



Adoption of ICT Driven Approaches in Vocational Agriculture Education to Enhance Youths' Involvement in Agriculture in Delta State, Nigeria

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Abstract:

The digital revolution has transformed multiple sectors globally, with Information and Communication Technologies (ICTs) offering tools for efficiency, innovation, and youth empowerment. In Nigeria, where agriculture remains the backbone of the economy, vocational agricultural education faces persistent challenges, including outdated curricula, limited infrastructure, and declining youth participation. This study examined the adoption of ICT-driven approaches in vocational agricultural education as a strategy to enhance youths' involvement in agriculture in Delta State, Nigeria. A total of 105 copies of questionnaires were produced and distributed to tertiary students in selected Delta tertiary institutions, and data were analyzed using descriptive statistics, including means, standard deviations, frequencies, and percentages. The results showed that youths were more engaged in agricultural entrepreneurship (35.2%), farm management (19.1%), and crop production (18.1%), highlighting a preference for innovative and managerial aspects of agriculture. High levels of ICT competence were recorded in the use of e-commerce platforms (84.8%), internet resources (81.9%), blockchain technology (81.0%), and digital marketing platforms (78.1%), suggesting that youths recognize ICT's role in modern agribusiness. However, adoption of advanced tools such as IoT devices was relatively lower (61.9%). Respondents agreed that ICT promotes mentorship (Mean = 3.0) and collaboration (Mean = 3.37), but disagreed on its role in online training, networking, and job opportunities. Major barriers to ICT adoption included lack of technical know-how, poor facilities, low manpower, and high internet costs. The study concludes that integrating ICT-driven approaches into vocational agriculture education can modernize training, attract youth into agribusiness, and strengthen Nigeria's food security system.

Keywords: Vocational education, Youth involvement, Agriculture, Adoption, ICT

1. Introduction

The world is currently experiencing a digital revolution, with Information and Communication Technologies (ICTs) and the internet providing powerful tools for efficiency and effectiveness in various sectors (Lubua, 2022). ICTs are projected to remain both economically and socially transformative, driving fundamental changes across multiple aspects of human life (Jorgenson & Vu, 2016). In rural settings, ICTs are increasingly being deployed to address developmental challenges while simultaneously supporting the attainment of the Sustainable Development Goals (SDGs) (Jacobs-Basadien *et al.*, 2022). For instance, the emergence of community networks and broadband internet has created opportunities for farmers to access timely information on weather, input use, and farm management, thereby improving agricultural practices compared to a decade ago (Rich & Pather, 2021).

Smallholder farmers are central to global agricultural production and food security, especially in developing countries where they constitute the majority of farming operations. In Nigeria, smallholders account for over 98% of agricultural activities, serving as the backbone of the sector (Quayson, Bai & Sarkis, 2021). In today's digital age, many countries

have introduced ICT-based agricultural initiatives to support farmers, with smallholder digitization gaining increasing global attention (Mushi, Burgi & Serugendo, 2024; Abdulia, 2022). Digital technologies ranging from basic tools such as mobile telephony, to intermediate tools like drones and sensors, and advanced applications such as artificial intelligence (AI) and precision agriculture, are being adopted to transform agricultural practices (Simelton & McCampbell, 2021). Platforms such as big data analytics, IoT, and mobile applications now play critical roles in facilitating rural development, increasing productivity, and modernizing smallholder agriculture (Hoang & Tran, 2023; Yang *et al.*, 2024).

Vocational agricultural education focuses on imparting agricultural skills, knowledge, and attitudes necessary for students to pursue careers in farming, agribusiness, and related fields (Usman & Suleiman, 2006). It prepares individuals in areas such as crop production, animal husbandry, farm business management, and resource utilization (Ezeagu & Ezema, 2004). However, in Nigeria, vocational agricultural education faces serious constraints, including outdated curricula, weak technological integration, limited funding, inadequate infrastructure, and shortage of qualified personnel (Mbah *et al.*, 2022).

While AI and ICT tools are increasingly adopted globally to transform agriculture, their integration into vocational education remains limited. Current applications such as precision farming, pest and disease detection, predictive yield modeling, and climate-smart advisory services demonstrate the potential of AI-driven solutions. Yet, their role in revamping vocational agricultural education to effectively engage youth in agriculture is still underexplored (Songol *et al.*, 2021; Deji *et al.*, 2023). Moreover, barriers such as poor access to technology, inadequate infrastructure, and low awareness hinder the scalability of ICT and AI solutions in agricultural education (Adelbijola & Okonkwo, 2023).

