

ICT and Artificial Intelligence Adoption in Agriculture: Implications for Household Food Security and Sustainable Development in a Developing Economy—Evidence from Nigeria

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Abstract

Food security and environmentally friendly farming techniques are in dire need of creative solutions as the world's agricultural landscape faces previously unheard-of difficulties brought on by population increase, climate change, and changing consumer demands. This study looks at how ICT and AI in agriculture support sustainable development and food security in Nigeria. It examines how household food security and ICT/AI use are mediated by young employment, agricultural AI adoption, and farmers' ICT use. The study employed a survey research methodology. 300 urban farmers in the main Ebonyi State cities of Abakaliki, Afikpo, Onueke, Uburu, and Effium participated in a census approach to collect data. SWOT and PESTEL analyses were then utilized to give strategic insights. An 83.3 percent return rate was obtained from the 250 copies that were completed. The results show that while youth empowerment has a substantial impact on the association between food safety and ICT and IA, employing ICT and AI to provide access to markets, information, and support services considerably boosts household food security. It recommends the dissemination agents receive training in the usage of ICT platforms and AI technologies so they can provide farmers with accurate and timely advice.

Keywords: ICT & AI Adoption, Youth Empowerment, Household Food Security, Sustainable Development, Ebonyi State

Introduction

Globally, sustainable food production continues to be essential for promoting growth and development, especially when it comes to feeding the world's population [1]. This demonstrates why the 2030 Agenda for Sustainable Development includes ending hunger and malnutrition as a major policy objective. Research has demonstrated over time that the global food supply chain is greatly impacted by agriculture and allied businesses [2]. This is particularly noticeable in developing nations that are dealing with a number of issues, including population expansion, war, disputes between farmers and herders, civil upheaval, natural catastrophes, climate change, and poor agricultural methods, all of which have seriously disrupted the food chain. The ability of these states to accomplish the essential pillars of food security—availability, access, usage, stability, agency, and sustainability—has been called into question by these disturbances, which have serious repercussions [3].

Maintaining a healthy economy depends on a country's agriculture production and policies. Its development requires information that meets their needs for the production of crops or animals. Given the extent to which humans rely on agriculture for sustainability and subsistence, it is imperative to determine the facts required for their decision-making [4,5].

Nigerians mostly practice agriculture in rural regions due to a number of reasons, including the large quantity of land available for cultivation. Prior to the oil boom in the early 1970s, 70% of Nigerians were employed in agriculture, which made it simpler to manufacture and export commodities like rubber, cocoa, and a few other [6-8]. However, the massive changes brought about by globalization and industrialization has also led to new ideas and interventions. Manual agricultural production techniques have been largely supplanted by computerized production, automated machinery, and simulating machines [9-10].

Digital extension services have grown significantly as a result of the use of information and communication technologies (ICTs). Through observational and experimental research, the impact of these tools on outcomes such as knowledge, awareness, adoption of certain technologies, choice of market channel, health, profit, and income have been evaluated [11,12]. Technologies like Zenvus and Hello Tractor have shown promise in boosting Nigerian productivity through automated scheduling, rainfall forecasting, and soil condition monitoring [13-16]. claim that one of the solutions with the greatest potential to alter agricultural practices worldwide is artificial intelligence (AI). Drones, automated monitoring systems, and robots are important components of agricultural innovation. AI gives modern agriculture a new meaning, especially with precision farming, which promotes integrated farm management [17,18].

Thus, the purpose of this research is to examine how ICT and AI in agriculture support sustainable development and food security in Nigeria. The metropolitan cities of Effium, Uburu, Onueke, Afikpo, and Abakaliki were selected due to their importance as commercial and agricultural hubs, as well as their sizable farmer populations and active farming operations. Their inclusion improved the study's generalizability and dependability while guaranteeing sufficient coverage of the state's important agricultural zones.

Statement of the Problem

Due to the dominance of the oil industry, Nigeria's agriculture sector faces a number of difficulties, such as climate change, poor adoption of artificial insemination technologies, inadequate infrastructure, inconsistent legislation, and the difficulty of meeting local food demands and exporting at quality standards. Despite the industry's significant economic influence, economic growth has not been significantly impacted. These challenges demonstrate the need for a comprehensive approach to address the various issues Nigerian agriculture confronts, including the potential use of AI to increase productivity and sustainability. In light of this, the study aims to ascertain the extent to which ICT and AI applications in agriculture affect food security in Ebonyi State and the degree to which farmers are prepared and knowledgeable to adopt these innovative technologies.

