

# Strengthening Food Security Through Digital Agriculture and Youth Empowerment in Nigeria

Augustine I. Wonor  
City University, Cambodia

Gloria Chigbu  
Anchor University Lagos, Nigeria

Maryjane Y. Oghogho  
City University, Cambodia

O.M.C Osazuwa  
City University, Cambodia

Received: 05 Feb 2026 | Received Revised Version: 25 Feb 2026 | Accepted: 10 Mar 2026 | Published: 31 Mar 2026

Volume 08 Issue 03 2026 | Crossref DOI: 10.37547/tajabe/Volume08Issue03-07

## Abstract

*Food security is a critical component of national development, with clear links to agricultural output, youth involvement, and technological innovation. Despite Nigeria's enormous agricultural potential, food poverty remains due to poor youth engagement, limited digital adoption, and ineffective institutional coordination. This study investigates how digital agriculture strengthens food security in Nigeria by increasing youth participation, creativity, and agricultural transformation, utilising the Sustainable Livelihood Framework (SLF) as a theoretical framework. The study uses a descriptive and analytical research design, relying solely on secondary data from peer-reviewed publications, policy documents, and worldwide databases. Comparative analyses were undertaken on worldwide experiences such as India's Digital Agriculture Mission, Kenya's M-Farm, and Brazil's AgroSmart, as well as Nigerian AgriTech platforms such as ThriveAgric, FarmCrowdy, Crop2Cash, and Hello Tractor. The findings show that digital agriculture improves human, financial, and social capital through increased digital literacy, Agri-FinTech inclusiveness, and AI-driven innovation, increasing the four dimensions of food security: availability, access, utilisation, and stability. The study concludes that coordinated digital inclusion, infrastructural investment, and gender-responsive innovation are critical for long-term food system resilience. It contributes to knowledge by demonstrating how digital agriculture improves food security through youth empowerment in Nigeria.*

Keywords: Food security, digital agriculture, youth empowerment, Agri-Fintech, AI-driven.

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**Cite This Article:** Augustine I. Wonor, Gloria Chigbu, Maryjane Y. Oghogho, & O.M.C Osazuwa. (2026). Strengthening Food Security Through Digital Agriculture and Youth Empowerment in Nigeria. The American Journal of Agriculture and Biomedical Engineering, 8(03), 43–59. <https://doi.org/10.37547/tajabe/Volume08Issue03-07>

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## 1. Introduction

## Background to the Study

Food security is a major concern in the twenty-first century, especially in developing nations where variables such as population increase, environmental stress, and economic instability endanger access to adequate and nutritious food. Food security is the state in which all people always have physical, social, and economic access to adequate, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy lifestyle (FAO, 2021). Agriculture is essential to food security in low- and middle-income nations, notably in Sub-Saharan Africa, where it employs over 60% of the workforce and provides a major livelihood. Although important, the industry faces persistent issues such as falling productivity, land degradation, climate variability, and a rising age gap that jeopardise food systems.

Food security underpins global development. By 2030, UN Sustainable Development Goal 2 seeks to end hunger, improve nutrition, and promote sustainable agriculture. This goal emphasises the need for sustainable agricultural systems that can feed growing populations and promote inclusive economic development. Nigeria is not meeting SDG 2 targets, with millions facing acute food insecurity by 2025. This is due to poor agricultural infrastructure, post-harvest losses, and insufficient innovation and human capacity investment (OSSAP-SDGs, 2024; Nnanna, 2024). Low productivity and inefficient supply networks impede Nigeria's agricultural economy, despite its vast fertile land and economic potential. The UN in Nigeria (2025) claims that SDG 2 requires small-scale producers, particularly women and youth, to double their agricultural production and earnings by ensuring secure access to land, technology, and financial services. This supports the need to empower adolescents and use digital tools to improve food system inclusion, adaptability, and efficiency.

Digital agriculture is transforming food systems and ensuring sustainability. Digital agriculture uses information and communication technologies, artificial intelligence, mobile apps, and financial technologies to improve farm management, information access, and farmer-market and input relationships. India, Kenya, and Brazil use digital platforms to boost productivity and market links, affecting food availability and stability. These experiences show that technology-driven initiatives can increase youth agriculture engagement and food system resilience to economic and climatic disturbances. The UN Food Systems Summit (2025)

stressed youth-led innovation and digital tools for global food security.

Despite the sector's strategic importance, food hunger in Nigeria is a development issue. Over 70% of rural people work in agriculture, which accounts for 24% of GDP (National Bureau of Statistics, 2023). Population expansion has outpaced food supply, increasing reliance on imports and price volatility. Youth disengagement from agriculture worsens the problem as an aged farming population and antiquated production methods reduce productivity. The Federal Government's Digital Agriculture Strategy (2020–2030) promotes digital inclusion, young entrepreneurship, and smart agricultural technology to boost food security (NITDA, 2020). AgriTech 2.0 platforms like ThriveAgric, FarmCrowdy, and Hello Tractor show how digital innovations can improve food systems by improving inputs, financing, mechanisation, and markets. By connecting young farmers to agricultural value chain opportunities, these projects directly address food security's availability, access, use, and stability. This is supported by empirical study. Digital literacy enhances youth participation and production, according to Archibong (2025), whereas Sadiq et al. (2025) found that Agri-FinTech platforms help access funding and resources. Awolaye et al. (2025) found that AI technologies aid climate adaption and market forecasting, stabilising food supply. Olawale and Aluko (2024) showed that digital platforms reduce young unemployment and enhance food production.

Despite these advances, little is known about how digital technologies affect Nigerian food security. Many studies have focused on technological adoption without examining its effects on food availability, access, and use. This study seeks to provide a comprehensive, evidence-based analysis of how digital agriculture and youth empowerment collaboratively enhance food security in Nigeria. Digital transformation is used to achieve food security in this study. In line with SDG 2, it contributes to the conversation on resilient and sustainable food systems.

### Statement of the Problem

Despite Nigeria's agricultural capacity and decades of policy, food insecurity persists. Population expansion, climate variability, instability, and declining productivity make inexpensive, nutritious, and safe food scarce for many Nigerians. MORE than 30% of Nigerians endure moderate to severe food insecurity, according to FAO

(2021), indicating a growing gap between national food supply and household demand. This undermines Sustainable Development Goal 2, which seeks to end hunger, secure food, and promote sustainable agriculture by 2030.

Digital agriculture can enhance agricultural efficiency, resilience, and inclusivity, but it struggle to reduce food insecurity in Nigeria. Technology drives agricultural change, according to the Federal Government's Digital Agriculture Strategy (2020–2030) and related projects like N- Power Agro and the Digital Nigeria Initiative. Systemic problems include poor ICT infrastructure, uneven policy execution, and low rural youth digital literacy have hindered adoption (Abe et al., 2025; Okorie, 2025). The lack of unified monitoring and evaluation frameworks limits empirical understanding of how digital tools improve food security outcomes. Current empirical research often views digital agriculture as a monolith, ignoring the distinct roles of AI-driven advisory systems, Agri-FinTech platforms, and mobile-enabled extension tools in improving food system performance. This conceptual generalisation makes it harder to identify technological elements affecting availability, access, use, and stability, the four key dimensions of food security. Thus, policy responses are generally wide and fragmented, failing to address the most important digital levers.

Research and policy discourse on digital agriculture in Nigeria show gender and geographical differences. Research emphasises on urban and southern areas, under-representing Northern Nigeria, where food insecurity and youth unemployment are acute (Musa & Ibrahim, 2022). Similarly, Young women face institutional impediments to digital finance, training, and agripreneurship, which worsen gender inequities in agricultural productivity and income (Eze & Ekwueme, 2023).

There is a critical need for a comprehensive analysis that contextualises digital agriculture and youth empowerment within the broader context of food security. A thorough evaluation of how digital technologies might promote youth involvement and food security; availability, access, use, and stability in Nigeria's regions is needed. The research consolidates secondary data and comparative case studies to create a comprehensive, evidence-based framework for national plans to achieve sustainable food security through inclusive digital transformation.

