and thus higher food insecurity. The index can be used comparatively across groups, seasons, or interventions to monitor food security trends and evaluate program impacts (Maxwell and Caldwell, 2008; Coates *et al.*, 2006).

The Food Insecurity Resilience Index (FIRI) is a composite indicator used to quantify how well a household or community can anticipate, absorb, adapt to, and recover from food insecurity shocks. It provides an integrated measure that captures the multidimensional nature of resilience, recognising that resilience is not merely about having food today, but about sustaining food security in the face of stress and change.

The FIRI is typically constructed using Principal Component Analysis (PCA) or similar multivariate statistical methods to combine several proxy indicators into a single, standardized index. The FIRI is built on the three dimensions of resilience capacity (Alinovi *et al.*, 2010; Béné *et al.*, 2016; FAO, 2018):

i. Absorptive Capacity: The ability of households to withstand and buffer the immediate impacts of shocks (e.g., access to savings, food storage, social support).
ii. Adaptive Capacity: The ability to make incremental adjustments to livelihoods and food systems (e.g., education, income diversification, use of improved inputs).
iii. Transformative Capacity: The ability to create enabling environments that support long-term change and reduce vulnerability (e.g., access to credit, infrastructure, governance structures).

These capacities are represented by measurable indicators drawn from socioeconomic, institutional, environmental, and livelihood dimensions. Since the chosen indicators have different units of measurement, they are standardized to ensure comparability using the z-score method:

$$Z_{ij} = \frac{X_{ij} = X_i}{S_i} \qquad (2)$$

Where:

Z_{ij}= standardized value of indicator *i* for household *j*

X_{ij} = original value of indicator *i* for household *j*

X_i = mean of indicator *i*

S_i = standard deviation of indicator *i*

PCA is applied to the standardized indicators to identify principal components that explain the largest proportion of variance in the data.

Components with eigenvalues greater than 1.0 (Kaiser Criterion) are retained. Each component represents a dimension of resilience. The factor loadings (weights) indicate the contribution of each indicator to the component.

The Food Insecurity Resilience Index (FIRI) for each household is computed as a weighted sum of the retained components:

$$FIRI_j = \sum_{k=1}^{m} (W_k * PC_{jk}) \quad (3)$$

Where:

$FIRI_j$ = resilience index for household *j*

W_k = variance explained (weight) by component *k*

PC_{jk} = principal component score of household *j* on component *k*

m = number of retained components

The computed FIRI scores are normalized between 0 and 1 to ease interpretation and classification:

$$FIRI_{norm} = \frac{FIRI = FIRI_{min}}{FIRI_{max} - FIRI_{min}} \quad (4)$$

Households are then grouped according to resilience levels:

i. High resilience: 0.67–1.00
ii. Moderate resilience: 0.34–0.66
iii. Low resilience: 0.00–0.33

A higher FIRI score indicates greater resilience; such households have stronger capacities to anticipate, absorb, and recover from food insecurity shocks. Conversely, lower FIRI scores imply vulnerability and weaker livelihood stability.

The use of the Tobit regression model in this study is justified by the censored nature of the dependent variable and the need to obtain consistent and unbiased parameter estimates. Specifically, the outcome variable of interest (resilience index) is continuous but limited within a defined range, with a substantial proportion of observations clustered at a boundary value, usually zero. For instance, some households report zero resilience to food insecurity, not because the true value is negative, but because the observed outcome is censored at zero. The Tobit model appropriately accounts for this censoring by modelling the latent outcome underlying the observed data, thereby yielding consistent and unbiased estimates compared to conventional linear regression methods. The model is specified as:

$$FIRI_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots \ldots \ldots \ldots \ldots \ldots + \beta_{17} X_{17} \quad (5)$$

Where, $FIRI_i$ is the food insecurity resilience index (dependent variable); a is the intercept; β_i and X_i are the coefficients and the set of predictors, respectively. A total of 17 explanatory variables were included in the regression model, which predicted the farm households.