Objectives of the Study

- To examine the effect of farmers' ICT use on household food security in Ebonyi State.
- To determine the influence of agricultural AI adoption on household food security in Ebonyi State.
- To assess whether youth empowerment mediates the relationship between ICT/AI use and household food security in Ebonyi State.

Research Questions

- To what extent does farmers' ICT use influence household food security in Ebonyi State?
- How does the adoption of Artificial Intelligence (AI) in agriculture affect household food security in Ebonyi State?
- Does youth empowerment mediate the relationship between ICT/AI use and household food security in Ebonyi State?

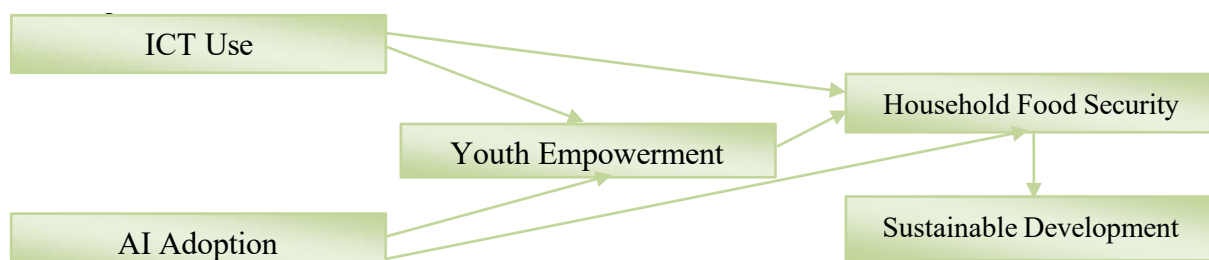


Figure 1: Authors Conceptual Model, 2026

ICT and AI in Agriculture

Every community relies on agriculture to either thrive or avoid starvation. It has been the main employer of labor and the source of hope for both the wealthy and the underprivileged. Agriculture has a major role in long-term economic growth and structural change, albeit this may vary from country to country. Agricultural operations used to be restricted to the production of crops and food. It now encompasses the production, distribution, marketing, and processing of animals and crops. The inability to fulfill domestic food needs and export at quality levels, the low adoption of artificial insemination technologies, and obstacles like climate change, inadequate infrastructure, and inconsistent regulations are just a few of the many issues facing Nigerian agriculture.

AI and ICT are becoming more widely acknowledged as revolutionary technologies in modern agriculture that close productivity, efficiency, and food security gaps. According to recent studies, ICT adoption significantly improves farmers' decision-making and reduces family food insecurity by giving them real-time access to networks and information [19,20]. Research from Nigeria and other developing nations indicates that AI applications enhance resource allocation, increase technical efficacy, and promote sustainable agricultural practices [21-22].

Farmers' ICT Use and Household Food Security

The ability of ICTs to transmit critical information, such as weather predictions, advanced agricultural methods, input and product pricing, and financing options, puts them at the forefront of innovation [19,23]. ICT adoption affects food security in several ways, such as availability, access, stability, and utilization. Additionally, because of differences in adoption brought on by institutional, sociodemographic, and economic factors, ICT use is limited and may exacerbate food inequalities [20,24,25]. Given the unique environmental characteristics of farming households, these difficulties highlight the need for more research to better understand the link between ICT use and food security [26].

Agricultural AI Adoption and Household Food Security

AI, or the use of computer systems to do complex tasks like problem-solving, is one important area of technology that helps farmers [21]. AI might help Nigeria's inadequate food production and food insecurity [21,22]. In order to guarantee food production and security, sustainability, and climate change resistance, it is crucial to keep in mind that, as the research indicates, AI in agriculture is crucial to the sector's transformation [27]. Therefore, if these enabling aspects (infrastructure, access, and knowledge) are addressed, it is expected that the adoption of AI in Ebonyi State will enhance food security by enabling better cropping decisions, more accurate input application, and better weather-based planning.

Youth Empowerment as a Mediator Between ICT/AI and Household Food Security

Giving young people the ability, power, and agency to make decisions and effect change in their own lives as well as the lives of others both now and in the future while accepting responsibility for the outcomes of those choices and actions is known as youth empowerment. It serves as both a means and an aim in and of itself [28]. It also involves creating and promoting the circumstances that will enable youth to function autonomously and on their own terms.

