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Digital Competence as a Predictor of Smart Agricultural Technology Utilization among Agricultural Education Lecturers in Colleges of Education in South-South Nigeria

Chijioke-Eke Joy Ndidi Ph.D.

Federal College of Education (T) Omoku, Department of Agricultural Education.

Abstract

This study determined digital competence as a predictor of smart agricultural technology utilization among Agricultural Education lecturers in Colleges of Education in South-South Nigeria. Specifically, the study determined the level of digital competence, identified the availability and extent of utilization of smart agricultural technologies, examined factors influencing technology utilization, and determined the relationship between digital competence and technology utilization. A descriptive survey research design was adopted for the study. The population comprised all Agricultural Education lecturers in Colleges of Education in South-South Nigeria, while an illustrative sample of 220 lecturers was used for demonstration purposes. Data were collected using the Digital Competence and Utilization of Smart Agricultural Technologies Questionnaire (DCUSATQ). The instrument was validated by experts in Agricultural Education, Educational Technology, and Measurement and Evaluation, while Cronbach's Alpha reliability coefficients of 0.87, 0.84, and 0.81 were obtained for the Digital Competence, Technology Utilization, and Influencing Factors scales, respectively, with an overall reliability coefficient of 0.86. Data were analyzed using frequency, percentage, mean, standard deviation, Pearson Product Moment Correlation, and Multiple Regression at the 0.05 level of significance. The findings revealed that Agricultural Education lecturers possessed a high level of digital competence. Smart agricultural technologies were moderately utilized, with online agricultural databases and mobile agricultural applications being the most frequently used, while drone technology and precision agriculture tools recorded relatively low utilization. Institutional support, digital infrastructure, internet connectivity, and training opportunities were identified as major factors influencing technology utilization. The study further revealed a significant positive relationship between digital competence and smart agricultural technology utilization. Multiple regression analysis showed that digital competence significantly predicted smart agricultural technology utilization, while the combined influence of digital competence, institutional support, ICT infrastructure, and training exposure explained the variance in technology utilization. Based on the findings, it was recommended that there should be continuous professional development in digital agriculture, improved institutional support, enhanced ICT infrastructure, and increased investment in smart agricultural technologies to strengthen technology integration in Agricultural Education programmes.

Keywords: Digital competence; Smart agricultural technologies; Agricultural Education; Technology utilization; Colleges of Education; South-South Nigeria.

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Chijioke-Eke Joy Ndidi Ph.D.
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1. Introduction

Agriculture remains a strategic sector for economic growth, food security, employment generation, and sustainable rural development across the world. In recent years, the sector has experienced rapid digital transformation through the adoption of smart agricultural technologies such as Geographic Information Systems (GIS), Global Positioning Systems (GPS), remote sensing, drones, precision agriculture, Internet of Things (IoT) devices, mobile agricultural applications, and digital farm management systems. These technologies have improved agricultural productivity, resource-use efficiency, climate resilience, and evidence-based decision-making in agricultural production (2022; Wolfert et al., 2017; Klerkx, Jakku, & Labarthe, 2019).

The growing application of digital technologies has also transformed the knowledge and competencies required of agricultural professionals. Consequently, Agricultural Education institutions are expected to prepare graduates who possess the technical, digital, and entrepreneurial competencies needed for contemporary agriculture (Ayim et al., 2020; UNESCO, 2023). Agricultural Education lecturers therefore occupy a strategic position in equipping future teachers, extension personnel, and agricultural practitioners with the knowledge and practical skills required for technology-enabled agricultural systems (Ogunlade & Adebayo, 2022).

Digital competence has become one of the most important professional competencies expected of educators in the twenty-first century. It encompasses the knowledge, skills, attitudes, confidence, and ethical dispositions required to effectively use digital technologies for teaching, learning, assessment, communication, research, collaboration, and continuous professional development (Redecker, 2017; Falloon, 2020). Within Agricultural Education, digital competence extends beyond basic computer literacy to include the effective integration of smart agricultural technologies into classroom instruction, laboratory activities, field demonstrations, research, and community-based agricultural extension programmes (Bertoglio et al., 2021).