X_1 = Crop diversification (Number of crops cultivated)
X_2 = Use of improved inputs (1= Yes, 0= Otherwise)
X_3 = Livelihood diversification (Number of income sources)
X_4 = Market access/distance to markets (1= Yes, 0= Otherwise)
X_5 = Membership in cooperatives/farmer associations (1= Yes, 0= Otherwise)
X_6 = Access to social safety nets (1= Yes, 0= Otherwise)
X_7 = Asset ownership (1= Yes, 0= Otherwise)
X_8 = Sex of household head (1= Yes, 0= Otherwise)
X_9 = Age of household head (Years)
X_{10} = Year of schooling (Years)
X_{11} = Household size (Number of persons)
X_{12} = Dependency ratio (ratio of dependents to household size)
X_{13} = Access to credit (1= Yes, 0= Otherwise)
X_{14} = Farm size (Hectares)
X_{15} = Farming experience (Years)
X_{16} = Income (Naira per month)
X_{17} = Extension agent contact (1= Yes, 0= Otherwise)

Results and discussion

Socioeconomic characteristics of the respondents

Table 2 presents the socioeconomic characteristics of the respondents, including sex, marital status, age, education, household size, experience, cooperative membership, extension contact, and access to credit. These variables are essential in understanding the demographic and socioeconomic composition of the study population, as they influence participation, productivity, and decision-making in agricultural and livelihood activities.

The results show that 51.7% of the respondents were male, while 48.3% were female, indicating a fairly balanced gender participation. This implies that both men and women were actively involved in the activity under study, though male respondents were slightly more represented. Similar findings were reported by Adenegan *et al.* (2020) and Akinbile and Oluwakemi (2018), who noted that agricultural enterprises in Nigeria often have moderate male dominance due to gendered roles and access to productive resources. A majority (86.7%) of the respondents were married, while 13.3% were single. This suggests that most participants are family heads with dependents, which may influence their economic responsibilities and livelihood strategies. According to Oladejo *et al.* (2019), marital status is a crucial determinant of social stability and resource allocation in rural households. The age distribution indicates that 10% of the respondents were below 40 years, while 90% were above 40 years, with a mean age of 51.35 years. This implies that most respondents were middle-aged or elderly, reflecting an aging workforce in the sector. Ogunniyi *et al.* (2018) observed a similar trend, noting that aging farmers dominate rural production systems in Nigeria due to youth migration to urban areas. The implication is a potential decline in labor productivity and innovation adoption.

Regarding education, 28.3% of respondents had no formal education, and 43.4% attained primary education. This distribution suggests a low literacy level among respondents, which could affect access to information, extension services, and adoption of improved practices. Ojo *et al.* (2021) emphasized that education enhances awareness and decision-making capacity among rural dwellers, improving efficiency and resource management. Most respondents (95%) had household sizes ranging between 3 and 6 persons, with a mean of 5. A moderate household size indicates potential availability of family labor for production activities. According to Adesina and Fadare (2020), larger household sizes often contribute to labor availability in rural economies, though they may also increase dependency ratios. The respondents had an average of 11.2 years of farming experience, with 31.7% having between 11–15 years. This suggests that most respondents possess substantial experience, which may enhance their expertise and decision-making. Oluwatayo and Adedeji (2019) observed that experience contributes significantly to efficiency and adaptability among rural producers. About 75% of respondents belonged to cooperative societies, while 25% were non-members. Cooperative membership enhances access to inputs, credit, and market information, which can improve productivity and income. This finding aligns with Afolabi *et al.* (2020), who emphasized that cooperatives play a vital role in empowering smallholders and improving their access to resources. The table shows that 60% of respondents had contact with extension agents, while 40% had no such contact. This indicates a moderate level of access to agricultural advisory services. According to Ezeh *et al.* (2019), extension contact facilitates technology adoption and better management practices, contributing to higher productivity and resilience. Also, 65% of respondents reported having access to credit, while 35% did not. Access to credit is essential for improving investment capacity and expanding production. Oni *et al.* (2018) highlighted that access to financial services positively influences farm performance and

livelihood diversification among rural households.

The socioeconomic characteristics reveal that the respondents are mostly married, middle-aged individuals with moderate educational attainment and substantial experience in their occupations. Their involvement in cooperatives, access to credit, and extension services indicate moderate institutional support, which could be leveraged to enhance productivity and livelihood outcomes.