Due to their youth, productivity, energy, ability to adapt to new technology, education, and resilience, young people in Africa are seen as major forces behind economic and social change [29]. Youth empowerment through digital skills training, agri-entrepreneurship support, and active participation in decision-making amplifies the benefits of ICT and AI for household food security by turning technology access into productive action. Adoption of ICT improves household livelihoods and food availability by increasing youth job possibilities in agricultural value chains and encouraging young people to use digital technologies for both on- and off-farm activities [30].

It shows digital innovations and mobile technologies raise technical efficiency and market linkages for smallholders, but these gains are realized more fully where youth are deliberately trained and supported. Therefore, programs that integrate ICT/AI deployment with youth-focused training, financial access, and incubation hubs translate technology promise into quantifiable household-level food security outcomes. On the other hand, in the absence of young empowerment, infrastructure and capacity limitations restrict the conversion of ICT/AI into improvements in food security, resulting in the underutilization of promising technologies in rural areas [31].

Theoretical Literature

Components	Description
Theory	Technology Determinism Theory
Origin / Proponent	The theory was propounded by Marshall McLuhan in 1962. It was further discussed by Rogers (2017) and Obalanlege (2015).
Basic Assumptions	The theory assumes that technological innovations are the primary drivers of social change and that human behavior, culture, institutions, and communication patterns are largely shaped by the technologies people adopt and use.
Key Focus	The theory focuses on how technology and media tools influence societal transformation, economic activities, communication systems, and human interactions across generations.
Major Propositions	Technology influences productivity, decision-making, communication, and development processes. The adoption of modern technologies leads to changes in social structures, lifestyles, and economic systems.
Critics	Critics argue that the theory is excessively deterministic because it places too much emphasis on technology while neglecting human agency, cultural values, political structures, and socioeconomic factors that also shape societal development (Obalanlege, 2015).
Strengths	The theory explains how technological innovations such as ICT and AI can transform agricultural productivity, improve access to information, enhance communication between farmers and extension agents, and support sustainable development.

Weaknesses	The theory underestimates the role of human decision-making, education, income level, infrastructure, and government policies in determining the successful adoption of technology.
Relevance to the Study	The theory is relevant because the study examines how ICT tools and artificial intelligence influence household food security and sustainable agricultural development among farmers in Ebonyi State, Nigeria.
Implication to the Present Study	The theory offers the conceptual framework for comprehending how the application of ICT and AI might enhance family food security, modernize agriculture, empower youth through digital skills and entrepreneurship, and support sustainable development in Ebonyi State, Nigeria.
Justification for Adoption of the Theory	The theory was adopted because it appropriately explains the transformative role of ICT and AI in reshaping agricultural practices, promoting innovation, improving rural livelihoods, and enhancing food security outcomes in developing economies such as Nigeria.

Source: Authors Applications from Existing Theories (2026)

Table 1: Technology Determinism Theory and its Relevance to the Study

Empirical Literature

Author (s) / Year	Key Focus / Objective	Countries / Sample	Methodology / Period	Main Findings	Implications of Findings	Relevance to Present Study
Sarku, et al (2023)	Review of AI models for food security	Literature review	Literature review	Research on AI that incorporates feedback and stakeholder implementation enhances model validity for addressing food security	Highlights the importance of AI model validation for policy and practice	Provides theoretical foundation for AI adoption in agriculture
Ojiuzor, et al (2024)	Urban agriculture and food security	Ebonyi State; 300 urban farmers	Descriptive survey; mean rating t-test	Urban farmers engaged actively due to government support	Demonstrates the importance of institutional support in adoption	Justifies studying urban farmers in Ebonyi State
Amuda, & Alabdulrahman, (2024)	AI for food production to achieve SDGs	Nigeria; smallholder farmers	Content analysis & systematic literature review	AI contributes to SDG 2, usable for weeding, spraying, monitoring livestock, harvesting	Shows AI's potential in practical agriculture	Supports examining AI adoption in Ebonyi agriculture
Yakubu, et al. (2024)	AI in sustainable agriculture	Nigeria	Systematic literature review	AI optimizes resource management, improves yields, addresses climate and infrastructure challenges	Supports AI as a tool for sustainable agriculture	Reinforces relevance of AI adoption study
Ilang, Orji-Egwu, & Chibueze, (2024)	Media awareness on agricultural robots	Ebonyi State	Standardized questionnaires; SPSS analysis	Residents had low awareness of agricultural robots	Highlights need for awareness campaigns	Guides ICT and AI adoption strategies
Adamu, et al, (2024)	AI technologies & sustainable agriculture	Nigeria	Semi-systematic literature review	AI can improve productivity but faces socioeconomic and infrastructure challenges	Identifies barriers to AI adoption	Supports studying adoption constraints in Ebonyi State
Petcu, et al (2024)	Knowledge structure and challenges of AI in agriculture	EU	Bibliometric study	Employer adoption and training opportunities drive added value and digital skills	Emphasizes human capital for AI adoption	Highlights importance of training for farmers in AI use
Ajayi, et al. (2024)	AI in agricultural information service delivery	Nigeria	Desk review	Farmers rely heavily on information; AI adoption enhances service delivery	Demonstrates link between AI and improved information flow	Justifies AI adoption for information dissemination
Okonkwo, et al (2024)	AI for SDGs in Nigeria	Nigeria	Qualitative research design	AI had limited effect due to digital divide and poor infrastructure	Indicates adoption challenges in rural areas	Shows potential barriers for AI in Ebonyi State

