



(RESEARCH ARTICLE)



## ACCESS OF FOOD SECURITY THROUGH FINANCE FOR SUSTAINABLE AGRIBUSINESS PERFORMANCE

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### ABSTRACT

Access to finance is vital for improving food security, particularly in developing nations where agricultural production is crucial. Despite several financial interventions targeted at increasing agricultural production, smallholder farmers continue to lack access to reasonable, timely, and sufficient financing, limiting their ability to invest in improved technology and inputs, lowering productivity and food supply. This study intends to examine the relationship between access to finance and food security among smallholder farmers in Adamawa State, employing institutional theory as a theoretical framework. The study takes a quantitative method, with a survey for the research design and a population of 37,200 agricultural smallholder farmers. A sample size of 380 will be chosen using probability sampling and simple random techniques. The data will be analyzed via Partial Least Squares Structural Equation Modelling (PLS-SEM).

**Keywords:** Food Security, Finance, Sustainable, Agribusiness.

### 1 INTRODUCTION

Agribusiness is crucial to promoting food security, economic growth, and sustainable development, especially in developing nations (Ichdayati *et al.*, 2025). The agricultural sector not only contributes significantly to the GDP, but it also employs a large number of the people, particularly in rural areas. In terms of food security, agribusiness contributes to the availability, accessibility, and affordability of food, which is critical for the survival and well-being of the populace (Effa *et al.*, 2025). However, despite agribusiness's critical role in providing food security, numerous hurdles limit the sector's ability to fulfill rising food demand. One of the most significant issues is limited access to finance. Smallholder farmers, who make up a sizable share of agribusiness entrepreneurs, frequently struggle to secure the capital needed to invest in productive technology, buy inputs, and scale their operations. Without enough capital, their ability to increase output, implement modern farming techniques, and develop their enterprises is severely limited. Access to finance is critical for increasing the performance of agribusinesses and maintaining food security (Mutea *et al.*, 2025). Adequate finance allows farmers and agribusinesses to invest in improved seeds, fertilizers, irrigation systems, mechanization, and post-harvest technology. It also enables them to withstand economic downturns, adjust to climate change, and capitalize on new market opportunities (Terchila, 2025). In contrast, agribusinesses' ability to grow is hampered by a lack of access to financing and financial services, resulting in negative repercussions on food production, availability, accessibility, affordability, and distribution. Smallholder farmers frequently fail to receive loans from commercial banks due to a number of factors, including high interest rates, collateral requirements, and a lack of

financial literacy. Furthermore, financial institutions view agriculture as a high-risk sector due to its susceptibility to climate change, pests, and market volatility (Thakur *et al.*, 2026). These issues are worsened by poor institutional frameworks, insufficient government support, and a lack of appropriate finance products for the agriculture industry. The availability of funds has a direct impact on food security. Agribusinesses can use financial resources to boost productivity, eliminate post-harvest losses, and improve the efficiency of food supply networks (Aworh, 2025). This, in turn, serves to guarantee that food is available in sufficient quantities, accessible to all parts of the population, and reasonably priced for customers. In many developing nations, particularly in Sub-Saharan Africa, food insecurity is a chronic problem. Limited access to finance exacerbates the situation, as smallholder farmers and rural entrepreneurs are frequently unable to invest in technology that would increase yields and stabilize the food supply (Chukwu *et al.*, 2026). Furthermore, inability to scale operations frequently results in lower production outputs and inefficient distribution systems, limiting food availability in both local and national markets. However, the post-COVID-19 epidemic has uncovered further vulnerabilities in the farming industry. Disruptions in supply networks, employment shortages, and reduced earnings have exacerbated food insecurity. In this setting, enhancing agriculture access to finance is even more crucial for promoting recovery, increasing productivity, and strengthening food systems. This study will look at how access to finance affects agribusiness performance.