If integrated effectively, ICT-driven approaches in vocational agricultural education can enhance experiential learning, personalize training, and expose youth to innovative agricultural practices. This not only improves agricultural productivity but also promotes youth entrepreneurship, employment opportunities, and sustainability across the agri-food value chain in Nigeria (Deji *et al.*, 2023).

Despite agriculture being the fulcrum of development in Nigeria, the sector continues to face persistent challenges such as low yields, limited access to modern technologies, unsustainable farming practices, and climatic variability (FAO, 2021). A major concern is the declining involvement of youth in agriculture, as many young people perceive farming as unattractive, labor-intensive, and unprofitable (Girdziute *et al.*, 2022). This situation threatens future food security, economic growth, and sustainable development. Inadequate vocational training is a key factor behind youths' disinterest in agriculture, as existing programs often fail to equip learners with relevant digital and technical skills (Maisule *et al.*, 2023). Without modernization through ICT-driven approaches, vocational agricultural education risks losing its relevance in preparing the next generation of farmers and agripreneurs. Hence, there is an urgent need to explore how ICT adoption in vocational agricultural education can reinvigorate youth participation in agriculture and contribute to addressing food security challenges in Nigeria.

Research Objectives

- i. examine the vocational agriculture education available in the study area;
- ii. **identify the key ICT tools** applicable to vocational agricultural education for youth engagement in agriculture;
- iii. determine the roles of ICT in enhancing vocational agriculture education to enhance youths involvement in agriculture in the study area;
- iv. **examine the factors influencing the adoption of ICT-driven approaches** in vocational agricultural education.

2. Materials and Methods

Area of Study

The research was carried out in Delta State. It has a land area of 436km² and a populace of 162,594 (NPC, 2006). The tropical climate is marked by dry and rainy seasons. The rainy season starts in April and finishes in October. August and September are the wettest months. The dry season begins in November and finishes in April. Yam, cassava, melon, tomatoes and plantains are among the major crops grown in the area. Primary data were collected using questionnaires.

A multiple stage selection procedure was used. Firstly, three tertiary institutions were carefully chosen from the state namely Delta State Polytechnic, Ogwashi-Uku, Federal College of Education (Technical), Asaba and Delta State University, Abraka. The next stage of the sampling involved the random selection of 35 students from each of the tertiary institutions to give an aggregate of 105 students. This study adopted a descriptive survey research design to assess the impact of ICT integration on student learning outcomes in Nigerian tertiary institutions. The design was chosen to allow for the collection of standardized data from a wide population, enabling both quantitative and qualitative analyses.

Method of Data Analysis

Various descriptive and inferential statistics were used for data analysis. Objective (i) (ii) (iii) and (iv) were achieved using mean, percentage and frequency counts.

3. Results and Discussions

Table 1. Vocational agriculture education in the study area

Variables	Frequency (105)	Percentage (100)
Crop production	19	18.1
Livestock farming	11	10.5
Marketing of agricultural produce	8	7.6
Processing of agriculture produce	10	9.5
Agricultural entrepreneurship	37	35.2
Farm management	20	19.1

Field study 2025

Table 1 highlights the distribution of vocational agriculture education activities in the study area. The results show that agricultural entrepreneurship (35.2%) recorded the highest participation among youths. This indicates that young people are increasingly drawn to agribusiness opportunities rather than traditional subsistence farming. The finding aligns with Adejo and Haruna (2021), who observed that ICT applications in agribusiness such as mobile money, online marketplaces, and digital record-keeping have transformed agriculture into a business-oriented sector attractive to youths. By leveraging ICT tools, youths can more easily access market information, financial services, and networks that enhance agribusiness success. The second largest proportion of respondents reported involvement in farm management (19.1%), reflecting a recognition of the importance of managerial and decision-making skills. ICT-enabled farm management systems such as precision agriculture tools, weather apps, and record-keeping software are essential in equipping young farmers with data-driven insights. This is consistent with Olowa (2021), who emphasized that ICT-driven decision support systems reduce risks and optimize farm operations.