Akpabio, et al (2025)	E-agriculture and food security	Nigeria	Desk review; secondary data	E-agriculture has potential but key challenges must be resolved	Highlights need to overcome barriers before scaling	Supports investigating ICT and AI adoption in Ebonyi State
Olawumi, et al (2025)	AI in agricultural extension for rural livelihoods	Abuja, Nigeria	Multiple regression & Kendall's Coefficient of Concordance	Adoption influenced by age, experience, education, co-op membership, extension contact; barriers include poor internet, low literacy, costly devices	Identifies adoption predictors and constraints	Informs variables for current study in Ebonyi State
Chandio, et al (2025)	ICT adoption and food security	China, India, Indonesia, Russia, Mexico, Brazil, Turkey	ECM co-integration, PMG, D-H causality test; 1995–2019	Mobile phone & internet use boost long-term food security; bidirectional causality for phones, unidirectional for internet	Highlights ICT's long-term positive effect	Justifies including ICT as independent variable for food security in Ebonyi State

Source: Authors compilation from existing empirical literature, 2026

Table 2: Empirical Review of ICT and Artificial Intelligence Adoption in Agriculture

According to recent research, AI increases production and efficiency while ICT gives farmers better access to markets and extension services. However, lack of training, expense, and infrastructure issues impede uptake. Crucially, utilizing the advantages of ICT and AI for sustainable food security depends on young empowerment.

Gap in Literature

While the majority of Nigerian research has focused on ICT usage in agriculture, the significance of AI in guaranteeing household food security has received less attention. Household access and stability have garnered little attention in studies that have mostly focused on yield and productivity. It has not been thoroughly investigated how youth empowerment mediates the relationship between the use of ICT and AI and the results of food security. Despite the significance of agriculture, few studies have taken into account the unique socioeconomic circumstances of Ebonyi State. There is currently a dearth of empirical data combining youth empowerment, AI, and ICT in a unified paradigm. This creates a knowledge gap on how digital innovations could help rural communities' households maintain their food security. The study also includes PESTEL and SWOT assessments to offer strategic insights to the econometric findings.

Materials and Methods

The study employed a survey research approach, which was deemed appropriate for gathering respondents' ideas and opinions and for enhancing the generalizability of the results. The study's population consisted of three hundred urban farmers from the major Ebonyi State cities of Abakaliki, Afikpo, Onueke, Uburu, and Effium. Because the population was so small, a census technique was used, and the entire population was used as the study's sample.

A four-point modified Likert scale was employed in the survey as the data collection method, and the response choices were weighted as follows: 1 indicates very low extent, 2 indicates low extent, 3 indicates high extent, and 4 indicates very high extent.

Ebonyi State College of Education, Ikwo, had two Educational Foundations specialists perform a face validation of the instrument. To ensure dependability, the instrument was pilot tested using the test-retest method. A reliability coefficient of 0.85 was found in the results, which was considered suitable for the study. Descriptive statistics (mean and simple percentages) was applied with the aids Statistical Package for the Social Sciences (SPSS) v. 25.