### **Aim and Objectives of the Study**

The aim of this study is to examine how digital agriculture contributes to strengthening food security in Nigeria through enhanced youth participation, innovation, and agricultural transformation.

#### **The objectives are to:**

1. analyze how digital literacy and AI tools influence food security through youth engagement in agriculture.
2. review global and Nigerian AgriTech cases, to assess their role in enhancing food security.
3. develop a framework linking digital adoption and youth participation to food security dimensions.
4. identify institutional, infrastructural, and policy constraints affecting digital agriculture's impact on sustainable food security in Nigeria.

#### **Research Questions**

1. How do digital literacy and the application of artificial intelligence tools influence food security through youth engagement in agriculture in Nigeria?
2. What lessons emerge from global and Nigerian AgriTech cases regarding their role in enhancing food security?
3. What institutional, infrastructural, and policy constraints limit the impact of digital agriculture on sustainable food security in Nigeria?

#### **Significance of the Study**

This study is significant to policymakers and government institutions responsible for agriculture, youth development, and digital innovation in Nigeria. By empirically examining the link between digital agriculture, youth empowerment, and food security, the study provides evidence-based insights that can inform the formulation and refinement of national policies and programmes. Its findings support the alignment of agricultural and digital economy strategies, offering guidance on how targeted investments in digital tools, skills development, and inclusive innovation can strengthen national food systems and advance progress toward Sustainable Development Goal 2.

The study is also valuable to development partners and international organizations engaged in food security, youth employment, and technological inclusion. By identifying effective pathways through which digital

agriculture enhances youth participation and productivity, the research offers practical knowledge for designing scalable, context-sensitive interventions. These insights can support more efficient allocation of resources, improve programme sustainability, and enhance the developmental impact of donor-funded initiatives across Nigeria's agricultural value chains.

For AgriTech firms and private-sector actors, the study provides strategic relevance by illuminating opportunities for meaningful youth engagement in digital agriculture ecosystems. The findings highlight how digital platforms, precision tools, and data-driven services can be tailored to address youth constraints while improving agricultural productivity. This contributes to the development of viable business models that combine commercial sustainability with social impact, particularly in underserved rural and peri-urban contexts.

The study further benefits young people involved in, or aspiring to participate in, agriculture by demonstrating how digital adoption can expand access to information, markets, and skills. By articulating the empowerment outcomes associated with digital agriculture, the research reinforces youth agency in agricultural transformation and underscores pathways for enhancing livelihoods, employability, and resilience within the sector.

Finally, the study contributes to academic scholarship and research communities by advancing understanding of the intersection between digital technology, youth empowerment, and food system resilience in a developing-country context. It enriches empirical literature on digital agriculture in Nigeria and provides a conceptual basis for future studies examining technology-

driven agricultural transformation, inclusive development, and sustainable food security outcomes.

### Scope of the Study

This study examines the relationship between digital agriculture, youth participation, and food security in Nigeria, with food security as the central focus. It covers key digital agriculture components such as ICTs, mobile applications, AI tools, and AgriFinTech platforms that influence food system outcomes. Geographically, it includes both rural and urban contexts across Nigeria to capture disparities in access and utilization. The research relies solely on secondary data from peer-reviewed literature, policy reports, AgriTech evaluations, and

datasets from the NBS, FAO, and World Bank, covering the period from 2020 to 2025—an era of accelerated digital transformation in agriculture.

### Conceptual Framework

The framework guiding this study is built on the recognition that technological transformation within agriculture can serve as a foundation for achieving sustainable food security (ThriveAgric, 2025). It reflects an integrated perspective in which digital innovations influence the behaviour, capacity, and productivity of young agricultural actors, thereby contributing to the stability and inclusiveness of the national food system (The Markets Online, 2024). This framework is premised on the understanding that modern agriculture extends beyond production to encompass access to finance, knowledge exchange, market linkages, and resilience to external shocks, all of which are increasingly mediated through digital solutions (Osabohien et al., 2020; Sadiq et al., 2025).

Digital agriculture represents a set of interconnected innovations that enable efficiency, connectivity, and inclusivity in the food system. Through mobile applications, digital finance, artificial intelligence, and data-driven platforms, technology enhances access to information, inputs, and markets while reducing the traditional barriers that have historically discouraged youth participation in agriculture. The emergence of platforms such as ThriveAgric, FarmCrowdy, and Hello Tractor exemplifies how digital tools can expand opportunities for participation and improve decision-making in production and marketing processes (ThriveAgric, 2025; Agritech Digest, 2025). These developments contribute to more resilient agricultural systems that are responsive to climatic and market fluctuations, ultimately supporting the continuity of food supply (Musa & Ibrahim, 2022; Olawale & Aluko, 2024).

The framework assumes that when young people are meaningfully integrated into agriculture through digital technologies, they become catalysts of innovation and productivity growth. Their engagement contributes to the strengthening of food systems through improved efficiency, higher output, and diversified livelihoods (Ajiboye & Onuoha, 2024). This process enhances the four fundamental dimensions of food security, ensuring that food is available in sufficient quantities, accessible to households, utilized in nutritionally beneficial ways, and stable over time. In this sense, technology acts as both an enabler and an outcome of broader agricultural

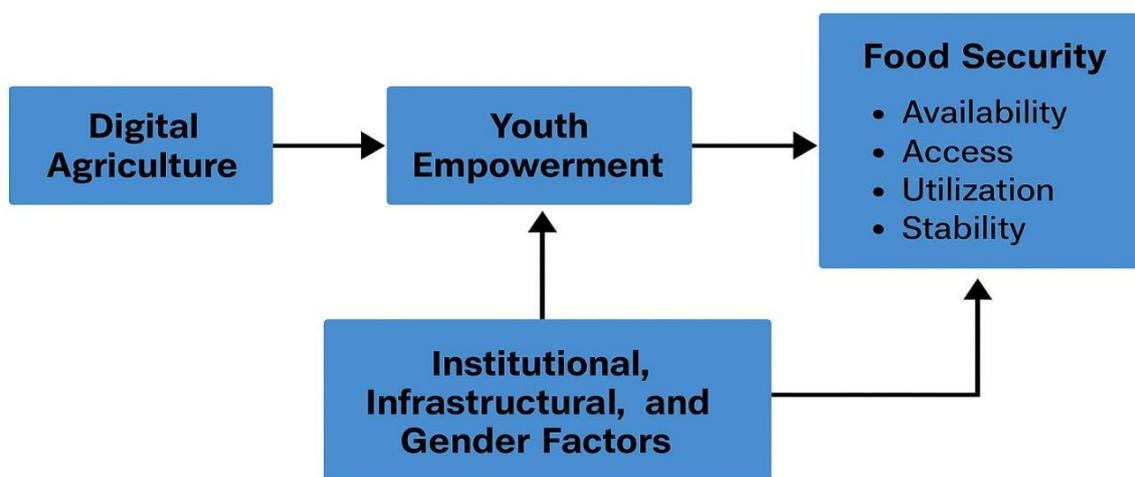
transformation, reinforcing the capacity of communities to meet food needs sustainably (Eze & Ekwueme, 2023; Sadiq et al., 2025).

The realization of these outcomes depends on contextual conditions such as infrastructure, governance quality, and policy coherence. Environments that support digital access, inclusive financing, and gender equity create a more enabling space for agricultural transformation. Conversely, limited connectivity, fragmented institutional arrangements, and socio-economic disparities weaken the ability of technological interventions to achieve meaningful impacts. In

Nigeria, these factors remain uneven across regions,

contributing to persistent spatial and social inequalities in food security outcomes.

Thus, the framework recognises a cyclical relationship in which progress in food security strengthens confidence in digital systems and encourages further technological adoption. As agricultural communities experience tangible improvements in productivity and income, they become more willing to invest in and sustain digital innovations. This continuous interaction highlights the transformative potential of digital agriculture not merely as a technological advancement but as a developmental mechanism that links human capability, innovation, and the long-term security of food systems.