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## 2 LITERATURE REVIEW

Access to finance refers to the ease with which individuals or businesses can obtain formal financial products and services, such as credit, savings, insurance, and payment systems, required for economic participation, as well as the ability of businesses or individuals to secure necessary funding or credit at reasonable interest rates without excessive bureaucratic hurdles or discriminatory practices (Adem *et al.*, 2026). Furthermore, access to finance describes a financial system that inclusively accommodates underserved or vulnerable populations, such as low-income households, rural enterprises, and women, ensuring that financial services are available to all, and it involves financial institutions' ability to facilitate the provision of loans, credit facilities, and investment capital to businesses, particularly small and medium-sized enterprises (SMEs), with minimal risk-related (Abid, 2026). Furthermore, access to finance entails the utilization of digital financial platforms, such as mobile banking and digital wallets, allowing individuals and businesses to participate in financial systems without the need for physical banking infrastructure, and it refers to the availability of financial services that are specifically designed to meet the unique needs of certain sectors or groups, such as microfinance for small-scale farmers or SMEs, which frequently face barriers in traditional lending models (Kakama *et al.*, 2026). Furthermore, access to finance entails ensuring that financial resources are provided on sustainable terms, which means that loans and other forms of credit are not only available but structured in a way that borrowers can repay them without causing financial distress, and it is characterized by the reduction of common barriers such as high collateral requirements, high interest rates, or complex application processes, allowing easier entry for businesses and individuals. (Abolade *et al.*, 2025). Access to finance is the process by which financial institutions provide adequate risk mitigation mechanisms, such as credit guarantees or insurance products, to reduce the perceived risks of lending to certain sectors, particularly agriculture or SMEs. It also includes the enhancement of financial literacy, which empowers individuals and businesses to make informed decisions about credit, savings, and investment opportunities, increasing their ability to participate in financial markets (Kyeyune *et al.*, 2025). Access to finance is broadly described as individuals and organizations' capacity to receive relevant financial products and services from formal financial institutions, such as credit, savings, insurance, and payment systems (Irene *et al.*, 2025). Access to these resources is critical for business growth, risk management, and investment in new opportunities. The World Bank (2020) emphasizes that without proper financial access, firms, particularly SMEs and agricultural sectors, are frequently unable to develop or enhance efficiency, contributing to economic stagnation.

### 2.1 Determinants of access to finance

Several factors influence financial access, including institutional frameworks, financial literacy, digital infrastructure, and financial institutions' risk perceptions. Hunter *et al.*, (2025) identify the regulatory environment as a crucial predictor, pointing out that countries with stronger legislative frameworks for financial inclusion have higher levels of loan availability. Ezeibekwe (2025) contend that corruption, bureaucratic inefficiency, and weak property rights severely hinder the availability of funding to SMEs in many emerging nations. Financial literacy is another important driver, as it influences whether individuals and businesses can obtain loans and financial services. Abdallah *et al.*, (2025) discovered that better levels of financial literacy among SMEs enhanced their ability to acquire formal loans and financial services, therefore supporting business growth.

## 2.2 Challenges of access to finance

Despite global attempts to enhance financial inclusion, major hurdles still exist, particularly for marginalized communities and rural businesses. According to Mahyuzar and Nugraheni (2025) main barriers to rural company financing include high interest rates, onerous collateral requirements, and a lack of specialized financial solutions. Furthermore, commercial banks view agribusiness and SMEs as high-risk due to their vulnerability to market volatility and environmental concerns, making financial institutions hesitant to lend to them (Deirmentzoglou and Anastasopoulou, 2026). Furthermore, gender discrepancies in financial access continue to exist. According to Irene *et al.*, (2025), cultural norms, a lack of collateral and low financial knowledge make it more difficult for women entrepreneurs to secure loans, particularly in Sub-Saharan Africa and South Asia. These inequities prevent women-led firms from growing, limiting their economic impact.

## 2.3 Digital finance and access to finance

The rise of digital banking has created new opportunities to improve financial inclusion. Mobile banking, digital wallets, and Fin-tech advances are revolutionizing access to finance, especially in areas with limited penetration of traditional banking institutions. According to Shahid *et al.*, (2026), mobile money platforms have played an important role in improving financial access in Africa by allowing individuals and businesses to save, borrow, and transact without the need for traditional banks. Akinwumi *et al.* (2023) found that digital finance has lowered transaction costs and expanded access to microfinance for SMEs in East Africa. Furthermore, digital lending platforms have made it simpler for small enterprises and farmers to obtain short-term loans without providing physical collateral (Wamba *et al.*, 2022). However, issues such as digital literacy, cybersecurity concerns, and regulatory deficiencies persist.