Table 2: Socioeconomic Characteristics of the Respondents

Characteristics	Frequency	Percentage	Mean
Sex			
Male	62	51.70	
Female	58	48.30	
Marital status			
Married	104	86.70	
Single	16	13.30	
Age (years)			
>40	12	10.00	
41 – 50	28	23.33	
51 – 60	40	33.33	
61 – 70	38	31.67	
70 and above	2	1.67	51.35
Educational level			
No formal education	34	28.30	
Primary education	52	43.40	
Secondary education	20	16.70	
Tertiary education	12	11.70	
Household size (number of persons)			
3 – 6	114	95.00	
7 – 10	4	3.33	
11 – 14	2	1.67	5
Experience (years)			
0 – 5	20	16.67	
6 – 10	32	26.67	
11 – 15	38	31.67	
15 – 20	16	13.33	
21 and above	14	11.66	11.20
Co-operative membership			
Non-member	30	25.00	
Member	90	75.00	
Extension contacts			
No	48	40.00	
Yes	72	60.00	
Access to credit			
No	42	35.00	
Yes	78	65.00	
Total	120	100	

Source: Field Survey, 2023.

Coping Strategies adopted by Farming Households in Response to Food Insecurity

Table 3 presents the various coping strategies adopted by farming households in response to food insecurity. Coping strategies are short-term behavioral adjustments that households employ to manage food shortages, income shocks, or other livelihood stresses. The findings indicate that farming households adopted multiple strategies to cushion the effects of food insufficiency.

Relying on Less Preferred and Less Expensive Foods: The most common coping strategy was relying on less preferred and less expensive foods, reported by 28.33% of respondents. This suggests that households prioritized maintaining food quantity over quality during periods of scarcity. This finding aligns with Maxwell *et al.* (2008) and FAO (2019)**,** who observed that households facing food insecurity often compromise dietary diversity by consuming cheaper and less nutritious foods to stretch limited resources. Such dietary adjustments are typical first responses to mild food insecurity.

Borrowing Food or Relying on Help from Friends or Relatives: About 17.50% of the respondents borrowed food or relied on support from social networks. This reflects the importance of social capital and community solidarity in rural food systems. According to Devereux (2007) and Aidoo *et al.* (2013), informal networks play a vital role in mitigating food crises among low-income rural households, as mutual assistance and borrowing are often culturally embedded strategies in African societies.

Limiting Portion Sizes at Mealtime: Limiting portion size at mealtime was reported by 19.17% of respondents, indicating that some households reduced individual food consumption to extend household food supply. This coping mechanism points to moderate food stress and is consistent with the findings of Coates *et al*. (2007)**,** who identified portion reduction as a moderate indicator of food insecurity severity. It is a conscious strategy to balance available food among family members.

Restricting Adult Consumption for Children to Eat: About 10.00% of respondents restricted adult consumption to allow small children to eat. This behavior demonstrates the protective attitude of parents toward children's nutrition in times of scarcity. Similar findings were reported by Amao and Awoyemi (2018) and Olagunju *et al.* (2020)**,** who noted that during food shortages, adults, especially mothers, tend to sacrifice their portions to protect younger or more vulnerable household members.

Reducing the Number of Meals per Day: Reduction in the number of meals eaten per day was practiced by 25.00% of the respondents, ranking as the second most common coping strategy. This approach is a typical sign of worsening food insecurity, as households move from three to two or one meal per day. According to Akinyele (2009) and Oni *et al.* (2018), this strategy indicates a more severe phase of food insecurity and often has nutritional implications, particularly for children and elderly members.

The results suggest that farming households employ a range of food-based coping strategies, from dietary adjustments to meal reduction, depending on the severity of food insecurity. The dominance of food

substitution and meal reduction indicates that food insecurity among these households is both chronic and seasonal. This finding corroborates the observations of Maxwell and Caldwell (2008) that food-insecure households often employ reversible consumption-related coping mechanisms before resorting to more erosive livelihood strategies, such as asset sales.

Table 3: Coping strategies employed by farming households to food insecurity

Coping Strategies	Frequency	Percentage
1. Rely on less preferred and less expensive foods	34	28.33
2. Borrow food or rely on help from friends or relatives	21	17.50
3. Limit portion size at mealtime	23	19.17
4. Restrict consumption by adults so that small children can eat	12	10.00
5. Reduce the number of meals eaten in a day	30	25.00
Total	120	100

Field Survey, 2023.