Authors' Conceptual Framework

**Theoretical Review**

**Sustainable Livelihood Framework**

The Sustainable Livelihood Framework (SLF), first proposed by the UK Department for International Development (DFID, 1999) and subsequently developed by researchers like

Chambers and Conway (1992), offers a comprehensive approach to analysing the ways in which individuals and households utilise resources to attain secure, resilient, and sustainable livelihoods. The framework asserts that livelihood outcomes are influenced by the interplay of five fundamental asset categories: human, financial, physical, social, and natural capital, situated within the larger context of institutional structures, policies, and vulnerability conditions. This approach is based on the principle that sustainable livelihoods are essential for achieving food security, as the stability of food systems relies on the strength and interdependence of these

livelihood assets (Awoniyi et al., 2023).

This study utilises the SLF as a conceptual framework to examine the role of digital agriculture in improving food security by enhancing livelihood assets among Nigerian youth. Digital literacy, capacity building, and access to agricultural knowledge enhance human capital, thereby improving young farmers' capacity to adopt innovative and climate-smart agricultural practices (Nigeria Digital Agriculture Strategy, 2020). AgriFinTech platforms enhance financial capital by broadening access to credit, digital payments, and insurance, which stabilises income and facilitates investment in productive ventures (IFAD DAS Program, 2025). Access to mechanisation services and digital infrastructure expands physical capital, as demonstrated by initiatives like Hello Tractor and Crop2Cash, which alleviate labour constraints and improve production efficiency (Awoniyi et al., 2023).

Digital networks enhance social capital by promoting

collaboration, facilitating knowledge sharing, and providing access to markets and extension services. Platforms like ThriveAgric and FarmCrowdy illustrate the potential of digital linkages to incorporate youth into extensive agricultural value chains, thereby improving trust and collaboration among market participants (Nigeria Digital Agriculture Strategy, 2020). Natural capital benefits from the implementation of data-driven and environmentally sustainable practices, facilitated by artificial intelligence and remote sensing tools that enhance input utilisation, manage climate risks, and foster ecological resilience (Awoniyi et al., 2023). The enhanced livelihood assets collectively support the four pillars of food security: availability, access, utilisation, and stability (FAO, 2021).

The application of the SLF in this study facilitates a comprehensive understanding of how digital agriculture enhances the foundations of food security, moving beyond a narrow focus on technology adoption. The framework positions youth empowerment as a catalyst in the livelihood system, highlighting the interdependence of digital transformation, income generation, and sustainable food production. Furthermore, it highlights that food security is not solely a result of agricultural production but rather a function of resilience, inclusion, and equitable access to livelihood resources. The SLF provides a strong analytical framework for assessing the role of digital agriculture in promoting long-term sustainability of food systems in Nigeria (IFAD DAS Program, 2025).

## Empirical Review

### Digital Literacy, Youth Engagement, and Food Security

Empirical evidence consistently highlights the importance of digital literacy in enhancing youth engagement and supporting national food security. Archibong (2025) conducted a survey-based study in Akwa Ibom State, utilising a stratified random sample of 300 young farmers to evaluate the impact of digital competence on agricultural participation. Regression analysis revealed a positive correlation between higher digital literacy levels and increased productivity, the adoption of advanced technologies, and improved food availability. Infrastructural deficits, especially in rural regions, restricted equitable access to digital tools, thus limiting the transformative potential of technology.

Eze and Ekwueme (2023) utilised a mixed-methods

approach involving 250 rural youths in Kaduna and Oyo States, demonstrating that access to ICT tools significantly improved productivity, enhanced input efficiency, and contributed to food stability at the household level. Regional disparities in connectivity and digital training exacerbate inequalities in food access and utilisation. Their findings indicate that enhancing digital literacy and ICT penetration is crucial for both youth empowerment and the attainment of sustainable food security outcomes.

### Agri-FinTech Platforms and Access to Agricultural Finance

Access to finance constitutes a significant barrier to attaining food security via enhanced agricultural participation. Sadiq et al. (2025) conducted an analysis of data from 400 young farmers in Northern Nigeria employing logit regression. The study revealed that digital financial innovations, including e-wallets, mobile savings, and input credit systems, significantly enhanced access to credit, stabilised income, and promoted market participation. The financial inclusion significantly improved productivity and food availability within local value chains.

Musa and Ibrahim (2022) conducted a study involving 150 youth agripreneurs in Kano and Bauchi States, utilising data from the ThriveAgric and FarmCrowdy platforms. The findings indicated that digital financial systems reduced entry barriers, increased access to credit, and facilitated sustainable livelihoods. Nonetheless, limited smartphone penetration and inadequate network connectivity restricted wider participation. The studies collectively demonstrate that Agri-FinTech platforms are essential in connecting youth engagement, inclusive finance, and food system resilience in Nigeria.

### Artificial Intelligence and ICT in Agricultural Knowledge Systems

The integration of artificial intelligence (AI) and ICT-based tools has significantly enhanced agricultural decision-making, risk management, and the sustainability of food systems. Awoloye, Adebisi, and Atoloye (2025) performed a pilot study examining an AI-powered advisory system with 120 indigenous farmers in Southwestern Nigeria. The findings indicate that AI applications enhanced climate adaptation, pest control, and market intelligence, thus reinforcing food availability and stability.

Akintola and Okeke (2021) employed a quasi-experimental design with 200 youth farmers in Enugu State to assess the effects of mobile decision-support tools. Analysis following the intervention indicated enhanced agronomic knowledge, increased yields, and improved market access. The findings indicate that AI-driven technologies and ICT tools are essential in mitigating information asymmetries and improving food system efficiency, particularly among technologically literate youth populations.

### **Digital Agriculture, Youth Entrepreneurship, and Food System Resilience**

The convergence of digital agriculture and youth entrepreneurship has become a significant factor in enhancing food security in Nigeria. Olawale and Aluko (2024) conducted an analysis of data from 350 youth farmers in Southwestern Nigeria, revealing that engagement with platforms such as Hello Tractor and Crop2Cash significantly mitigated youth unemployment and fostered agribusiness development. Digital systems facilitated mechanisation and market access, resulting in enhanced production and stable food supply chains.

Ajiboye and Onuoha (2024) conducted a mixed-methods study with 200 youth farmers in Oyo and Lagos States, demonstrating that digital transformation promotes entrepreneurial innovation and enhances food accessibility in peri-urban regions. Persistent challenges in connectivity and credit access continue to disadvantage rural youth. These studies collectively illustrate that youth-led digital entrepreneurship strengthens food system resilience through the integration of innovation, employment, and agricultural productivity.

### **Institutional and Policy Dynamics in Digital Agricultural Transformation**

Although digital agriculture has the potential to enhance food security, inefficiencies in institutions and policies persistently obstruct advancement. Abe et al. (2025) performed a policy review utilising data from the National Bureau of Statistics and the FAO, indicating that national programs like the e-Wallet and N-Power Agro have experienced inadequate coordination, inconsistent implementation, and insufficient monitoring. The identified deficiencies diminish the long-term efficacy of food system resilience.

Okorie et al. (2025) analysed communication systems within Nigeria's agricultural digitalisation strategy,

identifying that insufficient ICT infrastructure, inadequate inter-agency collaboration, and inconsistent regulatory frameworks hinder digital adoption. Fragmented governance structures hinder the incorporation of youth-oriented digital innovations into comprehensive national food security policies. Therefore, effective policy coherence and institutional strengthening are essential for optimising the food security potential of digital agriculture.

### **Digital Transformation and Food Security Outcomes**

Recent studies that explicitly connect digital transformation to food security outcomes underscore the complex and multifaceted nature of this relationship. The FAO (2021) asserts that digital technologies affect all four aspects of food security: availability, access, use, and stability. They do this by improving production, market efficiency, and resilience. Osabohien et al. (2020) established that ICT-based agricultural systems improve food supply chains and household welfare in West Africa.

