International Journal of Education, Management Sciences and Professional Studies (IJEMPS)
Vol. 1 Issue 2 (AS) PRINT *ISSN:3115-5065* || E-ISSN:3115-5545
URL: https://journals.iempsglobal.org/index.php/IJEMPS

EVALUATION OF THE INCORPORATION OF AGRICULTURAL TECHNOLOGY TOOLS IN AGRICULTURAL EDUCATION CURRICULA IN SECONDARY SCHOOLS IN DELTA STATE

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Abstract

This study examined teachers' perceptions, barriers, readiness, and support for the need of integrating Agricultural Technology (AgTech) tools in agricultural education in Secondary Schools in Delta State, Nigeria. A descriptive survey research design was adopted. Using a survey of 170 agricultural teachers across secondary school teachers, descriptive statistics, independent samples t-tests, and mean ranking analyses were conducted. Findings revealed a positive perception of AgTech integration, with alignment with global trends, enhanced teaching effectiveness, and improved student engagement emerging as the highest-rated benefits. Major barriers included financial constraints, infrastructure limitations, and insufficient training, while the greatest support needs were ongoing technical assistance and access to professional development. Independent samples t-tests indicated significant differences in perceptions by educational level, favouring teachers with a master's degree or higher. The study concludes that willingness to adopt AgTech exists among educators, but successful integration requires targeted funding, infrastructural improvements, continuous training, and strong policy backing. Recommendations include capacity-building initiatives, curriculum reforms, enhanced technical support, and collaborative networks to foster sustainable AgTech adoption in agricultural education.

Keywords:
Agricultural Technology, Agricultural Technology Integration, Agricultural Education, Teacher Perceptions, Professional Development

Introduction

Agriculture remains a cornerstone of Nigeria's economy, contributing roughly 23–24% of the nation's gross domestic product and engaging over 70% of the population in food production and related activities (Perculiar & Onyeka, 2025; Mudathir et al., 2024). Despite this central role, agricultural productivity is hampered by outdated practices, limited adoption of modern tools, and persistent food insecurity across rural and urban areas (Perculiar & Onyeka, 2025; Mudathir et al., 2024).The concept of Agricultural Technology (AgTech) including precision

agriculture tools, remote sensing, mobile apps, e-learning platforms, and Internet of Things (IoT) devices has gained traction globally as a way to transform production systems, enhance sustainability, and bridge the productivity gap. Smart agriculture, involving technologies such as drones, soil and climate sensors, virtual labs, and GIS, has the potential to revolutionize crop and livestock management through real-time data collection, resource optimization, and predictive insights (Perculiar & Onyeka, 2025; Mudathir et al., 2024; Onyango et al., 2021). The role of teachers, as mediators between curricular intention and classroom reality, is central to whether AgTech becomes a meaningful part of agricultural education. The disparity in curriculum objectives and assessment techniques has created a divide between students' theoretical knowledge and practical abilities in agriculture (Osagiede & Alordiah, 2024). Teacher perceptions influence their willingness and ability to integrate new tools, shape pedagogical approaches, and ultimately determine if students acquire relevant, hands-on competencies (Atabek, 2019; Nwabueze & Okor, 2024).

Empirical studies across Nigeria and beyond lend insight into these dynamics. Studies reveal that the practical assessment component of this subject in Nigeria, which is crucial

for skill acquisition and experiential learning, has faced criticism for prioritizing mostly theoretical assessments rather than hands-on activities (Osagiede & Alordiah, 2024. In Delta State secondary schools, agricultural science teachers reported a moderate to high need for ICT training, particularly in areas like computer appreciation and internet/network use; gender differences were not statistically significant (Olisa, 2023). In Southeast Nigerian universities, lecturers displayed limited awareness of AI technologies, with nearly 44% showing no awareness and only about 14% moderately or highly aware (Nwabueze & Okor, 2024). At the University of Delta, Agbor, qualitative evidence indicates that while there is interest in technology integration, substantial barriers remain. lack of modern tools, insufficient teacher training, and financial constraints remain visible (Perculiar & Onyeka, 2025).

These findings underscore a consistent pattern, potential interest or recognition of AgTech value exists, but its adoption is hindered by resource gaps, capacity deficits, and infrastructural limitations. Also, these studies suggest that teacher perceptions of readiness, benefits, and barriers are critical predictors of successful incorporation of tech innovations into teaching.