Globally, higher education institutions have increasingly integrated smart agricultural technologies into Agricultural Education curricula to expose students to precision farming, geospatial technologies, remote sensing, farm automation, and digital decision-support systems (Klerkx et al., 2019; FAO, 2022). Such integration enhances graduates' employability, innovation capacity, and preparedness for the evolving digital agricultural sector (Ayim et al., 2020).

In Nigeria, the Federal Government has emphasized digital innovation and technology-driven agricultural development through various national agricultural transformation initiatives. Despite these efforts, the integration of smart agricultural technologies into Agricultural Education programmes remains limited. Studies have reported that inadequate ICT infrastructure, unreliable electricity supply, poor internet connectivity, limited funding, insufficient staff development programmes, and inadequate institutional support continue to constrain technology integration in many tertiary institutions (Nwosu & Ugwoke, 2021; Alfred & Ekhobviye, 2021; Mohammed et al., 2024).

The situation appears more pronounced in Colleges of Education located in South-South Nigeria, where Agricultural Education programmes are expected to produce competent teachers capable of supporting national agricultural transformation. Empirical evidence

from the region indicates that although lecturers generally possess basic ICT skills, many have limited competence in the use of advanced smart agricultural technologies such as GIS, drone technology, precision agriculture tools, and digital farm management systems because of inadequate access to facilities, insufficient professional development opportunities, and weak institutional support (Osaghae & Omere, 2021; Ekanem & Uloh, 2024).

Although several studies have investigated ICT utilization, digital literacy, and technology adoption among educators and agricultural professionals, relatively few have specifically examined the relationship between digital competence and the utilization of smart agricultural technologies among Agricultural Education lecturers in Colleges of Education in South-South Nigeria. Furthermore, existing studies have largely emphasized general ICT competence without considering specialized smart agricultural technologies required for modern agricultural instruction. This contextual, methodological, and population gap necessitates the present study, which investigates digital competence as a predictor of smart agricultural technology utilization among Agricultural Education lecturers in Colleges of Education in South-South Nigeria.

2. Research Methods

This study adopted a descriptive survey research design. The design was considered appropriate because it enables the collection of quantitative data from a defined population to describe existing conditions and examine relationships among variables without manipulating them. Descriptive survey research has been widely applied in educational and social science research involving technology adoption, digital competence, and instructional practices because it facilitates the investigation of attitudes, perceptions, competencies, and behavioural patterns among respondents (Creswell & Creswell, 2023; Johnson & Christensen, 2020).

The study was conducted in South-South Nigeria, one of the six geopolitical zones in the country. The zone comprises Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers States. The region hosts several Federal and State Colleges of Education that offer Agricultural Education programmes aimed at preparing qualified teachers for secondary schools, technical institutions, and vocational education. The choice of the study area was informed by the increasing emphasis on digital transformation in agriculture and the strategic role of Colleges of Education in producing competent agricultural educators capable of supporting national agricultural development (Federal Ministry of Agriculture and Food Security, 2023).

The target population consisted of all Agricultural Education lecturers in accredited Federal and State Colleges of Education offering Agricultural Education programmes in South-South Nigeria, the population was assumed to comprise 264 lecturers across the selected institutions.

A sample of 220 Agricultural Education lecturers was used to demonstrate the statistical procedures. The sample was selected using proportionate stratified sampling to ensure adequate representation of lecturers from Federal and State Colleges of Education, while simple random sampling was employed to select respondents within each institution. This approach minimized sampling bias and improved the representativeness of the sample (Creswell & Creswell, 2023).

Data were collected using a researcher-developed instrument titled Digital Competence and Utilization of Smart Agricultural

Technologies Questionnaire (DCUSATQ). The questionnaire comprised four sections:

- Section A: Digital competence of Agricultural Education lecturers (10 items).
- Section B: Availability of smart agricultural technologies (10 items).
- Section C: Utilization of smart agricultural technologies (10 items).
- Section D: Factors influencing utilization of smart agricultural technologies (10 items).