According to the World Bank (2022), regions in Nigeria that exhibit higher levels of digital integration demonstrate improved food availability and decreased post-harvest losses. Awolaye et al. (2025) demonstrated that digital forecasting tools enhance food stability by facilitating adaptive responses to climate shocks. The findings support the notion that the effective integration of digital agriculture with youth empowerment and institutional support is crucial for achieving sustainable food security in Nigeria.

## **2. Methodology**

This study employs a descriptive and analytical research design to investigate the role of digital agriculture in enhancing food security in Nigeria, focussing on increased youth participation, innovation, and agricultural transformation. This study, informed by the Sustainable Livelihood Framework (SLF), examines the impact of digital technologies on the five livelihood assets: human, financial, physical, social, and natural capital. It further analyses how these assets collectively contribute to the enhancement of food availability, access, utilisation, and stability.

The study utilises secondary data obtained from credible sources, including peer-reviewed journals, policy reports, and institutional databases such as the FAO, IFAD, World Bank, and the National Bureau of Statistics (NBS). The review examined studies published from

2020 to 2025, highlighting current trends in digital agriculture and food system resilience. A comparative case analysis was performed to extract insights from both global and Nigerian contexts. International experiences from Kenya (M-Farm, DigiCow), India (Digital Agriculture Mission, e-NAM), and Brazil (AgroSmart, Solinftec) were analysed in comparison to Nigerian platforms including ThriveAgric, FarmCrowdy, Crop2Cash, and Hello Tractor. Data were analysed through qualitative content analysis and thematic synthesis, supplemented by descriptive summaries of relevant indicators.

### 3. Results

#### Impact of Digital Literacy on Food Security through Youth Engagement

Digital literacy is essential for food security, improving young farmers' ability to access, process, and utilise agricultural knowledge effectively. Archibong (2025) demonstrated that youths exhibiting high digital competence in Akwa Ibom State were significantly more inclined to adopt advanced agricultural technology, resulting in enhanced farm productivity and improved food availability and household nutrition. This is consistent with the findings of Liu et al. (2024), which indicate that digital literacy improves ecological cognition and fosters sustainable production behaviour in China, leading to more stable food supplies. Digital literacy in Nigeria empowers youth to leverage e-extension platforms, mobile advisory services, and virtual learning tools, thereby enhancing informed decision-making and promoting environmental protection. Ongoing deficiencies in ICT infrastructure and educational access, particularly in rural areas, impede the ability of digitally literate youth to effectively translate technical access into improved food security outcomes (Eze & Ekwueme, 2023).

#### Role of Agri-FinTech Platforms in Strengthening Food System Resilience

Agri-FinTech platforms like ThriveAgric, Crop2Cash, and FarmCrowdy have significantly contributed to enhancing food security by enabling youth to access finance, agricultural inputs, and organised markets. Sadiq et al. (2025) found that digital financial innovations enhanced youth farmers' capacity to obtain credit, acquire inputs, and invest in productive activities, leading to increased agricultural output and food availability. Digital platforms address traditional

financial barriers that have historically restricted youth involvement in food production. Olawale and Aluko (2024) demonstrated that the adoption of AgriTech platforms by youth in Southwestern Nigeria significantly enhanced food production and decreased rural unemployment. Musa and Ibrahim (2022) found that digital finance initiatives in Northern Nigeria improved the sustainability of youth livelihoods, facilitating household food access and economic stability. The evidence highlights that Agri-FinTech serves as a significant driver of resilient and inclusive food systems, beyond being a mere financial innovation.

#### Integration of Artificial Intelligence in Enhancing Food System Efficiency

Artificial intelligence (AI) is increasingly acknowledged as a significant factor in enhancing food security by facilitating improved agricultural precision, effective risk management, and adaptive strategies to environmental stressors. Awoloye et al. (2025) conducted a pilot study on an AI-powered virtual assistant designed to assist youth farmers in optimising pest control and adapting to climate changes, resulting in enhanced yields and decreased post-harvest losses. Olagunju (2024) observed that AI facilitates youth engagement by streamlining intricate decision-making processes and providing tailored recommendations that enhance input efficiency and crop productivity. AI applications enhance stability and predictability within food systems, especially in areas susceptible to climate-related disruptions. Digital literacy, infrastructural adequacy, and perceived ease of use are essential factors influencing AI adoption among youth farmers, aligning with Rogers' (2003) Innovation Diffusion Theory.

#### Regional Disparities and Unequal Food Security Outcomes

Significant regional disparities persist in influencing the interplay between digital agriculture and food security in Nigeria. Research indicates that Southern and urban areas possess enhanced ICT infrastructure and access to digital platforms, resulting in increased productivity and improved food availability. Northern and rural areas experience ongoing digital exclusion, which intensifies youth unemployment and food insecurity. Musa and Ibrahim (2022) noted that the restricted reach of AgriTech programs in Northern Nigeria has hindered the region's ability to fully benefit from innovations that could enhance food access and stability. The Nigeria Digital Agriculture Strategy (2020–2030) recognises

existing inequalities and advocates for targeted interventions; however, inconsistent policy execution perpetuates regional disparities (NITDA, 2020). Addressing these gaps is crucial for attaining national food security and facilitating equitable distribution of the advantages of digital transformation.

### **Gender Disparities and Food Security Implications**

Gender-based exclusion continues to significantly hinder the attainment of equitable food security outcomes within Nigeria's digital agriculture ecosystem. Sufian et al. (2023) identified that women, especially in rural regions, encounter structural obstacles in accessing digital tools, attributed to cultural norms, educational constraints, and insufficient infrastructural support. Afia (2023) noted that female youth are under-represented in digital agriculture initiatives, resulting in disparities in access to credit, training, and market information. These disparities limit women's involvement in agricultural value chains and negatively impact household food availability and nutrition. Ensuring gender inclusion via targeted digital literacy programs, accessible financing mechanisms, and gender-responsive policies is essential for achieving sustainable food security and optimising the socio-economic advantages of digital agriculture.

### **Global Evidence on Digital Agriculture and Food Security through Youth Empowerment**

Global evidence indicates that when young individuals are provided with digital technologies that enhance market access, promote financial inclusion, and support climate-resilient production, they serve as catalysts for improving food security. Digital agriculture has enhanced food system resilience across various agricultural systems by increasing productivity, minimising post-harvest losses, and optimising resource use. These worldwide models provide crucial lessons for Nigeria, where persistent youth unemployment and food insecurity continue to impede progress towards Sustainable Development Goal 2 (Zero Hunger), despite enormous agricultural potential and fertile arable land.

### **Kenya: M-Farm and DigiCow as Catalysts for Food System Efficiency**

The digital agriculture ecosystem in Kenya demonstrates how innovations led by youth significantly enhance food security through improved productivity, market integration, and income stability. Platforms like M-Farm and DigiCow, created and managed by Kenyan youth, offer real-time market data, digital payment solutions,

and livestock management tools. These innovations have enhanced food availability and access by allowing smallholders to make production and marketing decisions based on data. Kariuki et al. (2022) demonstrated that the implementation of M-Farm and DigiCow enhanced farm profitability and mitigated information asymmetry, thereby promoting a more stable food supply in local markets. The Kenyan model illustrates that digital agriculture, supported by youth involvement, can enhance food systems by reducing transaction costs and optimising the distribution of agricultural products. Comparable initiatives in Nigeria, including Crop2Cash and FarmCrowdy, have demonstrated similar potential for enhancing food access and market efficiency (Sadiq et al., 2025; Olawale & Aluko, 2024).