Strengthening household resilience through improved access to credit, income diversification, and agricultural extension services could reduce the need for negative coping strategies. Moreover, policies promoting food storage, small-scale processing, and social safety nets can enhance food security among rural farming households.

Food Insecurity Status of the Farm Households

Table 4 presents the food insecurity status of the farm households as measured using the Coping Strategy Index (CSI). The CSI is a widely used indicator that measures the frequency and severity of coping behaviors households adopt in response to food shortages (Maxwell and Caldwell, 2008). Higher CSI scores reflect more severe food insecurity and a greater reliance on distress coping strategies.

Table 4: Food insecurity status of the farm households

Food Insecurity Status	Frequency	Percentage
No/low food insecurity (CSI= 0-3)	32	26.67
Medium/moderate food insecurity (CSI = 4-9)	21	17.50
High coping/worse food insecurity (CSI ≥10)	67	55.83
Total	120	100

Field Survey, 2023.

Low Food Insecurity (CSI = 0–3): The results indicate that 26.67% of the respondents experienced low or no food insecurity, implying that about one-quarter of the farm households had sufficient food access and did not need to engage in serious coping behaviors. These households likely had more stable incomes, better food storage, and diversified livelihoods. According to Coates *et al.* (2007) and FAO (2019), such households typically enjoy more consistent access to food throughout the year, owing to better economic resilience and access to productive resources.

Moderate Food Insecurity (CSI = 4–9): About 17.50% of the respondents fell into the moderate food insecurity category. These households occasionally engaged in coping strategies such as reducing meal portions or relying on cheaper food items, but not to an extreme degree. This finding aligns with Aidoo *et al.,* (2013), who noted that moderately food-insecure households often experience temporary shortages, especially during lean seasons, but can recover with minimal external support. The moderate food insecurity level observed may be associated with seasonal fluctuations in food production and income, as reported by Amao and Awoyemi (2018) in rural southwestern Nigeria.

Severe Food Insecurity (CSI ≥ 10): The majority of respondents, 55.83%**,** were classified as experiencing high coping or severe food insecurity. This means that more than half of the households frequently resorted to distress strategies such as reducing meal frequency, restricting adult consumption for children, or borrowing food. This result indicates that food insecurity is a significant challenge among farming households in the study area. Similar high prevalence rates were reported by Olagunju *et al.* (2020) and Oni *et al.* (2018)**,** who found that over half of rural farming households in Nigeria suffer from moderate to severe food insecurity due to declining productivity, limited access to credit, and post-harvest losses.

The high percentage of severely food-insecure households also corroborates findings from FAO (2021), which reported that smallholder farmers in sub-Saharan Africa are paradoxically among the most food-insecure populations, despite being primary food producers. This paradox arises from structural constraints such as poor access to land, climate variability, and inadequate post-harvest infrastructure.

The results from Table 3 suggest that food insecurity is prevalent among farming households, with more than half of them experiencing severe food shortages. This finding implies that agricultural production alone does not guarantee household food security; factors such as access to credit, extension services, diversification of income sources, and food storage practices play crucial roles.

The predominance of high coping levels indicates a chronic and structural form of food insecurity, rather than a seasonal or temporary one. As Maxwell and Caldwell (2008) observed, when a majority of households exhibit high CSI scores, it signals deep-rooted vulnerability that requires policy interventions such as targeted social safety nets, improved agricultural extension delivery, and community-based resilience programs.

Farm Household Resilience to Food Insecurity

Table 5 presents the indicators of farm household resilience to food insecurity, measured across several dimensions including income and food access, asset possession, access to public services, social safety nets, stability, access to agricultural inputs and technology, and adaptive capacity. The overall resilience index (Ri) serves as a composite measure of the households' ability to withstand and recover from food insecurity shocks.

Table 5: Farm household resilience to food insecurity indicators

Indicators	Mean Score	Std. Dev
Income and food access (IFA)	0.528	0.511
Asset's possession (AP)	0.712	0.506
Access to public service (APS)	0.592	0.514
Social safety net (SSN)	0.466	0.404
Stability (S)	0.519	0.498
Access to Agricultural Inputs and Technology (AIT)	0.443	0.423
Adaptive capacity (AC)	0.518	0.501
Resilience index (Ri)	0.526	0.484
Level of resilience to food insecurity	Frequency	Percentage
High resilience: 0.67–1.00	32	26.67
Moderate resilience: 0.34–0.66	63	52.50
Low resilience: 0.00–0.33	25	20.83

Source: Field Survey, 2023.