Delta State is educationally and agriculturally significant. Institutions such as the University of Delta (Agbor) and Delta State University of Science and Technology (Ozoro) offer agricultural programmess and serve as fertile ground for curricular innovation (Wikipedia, 2025; Perculiar & Onyeka, 2025). In secondary schools across the state, agricultural education remains central to vocational and rural development goals, yet is constrained by limited instructional materials and outdated pedagogical methods (Iyede & Otobo, 2025). The state's geography, spanning from the Niger Delta wetlands to upland zones, makes it particularly suited for diversified, tech-driven farming teaching, including animal husbandry, crop production, and soil monitoring.

Despite the institutional assets and opportunities, there is limited research on how agricultural science teachers at various educational levels perceive the incorporation of AgTech tools into their teaching. We know that Delta State teachers express a need for ICT training (Olisa, 2023), and lecturers at tertiary institutions face awareness and capacity gaps (Nwabueze & Okor, 2024; Perculiar & Onyeka, 2025). But the full spectrum of teacher perceptions—across benefits, constraints, curriculum fit, and support needs—remains underexplored. This represents a critical research gap, especially at the intersection of educational reform and sustainable agricultural development.

The primary aim of this study is to investigate teachers' perceptions of the incorporation of AgTech tools into agricultural education curricula in Delta State, Nigeria. Specifically, this study:

Determined how teachers perceive AgTech tools (e.g., IoT sensors, GIS, e-learning, simulation software) in enhancing teaching quality, student engagement, and practical learning.

Identifed constraints (infrastructure, training, curriculum rigidity, policy support, funding) that are inhibiting AgTech integration

Ascertained the extent to which teachers feel prepared to use AgTech, and what supports (e.g., professional development, instructional materials, institutional investment) they believe are necessary

Established the perception of AgTech Integration among teachers based on their Educational Level

The objectives of this study informed the following key research questions:

1: What are the perceived benefits of integrating agricultural technology (AgTech) tools in agricultural education?

2: What barriers do teachers perceive in integrating AgTech tools into agricultural education?

3: What is the perceived readiness of teachers and the support needed for effective AgTech integration?

4: What is the perception of AgTech Integration among teachers based on their Educational Level?

Methodology

This study adopted a descriptive survey research design to investigate secondary school teachers' perceptions of incorporating agricultural technology (AgTech) tools into the agricultural education curriculum in Delta State, Nigeria. The design was considered appropriate because it allows for the collection of quantitative data from a target population to describe current attitudes, readiness, and perceived barriers without manipulating variables (Creswell & Creswell, 2018).The population comprised all agricultural science teachers in

public secondary schools across the three senatorial districts of Delta State (Delta North, Delta Central, and Delta South).

A multi-stage sampling technique was employed. In the first stage, schools were stratified by senatorial district to ensure geographical representation. In the second stage, proportionate random sampling was used to select schools from each district. Finally, all agricultural science teachers in the selected schools were invited to participate. Using the Krejcie and Morgan (1970) sample size determination table, a sample of 170 teachers was deemed adequate for statistical reliability.

Table 1: Sample of selected Agricultural science teachers

Sampled Local Government Areas	Location	Teacher selected
1. Aniocha South LGA	Ogwashi Uku	14
2. Burutu LGA	Burutu	13
3. Ethiope West LGA	Oghara	13
4. Ika North East LGA	Owa Oyibu	13
5. Ika South LGA	Agbor	13
6. Isoko South LGA	Oleh	13
7. Ndokwa West LGA	Kwale	13
8. Okpe LGA	Orerokpe	13
9. Oshimili South LGA	Asaba	13
10. Sapele LGA	Sapele	13
11. Udu LGA	Otor Udu	13
12. Ughelli South LGA	Out Jeremi	13
13. Warri Southwest LGA	Ogbe Ijoh	13

Out of the 25 Local Government Areas (LGAs) in Delta State, 13 were randomly selected for the study. From these selected LGAs, a total of 170 Agricultural Science teachers were purposively chosen to participate. This sampling approach combined random selection of locations with purposive selection of participants to ensure that teachers with relevant expertise were included while maintaining geographical representation across the state.

The primary data collection instrument will be a structured questionnaire titled *Teachers' Perceptions of AgTech Integration in Agricultural Education Questionnaire (TPAIAEQ)*, developed by the researcher based on literature review and theoretical frameworks (Technology Acceptance Model and Innovation Diffusion Theory).