### **India: Digital Agriculture Mission and AI-Driven Advisory Systems for Food Sustainability**

The Digital Agriculture Mission of India (2021) illustrates the potential of coordinated national policy and digital innovation to enhance food security through the promotion of precision agriculture and climate adaptation. The initiative combines artificial intelligence, remote sensing, and predictive analytics to deliver real-time, localised advisory services. Singh and Sharma (2023) found that AI-based advisory systems enhanced soil health management, optimised fertiliser application, and minimised yield losses, consequently improving food availability and stability at household and regional levels. Young farmers have utilised these technologies to implement sustainable and resource-efficient practices that enhance the resilience of food systems. The Indian experience aligns with findings from Nigeria, where AI-driven tools have enhanced pest management and climate responsiveness among young farmers (Awolaye et al., 2025). In contrast to India's systematic policy framework, Nigeria's digital agriculture initiatives are characterised by fragmentation and inconsistent implementation (Abe et al., 2025), which restricts their potential impact on national food security objectives.

### **Brazil: AgroSmart and Solinftec as Models for Climate-Resilient Food Systems**

Brazil provides important insights into the role of youth-centered digital cooperatives in improving food security via climate-smart agricultural innovations. AgroSmart and Solinftec utilise Internet of Things (IoT) sensors, data analytics, and digital cooperative models to enhance irrigation efficiency, assess crop health, and optimise

resource allocation. Fernandes et al. (2023) found that these technologies decreased water consumption and enhanced yields, thereby supporting food availability and sustainability in the face of environmental stressors. Through resource pooling and collaboration among young agripreneurs, these platforms have improved access to technology and markets, thereby promoting equitable food distribution and mitigating vulnerability to climate shocks. The Brazilian model highlights the importance of digital inclusivity and shared infrastructure in enhancing livelihood resilience and ensuring long-term food security.

### **The Nigerian Experience: AgriTech 2.0 and Food Security through Youth Inclusion**

Nigeria's developing digital agriculture ecosystem, propelled by private-sector innovation and bolstered by targeted government interventions, has become a crucial strategy for tackling food insecurity. The second-generation AgriTech platforms, known as AgriTech 2.0, integrate mobile technology, financial technology, and data analytics to improve productivity, broaden market access, and promote youth-led agricultural ventures. These platforms enhance youth inclusion while reinforcing national food systems through improvements in the four dimensions of food security: availability, access, utilisation, and stability.

### **Thrive Agric: The Role of Digital Finance in Enhancing Food Availability and Stability**

Thrive Agric demonstrates the impact of digital finance and data-driven tools on food production and stability in Nigeria. Thrive Agric's AYuTe Project, in collaboration with Heifer International and Crust Microfinance Bank, has empowered more than 125,000 youth and smallholder farmers in eight northern states, including Kaduna, Kano, and Bauchi (ThriveAgric, 2024). The platform's digital credit scoring and input financing mechanisms facilitate timely access to loans and essential inputs for farmers, thereby enhancing crop yields and mitigating production volatility. ThriveAgric improves resource allocation efficiency and reduces risks related to crop failure through the integration of data analytics in credit assessment. The outcomes enhance food availability and stabilise local food supply chains, particularly in areas historically prone to food insecurity.

### **FarmCrowdy: A Platform for Crowdsourced Investment in Food Accessibility and Economic Inclusion**

FarmCrowdy exemplifies a novel method for democratising agricultural investment and enhancing food access through participatory digital finance. Nigeria's inaugural digital agriculture platform facilitates connections between youth and smallholder farmers and sponsors who supply capital for production cycles, thereby enabling resource-limited farmers to participate in commercial farming. The platform provides training and ensures market access, thereby minimising post-harvest losses and enhancing food distribution networks (Naija Trends, 2024; Empower Africa, 2023). FarmCrowdy's inclusive model enhances the purchasing power and production capacity of rural youth, thereby improving food access at both household and community levels. The platform demonstrates that youth-driven digital investment ecosystems can concurrently create employment, alleviate hunger, and improve the affordability and variety of food in local markets.

### **Hello Tractor: Innovative Mechanisation for Agricultural Productivity and Labour Efficiency**

Hello Tractor enhances food security in Nigeria by tackling a significant production constraint: the lack of mechanisation. The mechanisation gap, characterised by fewer than 7,000 tractors for over 38 million farmers, has significantly hindered agricultural productivity and efficiency. Hello Tractor's GPS-enabled booking system facilitates the connection between tractor owners and young farmers, promoting equitable access to mechanised services and enhancing land cultivation capacity (Challenge Fund for Youth Employment, 2025). The MechHub initiative, jointly supported by Heifer International and the Federal Government, promotes youth-led agribusiness via smart mechanisation. Hello Tractor enhances food availability and supply chain stability by reducing labour bottlenecks, improving the timeliness of land preparation, and increasing crop yields. The success observed in northern Nigeria highlights the significance of targeted infrastructure and regional policy support in attaining equitable food security outcomes.

### **Crop2Cash: Enhancing Financial Inclusion to Strengthen Food Systems**

Crop2Cash enhances food security through the promotion of financial inclusion and the provision of reliable access to quality inputs for youth farmers. The platform operates in 13 states and serves more than 500,000 farmers by offering mobile-based credit access, input procurement, and digital recordkeeping services

(Crop2Cash, 2025). Empirical studies indicate that Crop2Cash users achieved income growth of up to 70% and yield increases of 35%, attributed to enhanced access to finance and climate-smart inputs (AgFunder News, 2022). These enhancements directly improve food availability and utilisation, while financial tracking and digital recordkeeping promote accountability and sustainable production. Crop2Cash's extensive regional coverage illustrates the potential of digital finance to enhance the resilience of Nigeria's food systems by mitigating vulnerability to price fluctuations and optimising supply chain coordination.

### **Digital Agriculture and Food Security outcomes**

Digital agriculture has emerged as a transformative mechanism for enhancing food security by addressing the four key dimensions identified by the Food and Agriculture Organisation: availability, access, utilisation, and stability. In Nigeria, the incorporation of digital tools, including artificial intelligence, mobile finance, precision technologies, and virtual advisory systems, has started to address structural constraints that hinder food production and distribution. The growing involvement of youth in digital ecosystems modernises agricultural practices and improves the resilience and sustainability of national food systems.

### **Food Availability: Enhancing Productivity through Precision and Predictive Tools**

The availability of food, influenced by agricultural production and resource efficiency, has significantly improved due to the implementation of precision farming technologies and AI-driven analytics. Platforms like ThriveAgric and Crop2Cash provide access to data-driven agronomic recommendations, input financing, and climate-smart resources, enhancing crop yields for youth farmers (ThriveAgric, 2024; Crop2Cash, 2025). Awolaye et al. (2025) demonstrated that integrating AI-powered advisory tools for pest control, soil diagnostics, and irrigation scheduling significantly enhanced farm productivity and minimised crop loss. International evidence, exemplified by India's Digital Agriculture Mission, underscores the significance of artificial intelligence in enhancing crop cycles and reducing input waste (Singh & Sharma, 2023). The findings indicate that youth utilising predictive analytics and precision technologies can improve national food availability by increasing production efficiency and minimising post-harvest losses.

### **Food Access: Strengthening Market Connectivity and Financial Inclusion**

Digital platforms significantly enhance food access by linking smallholder youth farmers to markets, credit facilities, and value chains. Platforms such as FarmCrowdy and Crop2Cash offer real-time market data, facilitate input procurement, and enhance mobile-based credit access, thereby lowering transaction costs linked to conventional agricultural markets (Sadiq et al., 2025). These platforms enhance the purchasing power and income generation capacity of youth farmers, thereby improving their ability to acquire food and invest in agricultural operations. Kenya's M-Farm has achieved significant outcomes by providing rural youth with access to transparent market prices and direct connections to buyers (Kariuki et al., 2022). Digital agriculture enhances financial and logistical inclusion, thereby improving both the physical and economic accessibility of food and connecting production areas with urban consumption centres.