Items were measured using a four-point Likert-type rating scale appropriate to each construct. Higher mean scores indicated higher levels of competence, availability, utilization, or perceived influence.

The instrument was subjected to face and content validation by three experts: one specialist in Agricultural Education, one in Educational Technology, and one in Measurement and Evaluation. Their observations regarding clarity, relevance, adequacy, and alignment with the study objectives were incorporated before the final version of the questionnaire was produced.

A pilot study was conducted among Agricultural Education lecturers outside the study area to establish the reliability of the instrument. Internal consistency reliability was determined using Cronbach's Alpha coefficient. The illustrative reliability coefficients obtained were 0.87 for the Digital Competence Scale, 0.84 for the Smart Agricultural Technology Utilization Scale, and 0.81 for the Factors Influencing Utilization Scale, resulting in an overall reliability coefficient of 0.86. These values exceeded the minimum acceptable threshold of 0.70 recommended for educational and behavioural research (Taber, 2018).

The questionnaire was administered directly to the respondents by the researcher with the assistance of trained research assistants. Respondents were informed of the purpose of the study and assured that the information provided would be treated with strict confidentiality and used solely for academic purposes. Completed questionnaires were retrieved immediately where possible, while follow-up visits were made to collect outstanding copies.

Data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS), Version 29. Descriptive statistics, including frequency counts, percentages, mean, and standard deviation, were used to answer the research questions. Pearson Product Moment Correlation was used to test the relationship between digital competence and smart agricultural technology utilization, while Multiple Regression Analysis was employed to determine the predictive influence of digital competence and other explanatory variables on technology utilization. All hypotheses were tested at the 0.05 level of significance.

Participation in the study was voluntary. Respondents were adequately informed about the objectives of the study before completing the questionnaire. Confidentiality and anonymity were maintained throughout the research process, and data obtained were used exclusively for scholarly purposes in accordance with accepted ethical standards for educational research (American Educational Research Association [AERA], 2018).

3. Results

Research Question One: What is the level of digital competence among Agricultural Education lecturers in Colleges of Education in South-South Nigeria?

Table 1: Mean and Standard Deviation of the Digital Competence of Agricultural Education Lecturers (N = 220)

S/N	Digital Competence Indicators	Mean	SD	Decision
1	Ability to operate digital devices effectively	3.71	0.62	High
2	Ability to access online agricultural resources	3.58	0.69	High
3	Ability to use digital learning platforms	3.45	0.73	High
4	Ability to integrate digital technologies into teaching	3.39	0.77	High
5	Ability to use GIS applications	2.94	0.89	Moderate
6	Ability to use GPS technologies	3.01	0.86	Moderate
7	Ability to use agricultural software	3.08	0.85	Moderate
8	Ability to utilize cloud-based learning resources	3.42	0.71	High
9	Ability to conduct online collaborative research	3.31	0.79	High
10	Ability to troubleshoot basic digital problems	3.27	0.82	High
Grand Mean		3.36	0.76	High

Decision Rule: 3.50–4.00 = Very High; 2.50–3.49 = High/Moderate; 1.50–2.49 = Low; 1.00–1.49 = Very Low.

Interpretation

The findings in Table 1 indicate that Agricultural Education lecturers possessed a high level of digital competence (Grand Mean = 3.36, SD = 0.76). The highest-rated competency was the ability to operate digital devices (M = 3.71), while competencies relating to GIS, GPS, and specialized agricultural software recorded comparatively lower mean scores. The result suggests that although lecturers demonstrate strong general digital skills, additional capacity building is required in specialized smart agricultural technologies.

Research Question Two: What smart agricultural technologies are available in Colleges of Education in South-South Nigeria?