Income and Food Access (IFA): The mean score for income and food access (IFA) was 0.528 (SD = 0.511), indicating that households have a moderate ability to generate income and access sufficient food. This suggests that although some households earn enough to sustain food consumption, others remain vulnerable to income shocks. According to Béné *et al.* (2016), income stability and diversity are critical components of resilience, as they determine a household's capacity to maintain food access during periods of stress, such as price fluctuations or poor harvests. Similarly, FAO (2019) emphasizes that diversified income sources enhance household resilience to food insecurity.

Asset Possession (AP): Asset possession recorded the highest mean score (0.712 ± 0.506), implying that asset ownership significantly contributes to household resilience. Assets such as land, livestock, and productive equipment provide a form of buffer against economic and climatic shocks. This finding aligns with Alinovi *et al.* (2010) and Cissé and Barrett (2018), who identified asset accumulation as a major determinant of rural resilience. Households with more assets are often better able to recover from shocks and sustain food availability through productive and financial means.

Access to Public Services (APS): Access to public services had a mean value of 0.592 (SD = 0.514), showing a moderately

favorable condition. This indicates that most households had some level of access to infrastructure such as roads, healthcare, education, and agricultural extension. Tambo and Wünscher (2017) argue that access to public services enhances resilience by improving information flow, market access, and adaptive capacity to climate and economic shocks. Where infrastructure is poor, resilience is often undermined due to isolation from social and economic support systems.

Social Safety Nets (SSN): The mean score for social safety nets was 0.466 (SD = 0.404), suggesting that households' access to formal or informal safety mechanisms was relatively weak. This could mean limited access to government relief programs, community-based assistance, or insurance schemes. According to Devereux (2007) and Béné *et al.* (2012), safety nets such as cash transfers, food aid, and cooperative support are critical for cushioning vulnerable groups during periods of hardship. The relatively low value implies the need for stronger institutional and community-based safety net programs.

Stability (S): Stability had a mean score of 0.519 (SD = 0.498), reflecting moderate resilience in maintaining consistent food supply and resource flow over time. Stability refers to the ability of households to maintain steady food access despite environmental or economic variability. Constas *et al.,* (2014) emphasized that stability is central to resilience because it integrates the capacity to absorb and adapt to short-term disturbances while maintaining long-term welfare.

Access to Agricultural Inputs and Technology (AIT)

Access to agricultural inputs and technology recorded a mean score of 0.443 (SD = 0.423), the lowest among the indicators. This suggests limited access to improved seeds, fertilizers, extension services, and mechanization, which are essential for boosting productivity and income. This finding corroborates Oni *et al.* (2018) and Tambo and Abdoulaye (2012), who found that low adoption of agricultural technologies among smallholders reduces their ability to adapt to climate variability and market shocks, thereby weakening resilience.

Adaptive Capacity (AC): Adaptive capacity showed a mean score of 0.518 (SD = 0.501), indicating moderate ability of households to adjust their practices in response to changing conditions. This includes the use of new farming techniques, diversification, or resource management strategies. According to Ellis (2000) and Taruvinga *et al.* (2013), adaptive capacity is essential for building long-term resilience as it enables households to respond proactively to shocks rather than reactively.

The overall mean resilience index was 0.526 (SD = 0.484), showing that farm households exhibit moderate resilience to food insecurity. Based on the classification, 74 households (61.7%) had a positive resilience index (Ri > 0), while 46 households (38.3%) had a negative resilience index (Ri < 0). This indicates that a majority of households possess moderate capacity to absorb and recover from food insecurity shocks, although a substantial proportion remains vulnerable.

This pattern is consistent with the findings of Darnhofer (2014) and Alinovi *et al.* (2010), who observed that most smallholder farmers in developing

countries display medium-level resilience strong enough to cope temporarily but not sustainable without institutional and infrastructural support.

The results suggest that while many farming households possess moderate resilience, their long-term stability remains fragile due to limited access to agricultural inputs, technology, and formal safety nets. The moderate scores across key indicators such as adaptive capacity and income access indicate that resilience-building interventions should target these weak areas. Policies that promote asset accumulation, technological adoption, and social protection mechanisms would significantly enhance food security resilience.