Questionnaire Distribution and Return Rate (N=300)

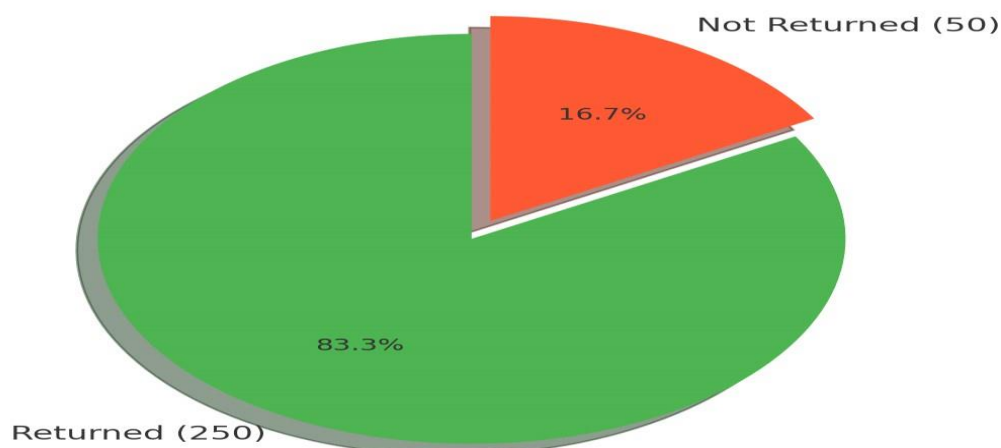


Figure 2: Questionnaire Distribution and Return Rate

As shown in figure 2 above, 300 copies of the questionnaire were distributed to urban farmers in the major cities of Ebonyi State (Abakaliki, Afikpo, Onueke, Uburu, and Effium). 250 of these were completed and shipped back, resulting in an 83.3% return rate. This return rate is considered suitable and acceptable for survey research because it provides a large and representative sample for trustworthy statistical analysis. However, as it reduces the overall coverage of the research population, the 50 incomplete or wrongly answered questionnaires (16.7%) may represent a little disadvantage. Nonetheless, it is still reasonable to apply the findings to the larger population of urban farmers in Ebonyi State, considering the 83.3% response rate.