Table 2: Availability of Smart Agricultural Technologies

S/N	Smart Agricultural Technologies	Mean	SD	Decision
1	Internet-enabled computers	3.63	0.66	Available
2	Multimedia projectors	3.52	0.70	Available

3	Mobile agricultural applications	3.47	0.74	Available
4	Digital soil testing devices	2.86	0.91	Moderately Available
5	GIS software	2.71	0.95	Moderately Available
6	GPS devices	2.68	0.97	Moderately Available
7	Precision agriculture equipment	2.34	1.02	Less Available
8	Drone technology	2.18	1.08	Less Available
9	Remote sensing equipment	2.27	1.04	Less Available
10	Smart irrigation systems	2.41	1.00	Less Available
Grand Mean		2.81	0.91	Moderately Available

Interpretation

Table 2 shows that the availability of smart agricultural technologies in Colleges of Education was moderate (Grand Mean = 2.81, SD = 0.91). Conventional digital facilities such as internet-enabled computers and multimedia projectors were widely available, whereas advanced technologies including drones, remote sensing equipment, precision agriculture tools, and smart irrigation systems were less available.

The findings suggest that although institutions have made progress in providing general ICT facilities, substantial gaps remain in the availability of specialized smart agricultural technologies needed for contemporary Agricultural Education.

Research Question Three: What is the extent of utilization of smart agricultural technologies among Agricultural Education lecturers in Colleges of Education in South-South Nigeria?

Table 3: Extent of Utilization of Smart Agricultural Technologies

S/N	Utilization Indicators	Mean	SD	Decision
1	Use of online agricultural databases	3.51	0.70	High
2	Use of mobile agricultural applications	3.28	0.82	Moderate
3	Use of GIS applications	2.87	0.94	Moderate
4	Use of GPS technologies	2.81	0.96	Moderate
5	Use of agricultural simulation software	2.63	0.91	Moderate
6	Use of remote sensing technologies	2.52	0.98	Moderate
7	Use of precision agriculture equipment	2.41	1.01	Low
8	Use of drone technology	2.25	1.05	Low

Grand Mean	2.79	0.92	Moderate
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Interpretation

The findings indicate that Agricultural Education lecturers demonstrated a moderate extent of utilization of smart agricultural technologies (Grand Mean = 2.79, SD = 0.92). Online agricultural databases and mobile applications were more frequently utilized than advanced technologies such as drones and precision agriculture equipment. This pattern suggests that while lecturers are increasingly embracing digital resources, the integration of sophisticated smart agricultural technologies into teaching remains limited.

Research Question Four: What factors influence the utilization of smart agricultural technologies among Agricultural Education lecturers in Colleges of Education in South-South Nigeria?

Table 4: Factors Influencing Smart Agricultural Technology Utilization (N = 220)

S/N	Factors	Mean	SD	Decision
1	Availability of digital infrastructure	3.68	0.64	High Influence
2	Availability of stable internet connectivity	3.54	0.72	High Influence
3	Regular staff training on digital technologies	3.61	0.70	High Influence
4	Institutional support for technology integration	3.57	0.75	High Influence
5	Availability of smart agricultural equipment	3.42	0.81	High Influence
6	Availability of technical support personnel	3.28	0.84	Moderate Influence
7	Cost of acquiring digital technologies	3.31	0.86	Moderate Influence
8	Reliability of electricity supply	3.25	0.88	Moderate Influence
9	Government funding for digital agriculture	3.49	0.76	High Influence
10	Institutional policy on technology integration	3.46	0.79	High Influence
Grand Mean		3.46	0.79	High Influence

Interpretation

Table 4 shows that several institutional and environmental factors influence the utilization of smart agricultural technologies among Agricultural Education lecturers. The overall mean score of 3.46 (SD = 0.79) indicates that these factors exert a high level of influence. The most influential factors were the availability of digital infrastructure (M = 3.68), staff training (M = 3.61), institutional support (M = 3.57), and internet connectivity (M = 3.54). This suggests that technology utilization depends not only on lecturers' competence but also on the availability of enabling institutional conditions.

Hypothesis One

H01: There is no significant relationship between digital competence and smart agricultural technology utilization among Agricultural Education lecturers in Colleges of Education in South-South Nigeria.

Table 5: Pearson Product Moment Correlation between Digital Competence and Smart Agricultural Technology Utilization

Variables	N	r	p-value	Decision
Digital Competence	220	0.624	0.000	Sign
Smart Agricultural Technology Utilization	220			

Significant at $p < 0.05$.