## 2.4 Agribusiness performance

Agribusiness, defined as the interconnected sectors of agriculture, food production, and related services, is critical to global economic development, food security, and rural lifestyles. This literature study focuses on conceptual definitions of agricultural performance, with a particular emphasis on food security and other aspects of performance. Agribusiness performance is a multidimensional notion that incorporates many aspects of efficiency, effectiveness, and sustainability in the agricultural industry. Kueh *et al.* (2021) define agribusiness performance as the ability of firms within the agricultural value chain to fulfill their strategic goals while maximizing resource utilization. This encompasses not only financial indicators like profit margins and ROI, but also operational efficiency, customer happiness, and environmental stewardship. Several researchers emphasize the relevance of integrating several performance variables. For example, Kariuki *et al.* (2022) recommend that agribusiness performance be evaluated using a balanced scorecard approach that takes into account financial performance, internal procedures, customer viewpoints, and learning and growth. This complete view enables stakeholders to evaluate how well agribusinesses respond to changing market conditions while meeting long-term sustainability objectives.

## 2.5 Food security

Food security is the state in which all individuals have consistent physical and economic access to sufficient, safe, and nutritious food that meets their dietary requirements for a healthy and active life. Food security is described by four pillars: availability, access, utilization, and long-term stability. These pillars work together to ensure that individuals and households can meet their food needs consistently and without disruption. Global food security refers to the ability of worldwide and national food supply systems to withstand and recover from economic, environmental, and health crises, providing continued food access (Laborde *et al.*, 2020). Food security at the home level refers to all members of a household having consistent access to the quantity and quality of food needed to live an active and healthy life. Food security is the state in which people have access not only to enough calories but also to nutritious food, which promotes good health and prevents malnutrition or diet-related disorders. Food security includes both economic and social factors, such as price and cultural tolerance of food. It guarantees that food systems deliver adequate quantities of culturally acceptable foods that are consistent with population tastes and social norms. Food security entails the long-term viability of food systems, which means that current food production and consumption patterns must not jeopardise future generations' access to sufficient and healthy food. Food security is inextricably related to environmental stability, as climate change, soil degradation, and water shortages all have an impact on food production and distribution, influencing long-term food availability and access. Food security is defined as a state in which policy measures ensure that food systems are resilient to shocks such as pandemics or conflicts that may disrupt food availability or access on a national or global scale. Food security is increasingly being viewed as a human right, with individuals having an intrinsic right to adequate food and governments being required to develop policies that ensure this right for all citizens (De Schutter & Giljum, 2021). Food security, a multidimensional term, is constantly evolving in academic and policy discourse. The Food and Agriculture Organisation (FAO) defines a state as one in which "all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious.

## 2.6 Operational efficiency

Operational efficiency is another important aspect of agricultural performance. It refers to the efficiency with which resources are used to produce goods and services. Balogun *et al.* (2021) define operational efficiency as agribusinesses' ability to optimize production processes, reduce waste, and improve supply chain management. Efficient operations not only decrease costs, but also improve product quality, resulting in increased customer satisfaction. Recent research emphasizes the importance of technology and innovation in improving operational efficiency in agribusiness. Uche *et al.*, (2023) state that the use of digital technologies, precision agriculture, and data analytics can considerably boost productivity and operational efficiency. Agribusinesses can use technology to streamline processes, manage resources more effectively, and respond quickly to market demands.

## 2.7 Sustainability and environmental impact

Sustainability has evolved as an important part of agribusiness success, reflecting the sector's broader commitment to environmental conservation and social equality. According to Fadahunsi and Adegboye (2023), sustainable agriculture practices include using natural resources responsibly, reducing environmental degradation, and improving social welfare. This aspect of performance is becoming increasingly relevant as consumers and stakeholders demand greater accountability for the environmental impact of agricultural practices. Furthermore, incorporating sustainability criteria into agricultural performance evaluations can increase long-term viability. According to a study by Nwankwo and Udo (2022), organizations that embrace sustainable practices generally profit from enhanced brand recognition, customer loyalty, and access to new markets. As such, sustainability is more than just an ethical consideration; it is a strategic need for improving agribusiness success.