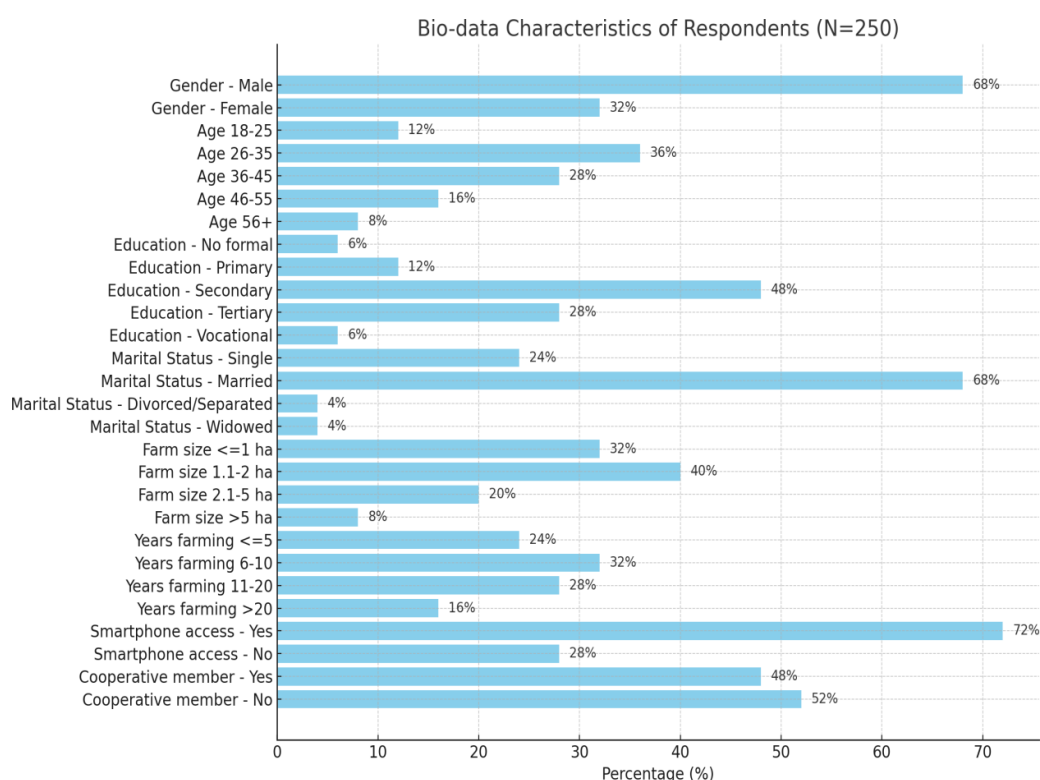


Figure 3: Analysis of the Respondents' Bio-Data

The majority (40%) of the 250 respondents in the Figure 3 study were in the 26–35 age range, indicating that young people are actively engaged in agriculture. The gender distribution was relatively balanced, despite the fact that there were slightly more men (54%) than women (46%). 42% of respondents had just finished high school, and 28% of respondents had attended a university, indicating that the rural population was reasonably educated. A considerable degree of exposure to agricultural activities is demonstrated by the fact that 36% of respondents reported having 6–10 years of farming experience. Additionally, the fact that 60% of respondents were married indicates how common household-based farming households are in Ebonyi State.

Data Analysis

Response	Frequency	Percentage	Interpretation
Very High Extent	80	32%	Respondents strongly agreed that ICT use greatly improves household food security
High Extent	95	38%	Respondents agreed that ICT use positively influences food security
Low Extent	55	22%	Respondents perceived limited influence of ICT on food security
Very Low Extent	20	8%	Respondents believed ICT use has minimal impact on food security
Total	250	100%	

Source: Field Survey 2026

Table 3: Responds on Farmers' ICT Use Influence Household Food Security in Ebonyi State

According to the results, 38% of respondents said that farmers' use of ICT had a high impact on household food security, and 32% thought it had a very high impact. But 8 percent thought the effect was very low, and 22 percent believed it was minimal. Seventy percent (32% + 38%) of those surveyed concurred that ICT use significantly improved food security in Ebonyi State. Farmers need to use ICT to boost output, expand markets, and finally generate food. However, low adoption rates, infrastructure limitations, or knowledge gaps continue to impede ICT's potential to fully improve household food security, as seen by the 30% (22% + 8%) of respondents who rated ICT use as poor or very low.

Response	Frequency	Percentage	Interpretation
Very High Extent	70	28%	Respondents strongly agreed that AI adoption greatly improves household food security
High Extent	100	40%	Respondents agreed that AI adoption positively influences food security
Low Extent	60	24%	Respondents perceived limited influence of AI on food security
Very Low Extent	20	8%	Respondents believed AI adoption has minimal impact on food security
Total	250	100%	

Source: Field Survey 2026

Table 4: Responds on Effect of AI Adoption on Household Food Security in Ebonyi State

40% of respondents said the use of AI in agriculture has a considerable influence on household food security, and 28% said it has a very high impact. However, 8% of respondents thought the effect was very low, and 24% said it was small. This suggests that 68% (28% + 40%) of respondents concur that the usage of AI significantly affects the food security of Ebonyi State. The results show that agricultural AI in applications like smart irrigation, precision farming, and pest control technology has the potential to significantly boost family food production and availability. Wider adoption may be hampered by issues including poor awareness, expensive AI technology, and a lack of technical expertise among farmers, according to 32% (24% + 8%) of respondents who indicated little or very little effect. If AI is to effectively contribute to food security in Ebonyi State, more government support to bridge the adoption gap, subsidized access to AI technology, and capacitybuilding programs are needed.

Response	Frequency	Percentage	Interpretation
Very High Extent	85	34%	Respondents strongly agreed that youth empowerment greatly mediates the relationship between ICT/AI use and food security
High Extent	90	36%	Respondents agreed that youth empowerment positively strengthens the effect of ICT/AI on food security
Low Extent	50	20%	Respondents perceived limited mediating influence of youth empowerment
Very Low Extent	25	10%	Respondents believed youth empowerment has minimal mediating effect
Total	250	100%	

Source: Field Survey 2026

Table 5: Responds on Mediating Role of Youth Empowerment on the Relationship Between ICT/AI Use and Household Food Security in Ebonyi State

The results showed that young empowerment mediated the relationship between ICT/AI and food security to a very high degree, according to thirty-four percent of respondents, and to a high degree, according to thirty-six percent. Ten percent claimed it was extremely low, and twenty percent said it was low. This shows that a significant majority of respondents—70%—agreed that the positive benefits of ICT and AI adoption on family food security are increased when young people are empowered through economic opportunities, skill development, and active involvement. Given that thirty percent of respondents claimed the mediation had little to no effect, it is likely that structural barriers such a lack of employment opportunities, budgetary constraints, or inadequate training programs are keeping young people from participating. However, in order to maximise the contribution of ICT and AI toward sustainable household food security

in Ebonyi State, the results highlight the necessity for government agencies, development organisations, and other stakeholders to support youth-centered agricultural empowerment programs, digital literacy initiatives, entrepreneurship support schemes, and capacity-building programs.