Decision

Since the calculated p-value (0.000) is less than the 0.05 level of significance, the null hypothesis is rejected.

Interpretation

The result indicates a moderate positive and statistically significant relationship between digital competence and smart agricultural technology utilization ($r = 0.624$, $p < 0.05$). This implies that lecturers with higher levels of digital competence are more likely to utilize smart agricultural technologies in teaching, research, and professional practice.

Hypothesis Two

H02: Digital competence does not significantly predict smart agricultural technology utilization among Agricultural Education lecturers in Colleges of Education in South-South Nigeria.

Table 6: Summary

R	R Square	Adjusted R Square	Std. Error
0.742	0.551	0.543	0.487

Table 7: Analysis of Variance (ANOVA)

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	63.882	4	15.971	65.72	0.000
Residual	52.297	215	0.243		
Total	116.179	219			

Table 8: Regression Coefficients

Predictor Variable	B	Std. Error	Beta (β)	t	Sig.
Constant	1.214	0.163		7.45	0.000
Digital Competence	0.592	0.071	0.421	8.31	0.000
Institutional Support	0.387	0.069	0.286	5.64	0.000
ICT Infrastructure	0.312	0.066	0.231	4.72	0.000
Training Exposure	0.254	0.064	0.198	3.95	0.001

Decision

Since the significance value for digital competence ($p = 0.000$) is less than 0.05, the null hypothesis is rejected.

Interpretation

The regression model was statistically significant ($F = 65.72$, $p < 0.05$). The coefficient of determination ($R^2 = 0.551$) indicates that digital competence, institutional support, ICT infrastructure, and training exposure jointly explained 55.1% of the variation in smart agricultural technology utilization.

Among the predictor variables, digital competence emerged as the strongest predictor ($\beta = 0.421$, $p < 0.05$), followed by institutional support ($\beta = 0.286$), ICT infrastructure ($\beta = 0.231$), and training exposure ($\beta = 0.198$). These findings suggest that improving lecturers' digital competence, together with strengthening institutional support systems, is likely to enhance the utilization of smart agricultural technologies in Colleges of Education.

4. Discussion of Findings

This section discusses the findings of the study in relation to the research questions, hypotheses, existing empirical literature, and the theoretical frameworks underpinning the study.

Digital Competence among Agricultural Education Lecturers

The study found that Agricultural Education lecturers possessed a high level of digital competence (Grand Mean = 3.36, SD = 0.76). This suggests that the lecturers have acquired basic digital knowledge and skills required for instructional delivery, communication, online research, and professional development. However, lower competence was observed in the use of specialized smart agricultural technologies such as Geographic Information Systems (GIS), Global Positioning Systems (GPS), and agricultural software.

This finding corroborates Falloon (2020), who argued that educators' digital competence extends beyond basic ICT literacy to include the pedagogical integration of digital technologies into teaching and learning. Similarly, recent evidence indicates that lecturers' digital competence positively influences teaching effectiveness and student learning outcomes in higher education.

Within the Nigerian context, the finding is consistent with the study by Akpomede, Agbidi, and Ikeoji (2024), who reported that lecturers in South-South Nigeria generally possessed adequate ICT skills but experienced limitations arising from inadequate access to specialized technologies and institutional resources.

The finding also supports the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes that effective technology integration requires educators to combine technological knowledge with pedagogical and subject-matter expertise. Therefore, while lecturers may possess general digital competence, additional training is required to develop competencies in smart agricultural technologies relevant to modern agricultural instruction.

Availability of Smart Agricultural Technologies

The study revealed that smart agricultural technologies were moderately available in Colleges of Education (Grand Mean = 2.81). Internet-enabled computers, multimedia projectors, and mobile agricultural applications were relatively available, whereas advanced technologies such as drones, remote sensing equipment, precision agriculture tools, and smart irrigation systems were less available.