### **Food Utilisation: Advancing Knowledge for Nutritional and Sustainable Practices**

Food utilisation involves not only production but also the effective application of food, which requires a thorough understanding of nutrition, processing, and safe handling practices. Digital agriculture platforms like Hello Tractor and FarmCrowdy provide virtual training and e-extension services that equip youth with knowledge in agronomy, post-harvest practices, and nutrition. Olawale and Aluko (2024) demonstrated that digital training modules improve the ability of youth farmers to implement enhanced agricultural practices, resulting in superior food quality and safety outcomes. Brazil's AgroSmart platform illustrates that ICT-enabled advisory systems can enhance climate-smart and nutrition-sensitive farming within youth-led cooperatives (Fernandes et al., 2023). These innovations demonstrate that digital agriculture enhances food utilisation through the dissemination of knowledge and the promotion of data-informed production and consumption patterns, effectively addressing shortcomings in traditional extension systems.

### **Food Stability: Building Resilience through Data and Early Warning Systems**

The stability of food systems, defined as their capacity to endure shocks and sustain a reliable supply, is increasingly bolstered by digital tools that facilitate

adaptive responses to environmental and market changes. Early warning systems, AI-driven weather forecasting, and satellite-based data platforms enable young farmers to predict climate risks, pest outbreaks, and price fluctuations. Awolaye et al. (2025) demonstrated that AI-driven forecasting markedly improves resilience through the facilitation of proactive resource allocation and adaptive planning. Nonetheless, these advantages are not uniformly allocated owing to variations in infrastructure. Musa and Ibrahim (2022) noted that rural and northern communities encounter ongoing obstacles, such as inadequate connectivity and restricted access to digital devices, which hinder their capacity to leverage stability-enhancing innovations. Investing in ICT infrastructure and promoting regional inclusion is essential for maintaining the food security advancements realised through digital agriculture.

### **Institutional and Structural Challenges Affecting Digital Agriculture and Food Security**

Nigeria faces significant institutional and structural barriers, hindering the potential of digital agriculture to enhance food security and empower youth. The challenges limit the scalability, inclusivity, and sustainability of digital agricultural systems, thereby hindering stable food availability, equitable access, and resilient utilisation patterns.

### **Fragmented Policy Implementation and weak Institutional Coordination**

Nigeria has launched various government programs, including the e-Wallet system and N-Power Agro, aimed at enhancing digital inclusion and engaging youth in agriculture; however, the effectiveness of these initiatives is constrained by inadequate institutional coordination. Research conducted by Abe et al. (2025) and Okorie et al. (2025) indicates ongoing deficiencies in program design, implementation monitoring, and collaboration among ministries. The absence of a cohesive digital agriculture framework leads to redundant interventions, ineffective resource allocation, and variable support for smallholder and youth farmers.

The fragmentation compromises the coherence necessary for the integration of digital agriculture into the overarching national food security agenda. In contrast, nations like India and Brazil have established coordinated digital agriculture strategies that integrate technological innovation with national food security objectives (Singh & Sharma, 2023; Fernandes et al.,

2023). Nigeria's

Digital Agriculture Strategy (2020–2030) outlines comparable objectives; however, it largely remains aspirational due to the lack of enforceable implementation plans, fiscal alignment, and mechanisms for performance accountability. Enhancing institutional coordination and aligning policies is essential for converting digital innovation into measurable food security results.

### **Gender Disparities and Unequal Access to Digital Opportunities**

Gender-based exclusion constitutes a structural barrier to achieving inclusive food security via digital agriculture. Young women, especially in rural areas, encounter overlapping challenges including low digital literacy, restricted financial independence, and persistent sociocultural constraints (Sufian et al., 2023; Afia, 2023). Eze and Ekwueme (2023) identified that restricted access to smartphones and digital training for women leads to a markedly lower adoption of AgriTech platforms in comparison to men.

This exclusion restricts women's involvement in digital agriculture and negatively impacts food system productivity and household nutrition, which are essential aspects of food utilisation and access. Research indicates that digital empowerment of women results in the reinvestment of earnings into food and family welfare, thereby enhancing nutrition and stability (FAO, 2021). Mainstreaming gender-sensitive design, promoting targeted digital literacy programs, and ensuring equitable financing mechanisms are essential for achieving comprehensive and sustainable food security outcomes.

### **Infrastructure Deficits and Private Sector Limitations**

Infrastructure deficits, especially in rural and northern areas, constitute a significant obstacle to digital agriculture and, consequently, food security. Poor internet connectivity, inconsistent electricity supply, and the elevated costs of digital devices persistently hinder youth farmers' access to online platforms and data services. Musa and Ibrahim (2022) observed that these constraints substantially hinder the utilisation of digital agriculture tools aimed at improving productivity, forecasting weather patterns, and enabling market access.

The private sector, exemplified by initiatives like Hello

Tractor and ThriveAgric, has shown notable innovation; however, its ability to scale these solutions is limited by insufficient regulatory support and a lack of strong institutional partnerships (ThriveAgric, 2024; Challenge Fund for Youth Employment, 2025). The absence of a national agricultural data infrastructure hinders real-time monitoring, impact assessment, and coordinated response mechanisms vital for the management of food supply chains and market stability.

Investment in rural broadband, renewable energy solutions and interoperable data systems is essential for realising the full potential of digital agriculture as a catalyst for food system resilience. Enhancing public-private collaboration and implementing policy reforms are essential for addressing these obstacles and promoting Nigeria's advancement towards Sustainable Development Goal 2 (Zero Hunger).

#### 4. Discussion

The primary finding indicates that digital literacy is essential for increasing youth participation in agriculture and enhancing food security results. Youths exhibiting elevated digital competence demonstrated a greater propensity to adopt e-extension services, utilise precision agriculture tools, and engage in data-informed decision-making. This finding reinforces the notion that the development of human capital is essential for agricultural transformation. This supports Archibong's (2025) findings that digital competence in Akwa Ibom State significantly enhanced youth productivity and engagement, and is consistent with Eze and Ekwueme's (2023) research indicating that ICT access improved agricultural decision-making among rural youth. This study enhances existing knowledge by demonstrating that digital literacy facilitates participation and mediates access to various elements of digital agriculture, including finance, AI applications, and online markets.

According to the SLF, digital literacy enhances human capital by augmenting the skills, knowledge, and adaptive capacities necessary for young individuals to achieve resilient and sustainable livelihoods. This finding aligns with the research of Liu, et al (2024), which indicates that digital literacy enhances ecological awareness and sustainable production behaviours among Chinese farmers, highlighting the connection between digital competence and sustainable food systems. In contrast to global initiatives like India's Digital Agriculture Mission (2021), which prioritises digital education nationally, Nigeria's fragmented approach to

digital training programs restricts its effectiveness for rural youth. This study underscores the necessity of institutionalising digital capacity-building as a fundamental element of national food security policy, acknowledging that resilience in food systems is rooted in improved human capital.

The second finding indicates that Agri-FinTech platforms, including ThriveAgric, Crop2Cash, and FarmCrowdy, have notably enhanced youth access to finance, inputs, and markets, leading to increased productivity and income stability. This finding indicates that access to financial capital is a crucial factor influencing livelihood resilience and food security. This is consistent with the findings of Sadiq et al. (2025), which indicate that digital credit systems enhance the purchasing power of young farmers, and with the observations of Musa and Ibrahim (2022), who noted that mobile finance tools in Northern Nigeria lowered entry barriers for youth agricultural entrepreneurs. Within the SLF framework, these platforms enhance financial capital through the diversification of income sources, the improvement of liquidity, and the mitigation of vulnerability to market fluctuations.

This study demonstrates that Agri-FinTech adoption exhibits regional variations, with Southern Nigeria exhibiting higher participation levels than the North, attributed to infrastructural disparities and lower digital literacy rates. This regional disparity reflects results from Kenya's M-Farm initiative, indicating that urban youth gained more advantages than those in rural areas due to superior connectivity (Kariuki et al., 2022). The study finds that Nigeria's emerging FinTech ecosystem, particularly the integration of data analytics and predictive credit scoring in platforms like ThriveAgric, parallels innovations in India's e-NAM and Brazil's AgroSmart (Singh & Sharma, 2023; Fernandes et al., 2023). The identified parallels indicate that digital financial inclusion can enhance financial resilience and facilitate improved access to food when integrated into cohesive agricultural policies.