## 2.8 Empirical review

According to Adebayo *et al.*, (2021), improved access to financing considerably enhances smallholder farmers' ability to invest in better agricultural methods. The study found that farmers who used financial services had higher crop yields and better food availability, showing a direct link between financial access and food security. Asfaw *et al.*, (2020) argue that access to financial services enables farmers to purchase required inputs such as seeds and fertilizers. Their findings showed that enhanced liquidity allows farmers to manage the risks associated with agricultural production, resulting in better food security. This access is essential for farmers to respond effectively to market swings and production constraints. Sulaiman *et al.*, (2022) claimed that financial inclusion measures greatly reduce food insecurity. Access to finance improves food security by allowing households to engage in productive activities and diversify their sources of income. The findings highlighted the importance of financial services in developing resistance to food insecurity. Furthermore, Zougmore *et al.*, (2021) did a study in West Africa and discovered that farmers who had access to microfinance institutions were better prepared to invest in climate-friendly agricultural techniques. This financial assistance enabled them to boost agricultural output and improve food security in their communities, illustrating the importance of access to finance in promoting sustainable agricultural practices.

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## 3 MATERIALS AND METHODS

This study intends to investigate the impact of access to finance on agricultural performance as food security in 21 Local Government Area of Adamawa State. 380 respondents will be chosen from a population of 37,200 rice farmers through probability sampling, using simple random selection procedures. Primary data will be used as a source of data. Questionnaire will be constructed to collect data. However, quantitative analysis will be performed to assess the extent to which explanatory variables (access to finance) influence the provided variable (food security). Partial Least Squares Structural Equation Modeling (*Pls-Sem*) will be utilized for data analysis, and regression and path measurement will be investigated.

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## 4 RESULTS AND DISCUSSIONS

The analysis of the demographic profile of the farmers indicates that males dominate rural farming, as expected (391 or 85%), with the number of females standing at 69 (15%). The number of female rural farmers who were either divorced or separated was 61, or 13.3%, while those who were widowed stood at 16, or 3.5% (see Table 1). The outcomes indicate that rural farming is dominated by young adults, as the number of respondents in their 30s was 129 (27.6%), while the number of those in their 40s was 187 (40%). The number of farmers in their 50s was only 49 or 10.7%, and this low number could be explained by the use of energy-sapping crude farm implements, which is still predominant in African rural farming (Table 1).

**Table 1: Demographic Characteristics of the Responded**

|                     | <b>Gender</b>             |         |
|---------------------|---------------------------|---------|
|                     | Frequency                 | Percent |
| Male                | 391                       | 85      |
| Female              | 69                        | 15      |
| Total               | 460                       | 100     |
|                     | <b>Age</b>                |         |
|                     | Frequency                 | Percent |
| 20 and below        | 11                        | 24      |
| 21-29               | 86                        | 18.7    |
| 30-39               | 128                       | 27.8    |
| 40-49               | 186                       | 40.4    |
| 50 and above        | 49                        | 10.7    |
| Total               | 460                       | 100     |
|                     | <b>Marital Status</b>     |         |
|                     | Frequency                 | Percent |
| Single              | 96                        | 20.9    |
| Married             | 287                       | 62.4    |
| Devoiced            | 61                        | 13.3    |
| Widowed             | 16                        | 3.5     |
| Total               | 460                       | 100     |
|                     | <b>Level of Education</b> |         |
|                     | Frequency                 | Percent |
| No formal education | 44                        | 9.6     |
| Primary School      | 96                        | 20.9    |
| O Level             | 202                       | 43.9    |
| ND/NCE              | 56                        | 12.2    |
| First Degree/ HND   | 48                        | 10.4    |
| Postgraduate        | 14                        | 3.0     |
| Total               | 460                       | 100     |