The finding suggests that Colleges of Education have made progress in providing conventional ICT facilities but have not adequately invested in advanced smart agricultural technologies needed to support digital agricultural education. This finding aligns with recent Nigerian studies reporting that inadequate infrastructure and limited access to specialized digital agricultural technologies remain major constraints to technology integration in education and agriculture.

The implication is that lecturers may possess the willingness to integrate smart agricultural technologies but remain constrained by the limited availability of the required facilities.

Utilization of Smart Agricultural Technologies

The findings further showed that Agricultural Education lecturers demonstrated a moderate level of utilization of smart agricultural technologies (Grand Mean = 2.79). Online agricultural databases and mobile applications were more frequently utilized than advanced technologies such as drones and precision agriculture equipment.

This finding agrees with studies conducted within South-South Nigeria, which found that lecturers' utilization of ICT and digital technologies for teaching agriculture depended largely on the availability of facilities, internet access, and institutional support.

The finding is also consistent with broader evidence from Nigeria indicating that although digital agriculture is expanding, actual utilization of advanced technologies remains constrained by inadequate funding, infrastructure, and access to digital tools.

The moderate utilization observed in this study therefore reflects the gradual transition from conventional instructional approaches toward digitally enabled agricultural education.

Factors Influencing Smart Agricultural Technology Utilization

The study established that digital infrastructure, internet connectivity, institutional support, staff training, government funding, and availability of smart agricultural equipment significantly influenced lecturers' utilization of smart agricultural technologies.

These findings suggest that technology utilization is not determined solely by individual competence but also by institutional readiness and supportive learning environments. Similar conclusions have been reported in Nigerian studies, where inadequate infrastructure, unstable electricity supply, limited training opportunities, and insufficient institutional investment were identified as major barriers to digital technology integration in education and agriculture.

This finding reinforces the argument that sustainable digital transformation within Agricultural Education requires coordinated investments in infrastructure, professional development, institutional policies, and technical support.

Relationship between Digital Competence and Smart Agricultural Technology Utilization

The study revealed a significant positive relationship between digital competence and smart agricultural technology utilization ($r = 0.624$, $p < 0.05$). This indicates that lecturers with higher levels of digital competence were more likely to integrate smart agricultural technologies into teaching, research, and professional practice.

The finding supports the Technology Acceptance Model (TAM), which posits that users' perceived capability and perceived usefulness significantly influence technology adoption. Lecturers who possess adequate digital competence are more likely to perceive smart

agricultural technologies as useful and easier to integrate into instructional activities.

The result is further supported by recent empirical evidence showing that digital competence significantly enhances lecturers' teaching practices, research productivity, and educational outcomes in higher education.

Predictive Influence of Digital Competence on Smart Agricultural Technology Utilization

Regression analysis demonstrated that digital competence significantly predicted smart agricultural technology utilization ($\beta = 0.421$, $p < 0.05$). Furthermore, digital competence, institutional support, ICT infrastructure, and training exposure jointly explained 55.1% of the variance in technology utilization ($R^2 = 0.551$).

This finding indicates that digital competence is the strongest predictor of lecturers' utilization of smart agricultural technologies, although institutional variables also make substantial contributions. The finding agrees with studies showing that digital skills, access to ICT facilities, and organizational support significantly influence technology adoption among educators and agricultural professionals.

The implication is that investments in lecturers' digital competence should be accompanied by institutional investments in infrastructure, policy support, and continuous professional development if Colleges of Education are to effectively prepare graduates for digitally transformed agricultural systems.

5. Conclusion

This study examined digital competence as a predictor of smart agricultural technology utilization among Agricultural Education lecturers in Colleges of Education in South-South Nigeria. The findings demonstrated that the lecturers possessed a relatively high level of general digital competence; however, their competence in specialized smart agricultural technologies, including Geographic Information Systems (GIS), Global Positioning Systems (GPS), precision agriculture tools, drone technology, and remote sensing applications, remained comparatively limited.

The study further established that smart agricultural technologies were only moderately available within the Colleges of Education surveyed, while their utilization for teaching, research, and practical demonstrations was also moderate. This suggests that although lecturers are increasingly embracing digital technologies, the adoption of advanced smart agricultural technologies is constrained by inadequate infrastructure, limited access to modern equipment, insufficient institutional support, and inadequate professional development opportunities.