The third finding indicates that artificial intelligence (AI) and precision agriculture technologies enhance youth engagement and agricultural productivity, consequently improving food availability and stability. AI tools have been identified as beneficial for climate adaptation, pest control, and efficient input management, resulting in substantial yield improvements. This finding supports the observations of Awolaye et al. (2025), who noted that AI-powered advisory tools enhanced agronomic

decision-making and decreased post-harvest losses, as well as those of Akintola and Okeke (2021), who found increased crop yields among youth utilising mobile decision-support systems. Through the lens of the SLF, AI and digital mechanisation improve physical capital by equipping young farmers with tools and technologies that enhance production efficiency and alleviate labour constraints. This study examines the relationship between technological adoption and food security outcomes, illustrating that increased productivity from AI adoption leads to greater food availability and system stability. India's AI-driven advisory platforms and Brazil's Solinftec exhibit comparable positive effects on precision agriculture; however, Nigeria's advancement is hindered by infrastructure deficiencies and a lack of technological literacy. This contrast supports the conclusion that AI integration, with sufficient physical infrastructure, can act as a catalyst for transforming livelihoods sustainably and enhancing food system resilience.

The fourth finding highlights ongoing regional and gender disparities in the adoption of digital agriculture, which directly influence food security outcomes. Youths in Southern Nigeria experience enhanced ICT infrastructure and improved connectivity, while their counterparts in Northern regions encounter considerable limitations. Young women face various obstacles, such as restricted access to finance, inadequate digital training, and sociocultural acceptance, which impede their involvement in digital agriculture. The findings are consistent with Sufian et al. (2023) and Afia (2023), who observed that gender-based digital exclusion hinders women's agricultural productivity and constrains household food security. Inclusive participation within the SLF enhances social capital by fostering networks, trust, and collaboration that are crucial for collective resilience. Platforms like ThriveAgric and FarmCrowdy have established virtual communities that facilitate market access and peer learning; however, disparities in access undermine the essential social fabric required for collective advancement. This observation is consistent with international cases such as Kenya's DigiCow and Brazil's AgroSmart, which have effectively incorporated gender-responsive training and youth engagement initiatives (Kariuki et al., 2022; Fernandes et al., 2023). This study contends that tackling gender and regional disparities via focused infrastructure investment and inclusive program design is essential for enhancing social capital and guaranteeing equitable distribution of digital agriculture benefits among demographic groups.

The final finding presents comprehensive evidence that digital agriculture enhances all four pillars of food security; availability, access, utilisation, and stability, by cumulatively strengthening livelihood assets. Precision agriculture technologies enhance yields and minimise input waste, thereby improving food availability. Agri-FinTech platforms facilitate access to finance and markets. Digital advisory systems foster knowledge sharing and promote better nutritional practices, supporting utilisation. Additionally, data-driven tools improve climate adaptation and risk management, contributing to stability. The findings align with Olawale and Aluko (2024), who noted that digital platforms enhanced food production and decreased youth unemployment, and with Awoleye et al. (2025), who reported that AI tools bolstered climate resilience. The impacts within the SLF demonstrate the interconnectedness of livelihood assets, indicating that enhancements in human, financial, physical, social, and natural capital collectively strengthen sustainable livelihoods and ensure food systems. This study builds on prior research by presenting an integrated model that connects digital transformation to food system resilience, illustrating that food security results from sustained, inclusive, and adaptive livelihood systems rather than solely from production outcomes.

Nigeria's digital agriculture ecosystem, while promising, is constrained when compared to global models like India's Digital Agriculture Mission, Kenya's M-Farm and DigiCow, and Brazil's AgroSmart and Solinftec. These nations have integrated digital transformation into cohesive national food security strategies, facilitating institutional coordination, data integration, and inclusive participation. The fragmented implementation, infrastructural deficits, and policy inconsistency in Nigeria persistently hinder the scalability of its digital agriculture programs. The findings of this study indicate that integrating digital agriculture into a cohesive sustainable livelihood strategy can enhance efforts to achieve food security and the Sustainable Development Goal 2 (Zero Hunger).

## 5. Recommendations

Establishing national digital literacy and capacity-building programmes for rural youth and women is the foremost priority. Beyond short-term training, these initiatives should be embedded in agricultural extension services, vocational curricula, and rural innovation hubs. Collaboration between universities, training centres, community organisations, and technology providers

should produce modular courses in data management, mobile agronomy, and digital finance. Strengthening human capital in this way will empower young farmers to both use and innovate with digital technologies, enhancing agricultural productivity and resilience.

Promoting financial inclusion through accessible, youth-friendly, and gender-responsive Agri-FinTech platforms is also essential. The Federal Ministry of Agriculture, Central Bank of Nigeria, and FinTech regulators should foster rural digital finance ecosystems integrating credit scoring, insurance and savings tools for smallholder youth. Initiatives such as subsidised mobile credit and interoperable digital wallets can expand access to loans, inputs, and markets mirroring successful models like India's e-NAM and Kenya's M-Farm. Embedding financial inclusion within digital agriculture will strengthen financial capital, boost equity, and improve household food access.

Expanding both physical and digital infrastructure is equally critical. Public-private partnerships should invest in rural broadband, solar-powered ICT hubs, and shared mechanisation facilities such as Hello Tractor's model. Prioritising underserved northern regions will reduce the digital divide, improve market integration, and increase food stability. Addressing gender and regional disparities through targeted programmes, such as digital literacy scholarships, agritech cooperatives, and mentorship networks will foster inclusive participation and strengthen social capital.

Finally, mainstreaming digital agriculture within a unified institutional framework is vital. Establishing a "Digital Food Security Coordination Unit" under the Federal Ministry of Agriculture will harmonise initiatives, manage national data systems, and align innovations with the Sustainable Livelihood Framework. Strengthened governance, investment, and multi-stakeholder partnerships, including research institutions and agritech firms will ensure long-term climate resilience, innovation, and sustainable food security in Nigeria.

## 6. Conclusion

This research investigates the impact of digital agriculture on enhancing food security by promoting youth empowerment in Nigeria, utilising the Sustainable Livelihood Framework (SLF) as a guiding framework. The findings indicate that digital agriculture functions as a transformative mechanism for enhancing the four

dimensions of food security; availability, access, utilisation, and stability by improving human, financial, physical, social, and natural capital among young farmers. Youth are increasingly positioned as agents of agricultural transformation and food system resilience through digital literacy, Agri-FinTech innovation, artificial intelligence applications, and digital market linkages.

The study indicates that digital literacy serves as the essential basis for effective digital participation. This facilitates youth engagement with precision agriculture, online advisory systems, and digital financing platforms, resulting in increased productivity and enhanced decision-making capabilities. Agri-FinTech solutions like ThriveAgric, FarmCrowdy, and Crop2Cash enhance access to finance and inputs, thereby promoting income stability and improving food access. Disparities in infrastructure, gender inclusion, and regional access persist, limiting equitable participation and national scalability.

The study compares Nigeria's experience with global models in Kenya, India, and Brazil, concluding that countries with coordinated digital agriculture policies and integrated institutional frameworks attain superior food security outcomes. The fragmented policy landscape in Nigeria necessitates a systemic and inclusive approach to align digital agriculture with food security objectives.

The study concludes that digital agriculture, integrated within the Sustainable Livelihood Framework, provides a viable pathway for achieving sustainable food systems, inclusive growth, and youth empowerment in Nigeria. This study enhances knowledge by linking digital innovation to livelihood improvement and food security outcomes, presenting an integrated model that illustrates how digital agriculture reinforces all five livelihood assets to attain multidimensional food security.

## References

1. Abe, O. E., Ojo, O. I., & Omotoso, D. C. (2025). The Nigerian political economy and agricultural sector. *International Journal of Development Studies*, 9(8), 610–621.
2. Afia, O. E. (2023). Gender participation in agricultural digitalization: Prospects and challenges. In *Faculty of Agriculture International Conference Proceedings*. University of Uyo.