Determinants of Resilience to Food Insecurity

Table 6 presents the results of the factors influencing farm household resilience to food insecurity. The results reveal that several variables significantly influence resilience at varying levels of statistical significance *(*$p < 0.01$ and $p < 0.05$), while others exhibit weak or insignificant relationships. The results show that a combination of livelihood activities, demographic characteristics, asset endowment, and institutional factors strongly shape households' capacity to withstand food insecurity shocks. These findings are consistent with previous empirical studies conducted in Sub-Saharan Africa and other developing regions.

Crop Diversification

Crop diversification has a positive and highly significant effect on resilience. This aligns with findings by Lin (2011) and Muller *et al.* (2020), who argued that diversified cropping systems reduce exposure to yield failure and provide more stable sources of food and income. By spreading risk across multiple crops, households are better able to absorb climatic and market shocks.

Table 6: Determinants of farm households' resilience to food insecurity

Variables	Coefficients	Std. Error	Z	p>/z/
Constant	9.371***	2.946	3.181	0.001
Crop Diversification	0.090***	0.025	3.600	0.000
Use of Improved Inputs	0.004	0.414	0.009	1.714
Livelihood Diversification	0.822***	0.312	2.635	0.001
Market Access/Distance to markets	0.695***	0.127	5.472	0.003
Membership in Cooperatives/Farmer Associations	0.011	0.426	0.026	1.622
Access to Social Safety Nets	0.003	0.124	0.024	3.012
Asset ownership	1.263**	0.526	2.401	0.017
Sex of household head	9.832***	1.999	4.918	0.001
Age of household head	4.823***	0.946	5.098	0.000
Year of schooling	11.865**	4.943	2.400	0.022
Household size	-8.672***	2.956	-2.934	0.000
Dependency ratio	-0.316**	0.129	-2.450	0.039
Access to credit	0.301	0.421	0.715	0.832
Farm size	0.111***	0.034	3.265	0.000
Farming experience	0.016	1.742	0.009	0.434
Income	2.945	3.001	0.092	1.137
Extension agent contact	0.078**	0.034	2.294	0.044
Number of observations	120			
Log-likelihood	-3456.267			

***, ** implies significant at 1 and 5 percent, respectively.

Livelihood Diversification

Livelihood diversification significantly enhances resilience, echoing the findings of Ellis (2000) and Barrett et al. (2001), who note that non-farm income acts as a buffer, stabilizing consumption and reducing households' vulnerability to agricultural risk. When income sources are diversified, households can smooth expenditures and invest in food even during production shocks, thereby improving resilience.

Market Access / Distance to Markets

Market access positively and significantly increases resilience. As argued by *Chamberlin and* Jayne (2013), proximity to markets reduces transaction costs and improves access to food, inputs, and remunerative markets for produce. Households closer to markets can sell produce faster, purchase food during lean periods, and obtain agricultural technologies more easily.

Membership in Cooperatives

Membership in cooperatives is positive but not significant. Cooperative benefits such as credit, training, and collective marketing depend heavily on the organizational effectiveness of the group. Studies such as Bernard and Spielman (2009) show that weak governance or low participation intensity often limits the developmental impact of farmer organizations.

Asset Ownership

Asset accumulation significantly enhances resilience. Assets, whether livestock, tools, or durable goods, provide a form of self-insurance that enables households to cope with shocks. This finding supports the argument of Carter and Barrett (2006) that assets function as a key resilience mechanism and determine a household's ability to recover from shocks.

Sex of Household Head

The sex of the household head had a strong positive and significant relationship (9.832; p = 0.001), implying that male-headed households tend to be more resilient to food insecurity compared to female-headed ones. This may be due to gender disparities in access to resources, credit, and decision-making authority. Similar findings were reported by Akinbile and Oluwakemi (2018) and Ojo *et al.* (2021), who emphasized that women's limited resource access reduces their ability to recover from livelihood shocks.

Age of Household Head

The coefficient for age (4.823; p = 0.000) was positive and significant, suggesting that older farmers are more resilient due to greater farming experience, social capital, and adaptive knowledge. Oluwatayo and Adedeji (2019) found that age positively correlates with resilience, as experienced farmers tend to diversify income and manage risks more effectively.