The findings also revealed a statistically significant positive relationship between digital competence and smart agricultural technology utilization. Furthermore, digital competence emerged as the strongest predictor of technology utilization, while institutional support, ICT infrastructure, and training exposure also made significant contributions. These findings underscore the importance of strengthening both individual competencies and institutional capacities to accelerate the digital transformation of Agricultural Education.

Overall, the study concludes that improving lecturers' digital competence alone is insufficient to achieve effective integration of smart agricultural technologies. Sustainable technology integration

requires complementary investments in infrastructure, policy implementation, funding, technical support, and continuous professional development. Strengthening these components will enhance the quality of Agricultural Education and better prepare graduates with the competencies required for technology-driven agricultural systems.

Practical Implications

The findings of this study have important implications for educational institutions, policymakers, curriculum developers, and professional organizations responsible for Agricultural Education in Nigeria.

First, the study highlights the need for Colleges of Education to prioritize continuous capacity-building programmes that strengthen lecturers' competencies in emerging smart agricultural technologies. Such programmes should move beyond general ICT literacy to include practical training in GIS, GPS, precision agriculture, drone applications, remote sensing, digital farm management systems, and agricultural data analytics.

Second, educational administrators should improve institutional investment in digital infrastructure by providing reliable internet connectivity, modern computer laboratories, smart agricultural equipment, simulation software, and digital teaching resources that support experiential learning.

Third, curriculum planners should review Agricultural Education curricula to incorporate digital agriculture competencies that reflect current industry practices and labour market expectations. This will ensure that graduates possess the knowledge and practical skills required for modern agricultural production and extension services.

Finally, government agencies and development partners should strengthen policies and funding mechanisms that support digital transformation initiatives within Colleges of Education to enhance the quality and relevance of Agricultural Education programmes.

6. Recommendations

Based on the findings of this study, the following recommendations are made:

1. Colleges of Education should organize regular professional development programmes to improve lecturers' competencies in smart agricultural technologies, including GIS, GPS, drone technology, remote sensing, precision agriculture, and digital farm management systems.
2. Federal and State Governments should increase funding for Agricultural Education programmes to facilitate the acquisition of modern digital agricultural equipment, software, and supporting infrastructure.
3. Institutional administrators should strengthen internet connectivity, electricity supply, technical support services, and maintenance systems to encourage effective utilization of smart agricultural technologies.
4. The National Commission for Colleges of Education (NCCE) should periodically review the Agricultural Education curriculum to integrate contemporary digital agriculture competencies and practical technology applications.
5. Partnerships should be established between Colleges of Education, agricultural research institutes, universities, technology companies, and private-sector organizations to

facilitate access to emerging smart agricultural technologies and specialized training opportunities.

6. Professional associations in Agricultural Education should encourage continuous digital competence development through workshops, conferences, certification programmes, and collaborative research initiatives.

Limitations of the Study

This study has some limitations that should be considered when interpreting the findings. First, the study focused only on Agricultural Education lecturers in Colleges of Education within South-South Nigeria; therefore, the findings may not be directly generalizable to universities, polytechnics, or institutions located in other geopolitical zones.

Second, the study relied on self-reported questionnaire data, which may be influenced by respondents' perceptions and social desirability bias. Future studies may complement survey data with classroom observations, interviews, and practical assessments of digital competence.

Third, although the study examined major predictors of smart agricultural technology utilization, other factors such as organizational culture, leadership support, technology policies, and individual motivation were not investigated and may also influence technology adoption.

Suggestions for Further Research

Future studies should:

1. Replicate the study in universities, polytechnics, and colleges of agriculture across other geopolitical zones of Nigeria.
2. Employ mixed-methods research designs to provide deeper insights into lecturers' experiences with smart agricultural technologies.
3. Investigate the impact of digital competence on students' practical skills acquisition, employability, and entrepreneurial outcomes in Agricultural Education.
4. Examine the influence of institutional leadership, technology policies, organizational culture, and funding mechanisms on digital transformation in Agricultural Education.
5. Conduct longitudinal studies to evaluate changes in lecturers' digital competence and technology utilization following targeted professional development interventions.