Participation in crop production (18.1%) also remains significant, highlighting the continued relevance of primary agricultural production. However, ICT tools such as remote sensing, mobile-based pest and disease diagnostics, and climate-smart apps can make crop farming more appealing to youths by reducing uncertainties and increasing efficiency (Aker *et al.*, 2016). On the other hand, livestock farming (10.5%), processing of agricultural produce (9.5%), and marketing of agricultural produce (7.6%) had lower participation levels. These activities, though critical for value chain development, may appear less accessible to youths due to higher capital requirements, inadequate infrastructure, and weak market linkages. Nevertheless, ICT adoption offers opportunities for expansion. For instance, Okeke *et al.* (2022) found that mobile-based veterinary services, e-extension platforms, and digital processing technologies can

reduce entry barriers for youths in livestock and processing. Similarly, Lubua (2022) noted that digital marketing platforms provide avenues for young farmers to access broader markets and improve profitability. Overall, the results suggest that while youths are involved in various vocational agriculture domains, their stronger inclination toward entrepreneurship and farm management underscores the importance of ICT integration into vocational agriculture education. ICT-driven approaches not only modernize traditional agricultural practices but also help rebrand agriculture as a viable and innovative career path for young Nigerians (Adejo & Haruna, 2021; Lubua, 2022).

Table 2. Key ICT tools applicable to vocational agricultural education for youth engagement in agriculture

Variables	Frequency	Percentage
Ability to use Microsoft Office Suite		
Yes	78	74.3
No	27	25.7
Ability to use digital marketing platforms		
Yes	82	78.1
No	23	21.9
Ability to use IoT devices in agriculture		
Yes	65	61.9
No	40	38.1
Ability to use e-commerce platforms		
Yes	89	84.8
No	16	15.2
Ability to use internet resources		
Yes	86	81.9
No	19	18.1
Ability to use block chain technology in agribusiness		
Yes	85	81.0
No	20	19.0

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Table 2 highlights the key ICT tools applicable to vocational agricultural education that can enhance youth participation in agriculture. The results demonstrate a high level of exposure and ability among youths to utilize modern ICT applications across various agricultural domains. The highest participation was recorded in the use of e-commerce platforms (84.8%), followed closely by the use of internet resources (81.9%) and blockchain technology in agribusiness (81.0%). This suggests that Nigerian youths are increasingly leveraging digital tools to explore market opportunities, access agricultural information, and ensure transparency in agribusiness transactions. This trend aligns

with the findings of Okeke *et al.* (2022), who reported that e-commerce and internet platforms provide new opportunities for young farmers to access wider markets, reduce transaction costs, and enhance competitiveness. Moreover, blockchain adoption reflects a growing awareness of innovations that ensure trust, traceability, and financial inclusion in agricultural trade (Tapscott & Tapscott, 2017). Similarly, digital marketing platforms (78.1%) also showed strong adoption levels, indicating that youths are embracing ICT in promoting agricultural products and services. This is consistent with Adejo and Haruna (2021), who highlighted that social media and online advertising tools are increasingly being used by young agripreneurs to expand their customer base and improve profitability.

The ability to use Microsoft Office Suite (74.3%) and IoT devices (61.9%) also demonstrates considerable capacity. While Microsoft Office remains a basic ICT competency for documentation, analysis, and reporting, IoT devices represent a more advanced form of ICT adoption that provides real-time data for precision agriculture. The 61.9% adoption rate for IoT tools indicates a significant but still growing area, as challenges such as high costs and infrastructural limitations may hinder full-scale utilization (Olowa, 2021). Interestingly, while adoption levels are generally high, some gaps remain. For example, 25.7% of respondents reported no ability to use Microsoft Office, and 38.1% indicated limited knowledge of IoT devices. These gaps highlight the need for structured ICT training in vocational agriculture curricula to ensure inclusiveness and sustainability. As noted by Aker *et al.* (2016), ICT tools only translate into agricultural transformation when users have adequate digital literacy and institutional support. Overall, the findings suggest that Nigerian youths possess considerable ICT potential for transforming agriculture. By integrating these tools into vocational agriculture education, policymakers and institutions can strengthen youth engagement, enhance agribusiness competitiveness, and reposition agriculture as a modern, profitable career pathway.