Results from the demographic analysis further indicate that the majority of the farmers (202 or 43.9%) possess secondary education, while 96 (20.9%) possess primary education, with 44 (9.6%) having no formal education. The low number of Nigerian rural farmers without formal education registered in the Central Bank of Nigeria's Anchored Borrower's Programmed suggests that the majority of the farmers are being excluded from the credit scheme, as the majority of rural farmers are not literate. Common Method Bias: Harman's single-factor test is a statistical technique for identifying common method bias (CMB) in datasets; it is especially pertinent when data are gathered through self-report questionnaires. By determining whether a single component accounts for significant variance, the single-component test can detect any common method bias in the data. The cumulative variance explained by the first component, 15.989%, further supports the conclusion that multiple factors contribute to the structure of the data a single factor typically needs to explain at least 50% of the variance to indicate a potential standard method bias issue. The first component in this dataset has an eigenvalue of 6.237, explaining 15.989% of the total variance, a relatively low percentage, suggesting a single factor does not dominate the dataset's variance (Table 2).

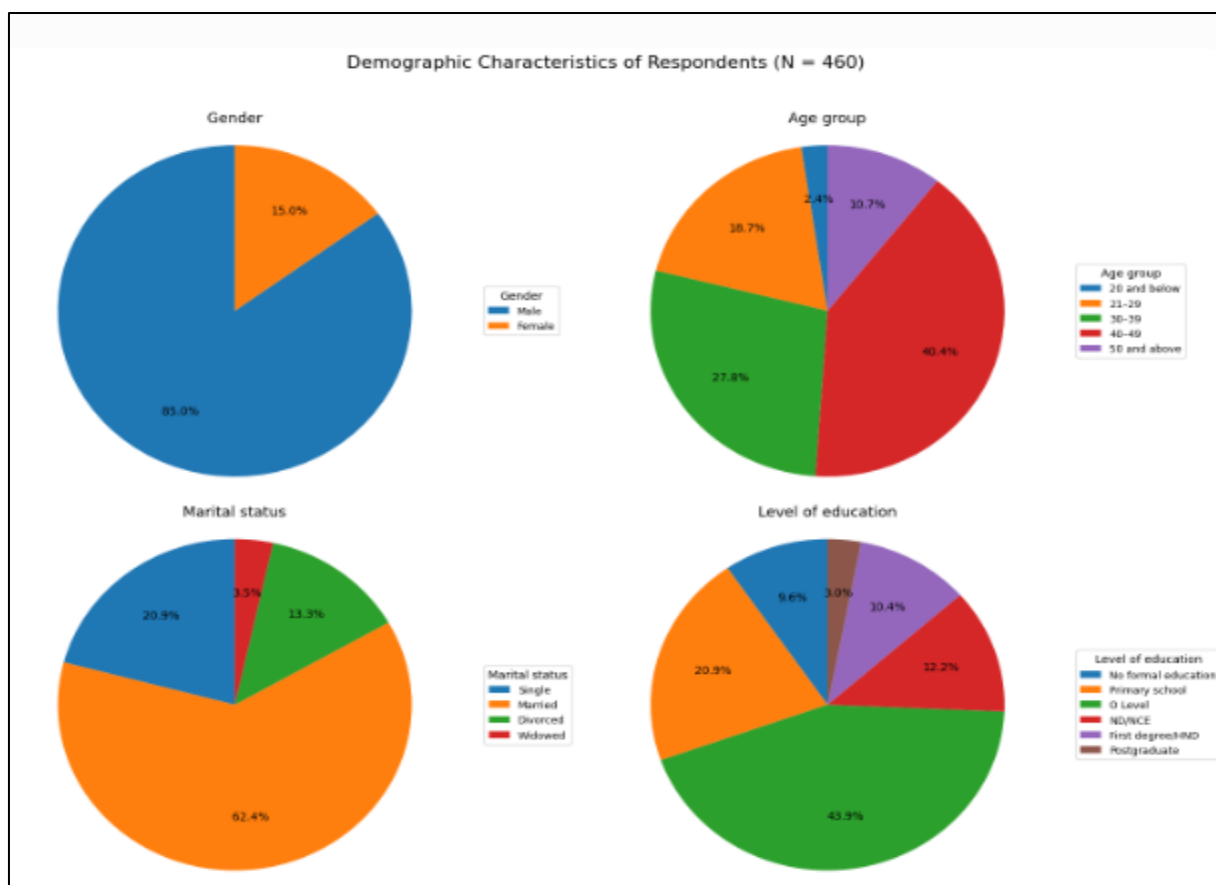


**Figure 1: Demographic pie chart of the respondents**

**Table 2: Harman's Single-Factor Test**

| Component | Eigenvalue (Total) | % of Variance | Cumulative % |
|-----------|--------------------|---------------|--------------|
| 1         | 6.237              | 15.992        | 15.992       |
| 2         | 2.910              | 7.462         | 23.454       |
| 3         | 2.410              | 6.179         | 29.633       |
| 4         | 2.201              | 5.644         | 35.277       |
| 5         | 1.890              | 4.846         | 40.123       |
| 6         | 1.750              | 4.487         | 44.610       |
| 7         | 1.594              | 4.087         | 48.697       |
| 8         | 1.419              | 3.638         | 52.336       |
| 9         | 1.357              | 3.479         | 55.815       |
| 10        | 1.302              | 3.338         | 59.154       |
| 11        | 1.252              | 3.210         | 62.364       |
| 12        | 1.190              | 3.051         | 65.415       |
| 13        | 1.100              | 2.821         | 68.236       |