Years of Schooling

Education level (11.865; p = 0.022) had a positive and significant effect, indicating that education enhances household resilience. Educated farmers are more likely to adopt improved technologies, seek information, and make informed production decisions. This agrees with Ojo *et al.* (2021) and Afolabi *et al.* (2020), who linked education to higher adaptive capacity and food security among rural farmers.

Household Size

Household size exhibited a negative and significant relationship (-8.672; $p = 0.000$), meaning larger households are less resilient to food insecurity. This is expected, as larger family sizes increase dependency ratios and pressure on household resources. Aidoo *et al.* (2013) and Amao and Awoyemi (2018) similarly observed that large household sizes exacerbate vulnerability to food shortages in rural settings.

Dependency Ratio

Dependency ratio was also negative and significant (-0.316; $p = 0.039$), reinforcing the earlier finding that a higher number of dependents weakens resilience. As noted by Olagunju *et al.* (2020), households with more non-working members face greater consumption burdens and reduced capacity to recover from shocks.

Access to Credit

Access to credit was positive but insignificant (0.301; $p = 0.832$), suggesting that credit access did not have a strong effect on resilience in the study area. This might be due to limited credit availability, high interest rates, or poor loan utilization. Oni *et al.* (2018) noted that while credit has the potential to enhance resilience, its impact depends on accessibility, repayment flexibility, and productive use.

Farm Size

Farm size (0.111; $p = 0.000$) was positive and significant, implying that households with larger farm holdings are more resilient to food insecurity. Larger farm size translates to higher production potential and better economies of scale. This is consistent with Adesina and Fadare (2020) and Babatunde *et al.* (2011), who found that landholding size significantly improves food self-sufficiency and resilience.

Farming Experience

Farming experience was positive but insignificant (0.016; $p = 0.434$), suggesting that experience alone does not guarantee resilience, especially when not complemented by innovation and modern technology adoption. This is similar to findings by Tambo and Abdoulaye (2012), who noted that traditional experience must be combined with adaptive learning to yield resilience gains.

Income

Total annual income had a positive but insignificant effect (2.945; $p = 1.137$). This may be due to the unstable nature of agricultural income, which fluctuates with seasons and market prices. According to FAO (2019) and Ogunniyi *et al.* (2018), inconsistent income sources limit household capacity to plan or save for shocks, thus weakening overall resilience.

Extension Agent Contact

Extension contacts (0.078; $p = 0.044$) was positive and significant, indicating that households that interact with agricultural extension agents are more resilient. Extension services improve access to new information, technologies, and management practices. This finding corroborates Ezeh *et al.* (2019) and Tambo and Wünscher (2017), who reported that extension contact enhances adaptive capacity and food security outcomes.

The results reveal that diversification strategies, education, market access, asset accumulation, and extension services significantly strengthen household resilience to food insecurity. Conversely,

household demographic pressures such as size and dependency ratio weaken resilience. These findings reinforce the idea that resilience is multidimensional and shaped by both economic and social factors.

Conclusion and recommendation

The analysis of the socioeconomic characteristics, coping strategies, food insecurity status, and resilience indicators of farm households provides a holistic understanding of the factors shaping their ability to withstand food insecurity shocks. The results on coping strategies indicated a reactive coping mechanism, though common, which undermines long-term nutritional security and well-being. The food insecurity status analysis showed that more than half (55.83%) of the households experienced high coping or severe food insecurity. This pattern highlights the prevalence of vulnerability and the limited capacity of rural households to maintain consistent food access. The resilience index results demonstrated that households exhibited moderate resilience levels across the different dimensions of income and food access, assets, public services, social safety nets, and adaptive capacity. This study establishes that food insecurity remains a significant challenge among rural farming households, largely shaped by socioeconomic disparities, limited access to productive resources, and weak institutional support systems. Enhancing resilience requires a multidimensional strategy that promotes asset accumulation, education, gender inclusion, and access to credit and extension services. Strengthening adaptive capacity through the adoption of improved technologies and diversification of livelihoods will further help rural households withstand and recover from food insecurity shocks. Policymakers should therefore prioritize investments in rural infrastructure, social protection programs, and agricultural innovations to foster sustainable food security and resilience among farm households.

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