Table 3. The roles of ICT in enhancing vocational agriculture education to enhance youths involvement in agriculture in the study area

Variables	Mean	SD	Remark
Promotes online courses and training opportunities	2.41	0.93	Disagreed
Facilitates networking with professional s through social media	2.2	0.82	Disagreed
Promotes mentorship and career guidance via online platforms	3.0	0.79	Agreed
Promotes cross disciplinary collaboration on agribusiness projects	3.37	0.56	Agreed
Promotes access to online job advertisement	2.10	0.65	Disagreed

Field study 2025

Table 3 presents the perceived roles of ICT in enhancing vocational agriculture education for youth engagement in agriculture. The results reflect both areas of agreement and disagreement among respondents regarding ICT's contributions. The respondents agreed that ICT plays important roles in mentorship and career guidance via online platforms (Mean = 3.0; SD = 0.79) and promoting cross-disciplinary collaboration on agribusiness projects (Mean = 3.37; SD = 0.56). These findings underscore the recognition that ICT fosters learning opportunities beyond traditional classrooms by connecting youths with mentors, role models, and experts in agriculture through online platforms. According to Adejo and Haruna (2021), mentorship supported by ICT increases youths' confidence, career awareness, and motivation to pursue agribusiness ventures. Similarly, ICT-facilitated collaboration allows young farmers and agripreneurs to work with stakeholders across disciplines, enhancing innovation and competitiveness in agribusiness value chains (Aker *et al.*, 2016). Conversely, respondents disagreed on ICT's role in promoting online courses and training opportunities (Mean = 2.41; SD = 0.93), facilitating networking with professionals through social media (Mean = 2.20; SD = 0.82), and promoting access to online job advertisements (Mean = 2.10; SD = 0.65). These

findings suggest that while ICT tools are widely available, their integration into structured vocational agriculture education remains weak.

Limited awareness, infrastructural constraints (e.g., poor internet connectivity), and inadequate institutional frameworks may explain why youths do not yet perceive ICT as a strong driver of training, networking, and employment opportunities. This supports Olowa (2021), who noted that gaps in digital literacy and ICT infrastructure limit the transformative potential of ICT in rural agricultural education. Overall, the results indicate that ICT is recognized more as a support tool for mentorship and collaboration than as a driver of formal training, professional networking, and job access. For ICT to fully enhance vocational agriculture education, institutions must mainstream online training modules, create digital platforms for professional networking, and establish ICT-based job-matching systems. As Lubua (2022) argued, ICT adoption in developing economies must go beyond access to technology to include enabling structures that align digital innovations with user needs.

Table 4. Factors influencing the adoption of ICT-driven approaches in vocational agricultural education

Variables	Mean	SD	Remark
Cost of internet	2.6	0.96	Agreed
Poor internet	2.25	0.67	Disagreed
Poor facilities	2.93	0.65	Agreed
Lack of technical knowhow	3.22	0.50	Agreed
Low manpower	2.83	0.59	Agreed

Field study 2025

Table 4 identifies the factors influencing the adoption of ICT-driven approaches in vocational agricultural education. The findings reveal that several structural and capacity-related challenges hinder the effective use of ICT tools among youths in agriculture. Respondents agreed that lack of technical know-how (Mean = 3.22; SD = 0.50) is the most significant barrier. This reflects the reality that many young people in rural and semi-urban areas lack adequate digital literacy skills to fully utilize ICT innovations in agriculture. According to Adejo and Haruna (2021), inadequate ICT knowledge reduces the effectiveness of e-learning platforms, digital extension services, and mobile applications in promoting agricultural education. Without proper training and exposure, ICT adoption in vocational agriculture will remain superficial and underutilized. Similarly, poor facilities (Mean = 2.93; SD = 0.65) and low manpower (Mean = 2.83; SD = 0.59) were identified as barriers. These findings suggest that institutions providing vocational agriculture education may not have sufficient ICT infrastructure, such as computer labs, internet-enabled devices, or qualified ICT instructors. Olowa (2021) emphasized that weak institutional capacity and inadequate investment in ICT infrastructure limit the transformative potential of digital agriculture, especially in rural training institutions.