| 14        | 1.047              | 2.685         | 70.921       |
| 15        | 1.009              | 2.587         | 73.508       |
| 16        | 0.899              | 2.305         | 75.813       |
| 17        | 0.843              | 2.162         | 77.974       |

|    |       |       |        |
|----|-------|-------|--------|
| 18 | 0.797 | 2.044 | 80.018 |
| 19 | 0.737 | 1.890 | 81.908 |
| 20 | 0.703 | 1.803 | 83.710 |
| 21 | 0.614 | 1.574 | 85.285 |
| 22 | 0.593 | 1.521 | 86.805 |
| 23 | 0.559 | 1.433 | 88.238 |
| 24 | 0.521 | 1.336 | 89.574 |
| 25 | 0.499 | 1.279 | 90.854 |
| 26 | 0.419 | 1.074 | 91.928 |
| 27 | 0.403 | 1.033 | 92.962 |
| 28 | 0.350 | 0.897 | 93.859 |
| 29 | 0.340 | 0.872 | 94.731 |
| 30 | 0.315 | 0.808 | 95.538 |
| 31 | 0.293 | 0.751 | 96.290 |
| 32 | 0.258 | 0.662 | 96.951 |
| 33 | 0.253 | 0.649 | 97.600 |
| 34 | 0.209 | 0.536 | 98.136 |
| 35 | 0.170 | 0.436 | 98.572 |
| 36 | 0.158 | 0.405 | 98.977 |
| 37 | 0.148 | 0.379 | 99.356 |
| 38 | 0.133 | 0.341 | 99.697 |
| 39 | 0.102 | 0.262 | 99.959 |

Harman's Single-Factor Test was conducted to assess the potential presence of common method bias in the study on access to finance for food security through sustainable agribusiness performance. The results, presented in Figure 1, indicate that the first factor accounted for approximately 22.9% of the total variance. This value is below the commonly applied 50% threshold, suggesting that a single factor did not account for the majority of the variance in the data as reported by Imhanrenialena *et al.*, (2025). The scree plot further illustrates a progressive decline in eigenvalues across the extracted factors, indicating that the observed variance was distributed among multiple factors. In the context of this study, the pattern is consistent with the multidimensional nature of access to finance, sustainable agribusiness performance, and food security. These dimensions may include credit accessibility, affordability of financing, agricultural productivity, farm income, investment in agricultural inputs, and food availability. Overall, the findings provide preliminary evidence that common method bias is not a dominant concern in the dataset. (Castillo *et al.*, 2026). Nevertheless, Harman's Single-Factor Test has limitations and cannot conclusively rule out common method bias. Therefore, the findings should be interpreted alongside other appropriate diagnostic procedures and the measurement model assessment (Figure 1).