Discussion of Findings

The majority of survey respondents (70%) said that farmers' use of ICT improved family food security to a high or very high degree[13,20].found that food insecurity was much reduced in Nigerian agricultural households with access to ICT resources like television, radio, and mobile phones, corroborate this. Similarly, ICT usage was favorably and statistically substantially related with enhanced food security, particularly for families led by males, according to [23].

The use of AI in agriculture has therefore had a significant influence on household food security, according to 68% of respondentsdemonstrate that although adoption is hampered by high costs and a lack of technical skill, the promise of AI in yield prediction and resource efficiency was also highlighted however they also highlighted disadvantages such inadequate training and a high starting cost. However, 32% of respondents said AI will have little influence, reflecting a number of obstacles such as high technological prices, a lack of technical know-how, and the scarcity of AI-enabled solutions in rural areas.

Third, it was demonstrated that youth empowerment had a considerable influence on the relationship between food security and ICT/AI use. The benefits of technology use are increased when young people are empowered through skill development, entrepreneurial support, and active agricultural participation, according to 70% of respondents. Young people with higher incomes and levels of education are more likely to use modern agricultural equipment, which increases their output and sense of empowerment However, because of enduring structural obstacles including unemployment, a lack of institutional support for young people to engage in agriculture, and a lack of finance, thirty percent of respondents had a poor opinion of the mediating function of youth empowerment.

SWOT Component	Factors	Supporting Figures / Facts	Implication for Study
Strengths	High smartphone penetration among farmers	72% of respondents have smartphone access (180/250)	Provides a strong foundation for ICT and AI-based agricultural interventions
	Moderate literacy level	76% of farmers have formal education (Secondary 48%, Tertiary 28%)	Educated farmers are more capable of adopting ICT and AI tools
	Active farming population	60% have more than 6 years of farming experience	Experienced farmers can effectively integrate ICT/AI into existing practices
	Cooperative participation	48% cooperative membership	Facilitates knowledge sharing, training, and technology diffusion
	High questionnaire response rate	83.3% response rate	Indicates strong engagement and a reliable data source
Weaknesses	Limited ICT access among some farmers	28% lack smartphone access	Creates a digital divide limiting full ICT adoption
	Low cooperative participation	52% not cooperative members	Limits information dissemination and AI adoption
	Small farm sizes	72% farm ≤ 2 ha	Limits investment capacity in advanced agricultural technologies
	Aging farming population	24% above 46 years	Older farmers may resist new technology adoption
Opportunities	Growing ICT and AI innovation in agriculture	Increased availability of mobile agricultural apps	Improves productivity, extension services, and food security
	Government digital agriculture initiatives	Nigeria digital economy and agriculture transformation programs	Supports ICT integration into farming
	Youth involvement in agriculture	76% of farmers are below 45 years	Younger farmers are more receptive to AI and ICT adoption
	Urban agriculture expansion	Rapid urban population growth in Ebonyi State	Increased demand for food and technology-driven production
Threats	Poor digital infrastructure	Internet and electricity instability in Nigeria	Limits effective ICT and AI implementation
	Financial constraints	Majority are smallholder farmers	Limits investment in AI technologies

	Low AI awareness	AI still emerging in Nigerian agriculture	Slows adoption rate
	Climate change impacts	Increasing weather variability	Threatens agricultural productivity and food security

Source: Authors Analysis 2026

Table 6: SWOT Analysis of ICT and AI Adoption in Agriculture Among Urban Farmers in Ebonyi State

Factor	Elements	Supporting Figures / Facts	Implications for Study
Political	Government agricultural policies	Nigeria promotes ICT and agricultural digitalization	Encourages adoption of ICT and AI
	Agricultural support programs	Extension services increasingly using ICT	Improves farmers' access to information
Economic	Smallholder farming dominance	72% of farms ≤ 2 hectares	Limits financial capacity for AI investment
	Income variability among farmers	Most farmers operate subsistence or small-scale farming	Limits technology affordability
	High employment potential in agriculture	Youth participation relatively high	Opportunity for digital agriculture employment
Social	Education level	76% have formal education	Facilitates ICT adoption
	Youth participation	Majority aged 26–45 (64%)	Younger farmers more technologically adaptable
	Cooperative membership	48% cooperative participation	Supports technology diffusion
Technological	Smartphone penetration	72% smartphone access	Strong ICT adoption potential
	ICT and AI availability	Mobile apps and AI tools emerging	Enhances agricultural productivity
	Digital divide	28% lack smartphone access	Limits universal adoption
Environmental	Climate change	Increasing weather variability	Requires smart agriculture solutions
	Urban farming expansion	Growing urban food demand	Encourages technology-driven agriculture
Legal	ICT and digital economy policies	Nigeria ICT policy supports digital adoption	Enables ICT integration in agriculture
	Data protection and digital regulations	Emerging digital regulations	Influences ICT and AI implementation