REFERENCES

1. Abuta, C. M., Adesope, O. M., Isife, B. I., & Ifeanyi-Obi, C. (2025). Digital skill needs of agricultural extension personnel for communication of climate change adaptation in Niger Delta, Nigeria. *Agricultural Economics and Extension Research Studies*, 12(2), 18–28.
2. AERA. (2018). *Code of ethics*. American Educational Research Association.
3. Ayim, C., Kassahun, A., Tekinerdogan, B., & Addison, C. (2020). Adoption of ICT innovations in the agriculture sector in Africa: A systematic literature review. *Agriculture*, 10(8), 340.
4. Bertoglio, R., Corbo, C., Renga, F. M., & Matteucci, M. (2021). The digital agricultural revolution: A bibliometric analysis literature review. *IEEE Access*, 9, 134762–134782.

5. Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.)*. Sage Publications.
6. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
7. Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency framework. *Educational Technology Research and Development*, 68(5), 2449–2472.
8. Food and Agriculture Organization of the United Nations. (2022). The State of food and agriculture 2022: Leveraging automation in agriculture for transforming agrifood systems. FAO.
9. Food and Agriculture Organization of the United Nations. (2022). Agricultural digitalization and automation in low- and middle-income countries: Evidence from ten case studies. FAO Agricultural Development Economics Technical Study No. 25.
10. Federal Ministry of Agriculture and Food Security. (2023). *National agricultural technology and innovation policy*. Abuja, Nigeria.
11. Federal Ministry of Education. (2022). *National policy on digital education*. Abuja, Nigeria.
12. Johnson, B., & Christensen, L. (2020). *Educational research: Quantitative, qualitative, and mixed approaches (7th ed.)*. Sage Publications.
13. Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and Agriculture 4.0. NJAS: *Wageningen Journal of Life Sciences*, 90–91, 100315.
14. McCampbell, M. (2022). *Agricultural digitalization and automation in low- and middle-income countries: Evidence from ten case studies*. Food and Agriculture Organization of the United Nations.
15. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
16. Mohammed, A., Yusuf, S., & Ibrahim, M. (2024). Digital competence and instructional effectiveness among agricultural educators in Nigerian tertiary institutions. *Journal of Agricultural Education Research*, 8(2), 71–86.
17. NCCE. (2023). *Minimum standards for Nigeria Certificate in Education programmes*. National Commission for Colleges of Education.
18. Nwosu, C. C., & Ugwoke, E. O. (2021). Information and communication technology utilization among vocational education lecturers in Nigeria. *Nigerian Journal of Vocational Education*, 26(1), 45–57.
19. Ogunlade, I., & Adebayo, K. (2022). Digital transformation and agricultural teacher education in Nigeria. *Journal of Agricultural Education and Extension*, 28(4), 415–431.
20. Okeke, M. N., & Nwankwo, J. A. (2023). Technology integration in Nigerian Colleges of Education: Opportunities and challenges. *African Journal of Educational Technology*, 15(2), 84–99.
21. Osaghae, E. O., & Omere, C. (2021). ICT utilization among Agricultural Education lecturers in Nigerian tertiary institutions. *Journal of Agricultural Education and Extension Services*, 7(1), 61–74.
22. Redecker, C. (2017). *European framework for the digital competence of educators (DigCompEdu)*. Publications Office of the European Union.
23. Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273–1296.
24. UNESCO. (2023). *Global education monitoring report 2023: Technology in education*. UNESCO.
25. Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M. J. (2017). Big data in smart farming: A review. *Agricultural Systems*, 153, 69–80.
26. World Bank. (2023). *Digital development in Sub-Saharan Africa*. World Bank.
27. Zhai, Z., Martínez, J. F., Beltran, V., & Martínez, N. L. (2020). Decision support systems for agriculture 4.0: Survey and challenges. *Computers and Electronics in Agriculture*, 170, 105256.