#### 4.1 Measurement Model Evaluation

The measurement evaluation results depicted in Table 3 indicate that the factor loading of each variable's specific items is greater than the recommended benchmark of 0.70. The average variance extracted estimate (AVE) results also support the instrument's validity. For example, the AVE coefficients for financial literacy, sustainable food production, access to funding, and innovative financial service adoption are 0.770, 0.645, 0.835, and 0.856, respectively, which exceed the recommended 0.50 threshold. The instrument's reliability was assessed with both composite reliability and Cronbach's alpha. The composite reliability for financial literacy, sustainable food production, access to funding, and innovative financial service adoption is 0.950, 0.849, 0.829, and 0.966, all of which are higher than the 0.70 benchmark. Cronbach's alpha values for financial literacy, sustainable food production, access to funding, and innovative financial service adoption are 0.934, 0.725, 0.884, and 0.949, respectively. The composite reliability values and Cronbach's alpha coefficients are all significantly higher than the 0.70 threshold, indicating internal consistency. The result from the

variance inflation factor (VIF) analysis shows that all factor-level VIFs from the collinearity test are less than 3.3, an indication that the model is free from common method bias (Ramezani and Mostafavi, 2025).

**Table 3: Confirmatory factor analysis**

| Constructs                            | Loading | VIF   | AVE   | Composite Reliability | Cronbach's Alpha |
|---------------------------------------|---------|-------|-------|-----------------------|------------------|
|                                       | ≥0.7    | <3.3  | ≥0.5  | ≥0.8                  | >0.7             |
| Financial Literacy                    |         |       | 0.770 | 0.950                 | 0.934            |
| FL1                                   | 0.864   | 2.221 |       |                       |                  |
| FL2                                   | 0.881   | 1.423 |       |                       |                  |
| FL3                                   | 0.846   | 2.443 |       |                       |                  |
| FL4                                   | 0.867   | 1.161 |       |                       |                  |
| Sustainable Food Production           |         |       | 0.645 | 0.849                 | 0.725            |
| SFP1                                  | 0.867   | 1.255 |       |                       |                  |
| SFP2                                  | 0.862   | 1.343 |       |                       |                  |
| SFP3                                  | 0.750   | 2.225 |       |                       |                  |
| Access to Agricultural Funding        |         |       | 0.835 | 0.829                 | 0.884            |
| AAF1                                  | 0.927   | 1.701 |       |                       |                  |
| AAF2                                  | 0.947   | 1.534 |       |                       |                  |
| AAF3                                  | 0.849   | 2.255 |       |                       |                  |
| Innovative Financial Service Adoption |         |       | 0.856 | 0.966                 | 0.949            |
| IFSA1                                 | 0.944   | 1.814 |       |                       |                  |
| IFSA2                                 | 0.951   | 1.553 |       |                       |                  |
| IFSA3                                 | 0.936   | 1.526 |       |                       |                  |
| IFSA4                                 | 0.967   | 1.735 |       |                       |                  |

The discriminant validity of the constructs was assessed using the heterotrait–monotrait (HTMT) ratio of correlations method, as displayed in Table 4. The results show that the upper confidence intervals are below 1, while all the HTMT values are different from 1, significantly indicating that the constructs are free from discriminate validity concerns. Also, the obtained HTMT values are below the critical value of the HTMT threshold of 0.85, suggesting that discriminate validity is established (see Table 4).

**Table 4: Discriminant validity**

|      | AAF                     | FL                      | IFSA                    | SFP |
|------|-------------------------|-------------------------|-------------------------|-----|
| AAF  |                         |                         |                         |     |
| FL   | 0.674<br>[0.547; 0.719] |                         |                         |     |
| IFSA | 0.588<br>[0.460; 0.670] | 0.449<br>[0.348; 0.531] |                         |     |
| SFP  | 0.474<br>[0.349; 0.507] | 0.450<br>[0.349; 0.518] | 0.470<br>[0.342; 0.544] |     |

Note: AAF: access to agricultural funding; FL: financial literacy; IFSA: innovative financial service adoption; SFP: sustainable food production.