3. AgFunder News. (2022). Crop2Cash is giving Nigerian farmers a pathway to financial inclusion. <https://agfundernews.com/crop2cash-is-giving-nigerian-farmers-a-pathway-to-financial-inclusion>
4. Agritech Digest. (2025). Thrive Agric, FarmCrowdy and VunaPay: What's Next for African Ag Fintech? Retrieved from <https://agritechdigest.com>
5. Ajiboye, O., & Onuoha, C. (2024). Digital transformation and youth agripreneurship in Nigeria's food system. *African Journal of Science, Technology, Innovation and Development*, 16(3), 213–225.
6. Akintola, F., & Okeke, U. (2021). Mobile technology and youth participation in agriculture: Pathways to food security in Nigeria. *ICT in Agriculture and Development Review*, 12(3), 88–104.
7. Archibong, E. M. (2025). Digital literacy and agricultural engagement among youth in Akwa Ibom State, Nigeria. *Society for Extension Education in Agriculture*.
8. Awolaye, O. M., Adebisi, O., & Atoloye, I. A. (2025). Leveraging artificial intelligence-powered virtual assistant for information retrieval in indigenous agriculture: Insights from Nigeria. In *ACM ICT and Development in Africa*.
9. Awoniyi, O., Okeke, C., & Ibrahim, M. (2023). Digital agriculture and youth livelihoods in Nigeria: A sustainable framework for food security. *Journal of Agricultural Innovation and Development*, 15(2), 45–62.
10. Challenge Fund for Youth Employment. (2025). Hello Tractor: Nigeria selection. <https://fundforyouthemployment.nl/nigeria-selection-hello-tractor/>
11. Chambers, R., & Conway, G. (1992). Sustainable rural livelihoods: Practical concepts for the 21st century (IDS Discussion Paper 296). Institute of Development Studies.
12. Crop2Cash. (2025). Grow it, cash it. <https://www.crop2cash.com.ng/>
13. DFID (Department for International Development). (1999). Sustainable livelihoods guidance sheets. London.
14. Empower Africa. (2023). FarmCrowdy: Revolutionizing agriculture and empowering farmers. <https://empowerafrica.com/farmcrowdy-the-nigerian-ag-tech-startup-revolutionizing-agriculture-and-empowering-farmers/>
15. Eze, N., & Ekwueme, S. (2023). ICTs and agricultural productivity among rural youths in Nigeria.
16. *Nigerian Journal of Agricultural Economics*, 14(2), 95–110.
17. FAO. (2021). The state of food security and nutrition in the world. Rome.
18. Federal Government of Nigeria. (2020). Nigeria digital agriculture strategy (2020–2030). NITDA.
19. Fernandes, L. M., Silva, R. A., & Costa, M. J. (2023). Digital cooperatives and climate-smart agriculture in Brazil: A youth-led innovation model. *Journal of Agricultural Systems and Technology*, 12(1), 45–62.
20. Food and Agriculture Organization. (2021). The four pillars of food security. FAO. <https://www.fao.org/food-security>
21. International Fund for Agricultural Development. (2025). Digital Agriculture Scale-Up (DAS) Program: Enhancing youth resilience and food systems in Nigeria. IFAD. <https://www.ifad.org/en/digital-agriculture>
22. Kariuki, J., Mwangi, P., & Otieno, D. (2022). Mobile platforms and youth agribusiness participation in Kenya: Evidence from M-Farm and DigiCow. *East African Journal of Agricultural Economics*, 8(2), 101–118.
23. Liu, X., Wang, Z., & Han, X. (2024). The impact of digital literacy on farmers' green production behavior. *Sustainability*, 16(17), 7507.
24. Musa, K., & Ibrahim, A. (2022). Digital agricultural innovation and the future of youth employment in Northern Nigeria. *Journal of Rural Social Sciences*, 37(1), 55–70.
25. Naija Trends. (2024). How FarmCrowdy empowers Nigerian farmers and creates jobs. <https://naijatrends.ng/the-role-of-farmcrowdy-in-empowering-nigerian-farmers-and-creating-jobs-exploring-farmcrowdys-platform-for-digital-agriculture-and-job-creation-in-rural-areas/>
26. Nigeria Federal Ministry of Agriculture and Rural Development. (2020). Nigeria Digital Agriculture Strategy (2020–2030). FMARD. <https://fmard.gov.ng/digital-agriculture-strategy>
27. NITDA. (2020). Nigeria digital agriculture strategy (2020–2030). <https://nitda.gov.ng/wp-content/uploads/2020/11/Digital-Agriculture->

[Strategy-NDAS-In-Review\\_Clean.pdf](#)

28. Nnanna, J. (2024, November 20). Food insecurity: Projections and policies for Nigeria's huge populations by 2025. BusinessDay NG. Retrieved from <https://businessday.ng>
29. Okorie, N., Osunkunle, O., & Oyesomi, K. (2025). Media and communication systems for sustainability in Nigeria. In Sustainability, communication and development studies. Springer.
30. Olagunju, O. O. (2024). Harnessing artificial intelligence for youth engagement in agriculture.
31. International Journal of Advance Social Sciences and Education, 2(2), 83–94.
32. Olawale, T., & Aluko, A. (2024). Youth adoption of digital agriculture platforms and its impact on food security in Southwestern Nigeria. Journal of Agricultural Extension and Rural Development, 16(4), 177–189.
33. Osabohien, R., Matthew, O., Olurinola, I., & Aderounmu, B. (2020). Agricultural transformation and youth participation in Nigeria. AIMS Agriculture and Food, 5(4), 911–928.
34. OSSAP-SDGs. (2024). Nigeria SDGs Progress Report. Office of the Senior Special Assistant to the President on SDGs. Retrieved from <https://ngfrepository.org.ng>
35. Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.
36. Sadiq, S. M., Singh, I. P., & Ahmad, M. M. (2025). Agri-Fintech solutions for youth: Developing financial products tailored for young Nigerian farmers. Moroccan Journal of Agricultural Sciences, 9(2).
37. Singh, R., & Sharma, V. (2023). AI-powered advisory systems and youth engagement in India's Digital Agriculture Mission. International Journal of Precision Agriculture, 11(3), 88–104.
38. Sufian, F., Nico, G., & Azzarri, C. (2023). Examining the gender digital divide: A case study from rural Nigeria (GCAN Policy Note 16). CGIAR.
39. The Markets Online. (2024, November 11). How Digital Platforms Are Transforming Nigeria's Agriculture. Retrieved from <https://themarketsonlineng.com>
40. ThriveAgric. (2024). ThriveAgric showcases AYuTe Project's impact. [https://thriveagric.com/resources/hectare/thrive-agric-showcases-a-yu-te-project-s-impact-on-empowering-125-000-farmers-and-youths-in-](https://thriveagric.com/resources/hectare/thrive-agric-showcases-a-yu-te-project-s-impact-on-empowering-125-000-farmers-and-youths-in-northern-nigeria)
41. ThriveAgric. (2025). Empowering African Farmers Through Technology. Retrieved from <https://thriveagric.com>
42. Time Express Nigeria. (2024, May). Empowerment: Agro tech, microfinance targets 125,000 youths in Northern Nigeria.
43. <https://www.google.com/search?q=https://www.timeexpressnigeria.com/2024/05/empowerment-agro-tech-microfinance-targets-125000-youths-in-northern-nigeria>
44. UK Department for International Development. (1999). Sustainable livelihoods guidance sheets. DFID. <https://www.livelihoods.org>
45. United Nations in Nigeria. (2025). Sustainable Development Goal 2: Zero Hunger. Retrieved from <https://nigeria.un.org/en/sdgs/2>
46. Vanguard News. (2025, July). Nigeria maps 10-year youth-led agricultural renewal plan. <https://www.vanguardngr.com/2025/07/at-un-food-summit-nigeria-maps-10-year-youth-led-agricultural-renewal-plan/>
47. World Bank. (2022). Digital agriculture: Pathways to prosperity.