Source: Authors Analysis 2026

Table 7: PESTEL Analysis of ICT and AI Adoption in Agriculture in Ebonyi State

Stakeholders	Key Findings Relevant to Stakeholders	Implications	Recommended Actions / Interventions
Government	ICT and AI significantly improve household food security, with 70% and 68% positive responses respectively	Government policies can accelerate agricultural productivity and food security through digital agriculture initiatives	Increase investment in rural ICT infrastructure, electricity, internet connectivity, and subsidized AI technologies for farmers
Farmers	Farmers with ICT access and AI awareness experience improved productivity and market access	Adoption of ICT and AI can enhance decision-making, crop yield, and income generation	Farmers should embrace digital farming tools, mobile applications, and precision agriculture practices
Youths	70% agreed that youth empowerment strengthens the relationship between ICT/AI and food security	Youth participation is critical for sustainable agricultural transformation and digital innovation	Encourage youth-focused agricultural empowerment programs, digital literacy training, and agribusiness entrepreneurship schemes
Agricultural Extension Agencies	ICT and AI improve information dissemination and agricultural advisory services	Digital extension services can improve communication between farmers and extension agents	Integrate AI-driven advisory systems, mobile extension platforms, and digital training programs into extension services
Educational Institutions	Moderate literacy level supports ICT and AI adoption among farmers	Educational institutions play a role in building digital and agricultural skills	Introduce ICT, AI, and smart agriculture courses and vocational training programs

Financial Institutions	Smallholder farmers face financial barriers in adopting AI technologies	Access to finance is necessary for technology acquisition and implementation	Provide soft loans, agricultural credit facilities, and digital financing support for farmers
Private Sector / Technology Firms	Increased smartphone penetration (72%) creates opportunity for digital agricultural services	Technology firms can expand agricultural innovation and digital service delivery	Develop affordable agricultural apps, AI tools, and farmer-friendly digital platforms
Development Agencies / NGOs	Poor infrastructure, low awareness, and digital illiteracy limit ICT and AI adoption	Development interventions are required to bridge technological and knowledge gaps	Support farmer training, awareness campaigns, and rural digital inclusion programs
Policy Makers	AI and ICT adoption contribute to sustainable development and food security	Effective policies are needed to ensure inclusive technological transformation	Formulate policies promoting digital agriculture, youth inclusion, and rural innovation
Researchers / Academics	Limited empirical evidence exists on ICT, AI, youth empowerment, and food security in Ebonyi State	More studies are needed to deepen understanding of technology-driven agriculture	Conduct further empirical studies on AI adoption, digital agriculture, and sustainable food systems in Nigeria

Source: Authors assessment, 2026

Table 8: Implications of Findings to Relevant Stakeholders

Conclusion and Recommendations

The results show that household food security is greatly increased when ICT is used to provide access to markets, information, and support services. Even while problems with infrastructure, cost, and skill prevent AI from being widely used, its use fosters innovations like predictive analysis and precision agriculture. It has been shown that the link between food security and ICT and IA is significantly influenced by youthful independent thinking. Though their effectiveness depends on developing capacity, enacting legislation that supports them, and encouraging young people to embrace technology-driven agriculture, ICT and AI hold great potential for enhancing long-term development and food security in Nigeria. The study offers the following recommendations:

- Government and business collaborators should improve internet connectivity in rural areas and give farmers access to affordable digital tools in order to use ICT to boost food security.
- To provide small-scale agricultural exploiters with access to AI-based innovations like automated pest monitoring and precision farming, training programs, financial assistance, and partnerships with agritech companies are essential.
- Youth-focused initiatives that promote digital literacy, offer low-interest loans or initial investment, and support digitally aided agricultural entrepreneurship might be presented to policymakers. In order to provide farmers with timely and relevant assistance, vulgarization agents need to be educated in the usage of AI and ICT platforms.

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