The model fit analysis was performed using three categories of model fit indices, which are absolute, incremental, and parsimony fit measures (Table 5). The absolute fit indices evaluate the accurate alignments of the sample data with the model's theoretical predictions. The SRMR value of 0.077 is below the 0.08 threshold, indicating an acceptable fit. The GFI value of 0.931 also surpassed the recommended 0.90 cut-off, while the CMIN/DF ratio of 2.644 is less than the acceptable limit of 3.0, confirming model adequacy. Incremental fit indices assess the model's improvement over a null model where variables are uncorrelated. The NFI value of 0.922 and other indices, such as the CFI of 0.940, exceeded the 0.90 benchmark, supporting a satisfactory fit. Parsimony fit indices, which evaluate model efficiency, showed a PCFI value of 0.625, above the 0.50 threshold. Also, the SRMR value of 0.077 falls within the acceptable range. The model's

overall validity was further supported by the dUS and dG discrepancy measures, indicating a robust fit with the data (Amatan *et al.*, 2025).

**Table 5: Model Fit**

| Model Fit Index       | Measures   | Benchmark | Model Value |
|-----------------------|------------|-----------|-------------|
| Absolute Fit Index    | SRMR       | <0.08     | 0.077       |
|                       | Chi-Square | <3.0      | 2.644       |
|                       | GFI        | ≥0.90     | 0.931       |
| Incremental Fit Index | CFI        | ≥0.90     | 0.940       |
|                       | NFI        | ≥0.90     | 0.922       |
|                       | PCFI       | ≥0.50     | 0.625       |
| Parsimony Fit Index   | dULS       | ≥0.50     | 0.811       |
|                       | dG         | ≥0.50     | 0.760       |

SRMR: standardised root mean squared residual; dULS: squared Euclidean distance; dG: geodesic distance; NFI: normed fit index; CFI: comparative fit index; PCFI: parsimony comparative fit index; GFI: goodness-of-fit index.

The proposed hypotheses were tested with partial least squares structural equation modelling (PLS-SEM) analysis, and the results are depicted in Table 6. The independent variable is financial literacy, while sustainable food production, access to funding, and innovative financial service adoption are the dependent variables. The decisions on the proposed hypothesis were taken based on path coefficient values, T-values, R-squared values, and p-values [41,46]. The results from H1 analysis show that financial literacy has a significant positive relationship with sustainable food production among rural Nigerian farmers ( $\beta = 0.743$ , T-value = 9.938 > 1.96,  $R^2 = 0.552$ , and p-value = 0.000 < 0.05). The  $R^2$  value of 0.552 shows that financial literacy explains 55.2% of the variation in sustainable food production. The T-statistic of 9.938 and a p-value of 0.000 confirm the statistical significance of this relationship between financial literacy and sustainable food production among the farmers. The outcomes further suggest in H2 analysis that a positive significant relationship exists between financial literacy and access to agricultural funding ( $\beta = 0.755$ , T-value = 11.782 > 1.96,  $R^2 = 0.571$ , and p-value = 0.000 < 0.05). The  $R^2$  value of 0.571 suggests that financial literacy explains 57.1% of the variance in access to funding. The T-statistic of 11.782 and a p-value of 0.000 also confirm that this relationship is statistically significant. Also, the path from financial literacy to the adoption of innovative financial services captured in H3 suggests a significant positive relationship between the two variables ( $\beta = 0.779$ , T-value = 15.071 > 1.96,  $R^2 = 0.607$ , and p-value = 0.000 < 0.05). An  $R^2$  value of 0.607 implies that financial literacy accounts for 60.7% of the variance in the adoption of such services among the rural farmers. The high T-statistic of 15.071 and the p-value of 0.000 indicate a strong and significant relationship between the two variables.

## 5 CONCLUSION

This study concludes that financial literacy significantly predicts sustainable food production, access to agricultural funding, and adoption of innovative financial services in rural farming communities in Nigeria. This contribution to the development of rural farming in Nigeria is important as it shifts research attention from the dominant topics of diversification, land use, agricultural policies/programmes, and agricultural loans for large-scale agro-allied industries to the neglected area of financial literacy among rural farmers. The findings of this study suggest the need for the Nigerian government and financial authorities to formulate financial inclusion policies that will further broaden the utilisation of financial literacy as a tool to realize economic development objectives in other sectors of the economy. The study suggested areas where future studies could address the limitations of this study. This includes the adoption of a longitudinal design to address the study's limitation of relying on a cross-sectional research design and the evaluation of gender differences in how financial literacy impacts rural farmers, which the current study did not cover.

## STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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