The cost of internet (Mean = 2.6; SD = 0.96) was also acknowledged as a barrier. Despite the growing penetration of mobile technologies in Nigeria, high data costs still constrain access to ICT-based resources. This aligns with Aker *et al.* (2016), who argued that affordability remains a critical determinant of ICT use in agricultural development initiatives in Africa. Interestingly, respondents disagreed that poor internet connectivity (Mean = 2.25; SD = 0.67) was a major barrier. This may imply that while internet coverage is increasingly available in the study area, affordability and user capacity remain bigger obstacles than connectivity itself. This contrasts with findings in other rural regions where connectivity is still a primary challenge (World Bank, 2021). Overall, the results indicate that adoption of ICT-driven approaches in vocational agriculture education is hindered more by capacity constraints (technical know-how, manpower) and resource limitations (facilities, internet cost) than by availability of internet infrastructure. Addressing these issues through digital literacy training, provision of ICT infrastructure, and subsidized internet access will significantly enhance youths' ability to leverage ICT for agricultural transformation.

4. Conclusion

This study examined the adoption of ICT-driven approaches in vocational agricultural education as a strategy to enhance youth involvement in agriculture in Nigeria. The results provide useful insights into the areas of vocational agriculture education, ICT tools utilized, roles of ICT in education, and factors influencing ICT adoption. 105 students were randomly selected from three (3) tertiary institutions in Delta State, Nigeria. Structured questionnaires were administered to 105 students of the institutions and the collected data were analysed using descriptive statistics. The findings reveal that youths are mostly involved in agricultural entrepreneurship (35.2%), farm management (19.1%), and crop production (18.1%), with lower participation in livestock, processing, and marketing. This indicates that young people are increasingly drawn to entrepreneurial and management aspects of agriculture, particularly where ICT tools can create business opportunities and reduce risks. Regarding ICT tools, the results show high levels of competence in using e-commerce platforms (84.8%), internet resources (81.9%), blockchain (81.0%), and digital marketing platforms (78.1%). These findings highlight the potential of ICT in creating market linkages, improving transparency, and modernizing agribusiness practices. However, relatively lower adoption of IoT devices (61.9%) suggests challenges in advanced technological uptake due to cost and infrastructure barriers. In terms of ICT's role in vocational agricultural education, respondents agreed that ICT is most effective in promoting mentorship and career guidance (Mean = 3.0) and cross-disciplinary collaboration (Mean = 3.37). However, they disagreed on its role in promoting online courses, professional networking, and job advertisements, suggesting that ICT's integration into structured educational systems is still weak. The major constraints to ICT adoption identified were lack of technical know-how (Mean = 3.22), poor facilities (Mean = 2.93), low manpower (Mean = 2.83), and high cost of internet (Mean = 2.6). Interestingly, respondents did not perceive poor internet connectivity as a major constraint, suggesting that affordability and digital literacy are more critical challenges than connectivity itself. Overall, the study highlights that while Nigerian youths are willing and able to adopt ICT tools in agriculture, barriers related to training, facilities, and institutional support limit the full potential of ICT-driven vocational agriculture education.

Recommendations

- i. Agricultural training institutions should revise curricula to embed ICT applications such as e-extension services, IoT, blockchain, and digital marketing into vocational agriculture education. This will ensure students acquire digital skills alongside technical farming competencies.
- ii. Government and development partners should implement ICT capacity-building programs for youths to improve digital literacy and technical know-how. Specialized training in data analytics, AI-based agriculture, and IoT will prepare youths for modern agribusiness opportunities.
- iii. Institutions should invest in ICT-enabled training facilities, such as computer labs, internet-access hubs, and smart classrooms, to support experiential and blended learning. Partnerships with ICT companies could provide affordable equipment and software.
- iv. Given that high internet costs were a major constraint, policymakers should explore subsidized data packages for students in vocational agriculture education, especially in rural areas. This will increase access to e-learning, digital platforms, and agribusiness applications.
- v. Stakeholders should establish online mentorship platforms where youths can connect with agricultural experts, entrepreneurs, and peers. These platforms should also support cross-disciplinary collaborations to foster innovation in agribusiness.
- vi. Recruiting and training more ICT-literate instructors in vocational agriculture institutions will reduce manpower shortages and enhance the effective integration of ICT into teaching and learning.
- vii. Government agencies such as the Federal Ministry of Agriculture and Rural Development (FMARD) should mainstream ICT into agricultural education policies, aligning with the goals of the Sustainable Development Goals (SDG 2 and SDG 8) to promote food security and youth employment.

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