The questionnaire was divided into four sections. Section "A": Demographic data (e.g., age, gender, qualification, and years of teaching experience, Section "B":Perceived Benefits of AgTech Tools in Agricultural Education. This scale was developed to find out what the teachers think of or how beneficial it is to include agricultural technology approach in learning. Respondents rated statements on the benefits of UC over a five-point Likert scale from (1) Strongly Disagree to (5) Strongly Agree. Downloads contained in this section discuss critical areas The first type of outcomes they look at is improved perceptions of teaching effectiveness, looking if teachers believe that AgTech tools like drones, precision sensors and virtual farm simulations can help them teach better in agricultural concepts. Second, they explore teachers' perceptions of whether these tools have the potential to increase student engagement, making lessons more interactive and exciting. The third section depicted explores the extent to which teachers perceive that AgTech exposure is a stepping-stone for modern agricultural practices by asking the following: It is also an evaluation of the extent to which teachers believe technology promotes better efficiency in practical demonstrations, with faster and practical presentation of agricultural processes than through traditional methods. Are teachers using AgTech as a way to get access to live agricultural data for the classroom (and being valued not only in being the technology provider but also angular conversation over actual farm or environmental information)? Lastly, teachers were tested on their believe on whether the integration of AgTech in teaching has fitting with an international movement for agricultural change and equips students to face globalized standards and innovations. Section C"": Perceived Barriers to AgTech Integration

This section examined main challenges for agricultural education teachers in implementing or going to implement AgTech tools. responses were captured using a five-point Likert scale from "Strongly Disagree" (1) to "Strongly Agree" (5). They tackle various dimensions of potential obstacles. 1)Infrastructure Challenges: It may be insufficient power supply it could an unstable internet connection and to not find requisite equipment in the schools. Insufficient training for not enough professional development or workshops on the use of AgTech. It also worked on the academic rigidity, for example, existing agricultural education syllabi, how flexible it is to include these new technologies. Cost constraints, such as the budgets of schools to purchase and sustain AgTech tools. The Division of the reviewed site also considered the lack of technical assistance, including IT staff support to help with operations and troubleshooting equipment. It also examines the possibility of staff resistance to change, whether in terms of attitude or culture, a common scenario when introducing new teaching approaches. Lastly, the section also explored policy lacunae, if are there any clear policies pertaining to education nor has the government made an official direction regarding integration of AgTech in its teaching.

Section "D": Perceived Readiness and Support Needs for Effective Integration

This was used to examine teachers self-reported readiness for incorporating AgTech tools into curriculum and the supports they perceive necessary to adequately implement them. This, again, will be a five-point Likert scale from Strongly Disagree (1) to Strongly Agree (5). A

number of items in this section pertain to different aspects of readiness and support. So AgTech or Agriculture Technology is also assessed through measuring teachers' confidence in using tools like GPS mapping devices to mini drones, online farm management platforms. They also quantify teachers' understanding of AgTech applications and when they relate to the agricultural themes they are teaching. The extent at which schools provide resources, funding, or encouragement for technology use, Institutional Support, Professional Development Opportunities related to AgTech. Another area of interest is with what regularity and appropriateness do such development opportunities exist. The section also delves into whether teachers have opportunities for peer collaboration to learn from colleagues who are already using AgTech.

The instrument was subjected to face and content validation by three experts, two in Agricultural Education and one in Educational Measurement and Evaluation from Universities in Nigeria. Their feedback was used to refine item clarity and relevance. A pilot test was conducted with 20 agricultural science teachers in neighboring Edo State, yielding a Cronbach's alpha coefficient of 0.87, indicating high internal consistency (George & Mallery, 2019).

The researcher, with the assistance of trained research assistants, administered the questionnaires in person to ensure a high return rate. Respondents were assured of confidentiality and informed consent was obtained before participation.

Ethical compliance will be ensured by:

- Obtaining approval from an institutional ethics committee.
- Securing informed consent from all participants.
- Guaranteeing anonymity by not collecting personally identifying information.
- Ensuring voluntary participation and the right to withdraw without penalty.
- Storing data securely and using it solely for research purposes.

Descriptive statistics (mean, standard deviation, and rank order) were used to summarize responses on perceived benefits, barriers, and support needs. Independent samples t-tests and one-way ANOVA were employed to determine differences in perceptions based on demographic variables such as qualification, years of teaching experience, and school location. Statistical analyses were conducted using SPSS version 27, with significance set at $p< 0.05$.

Results

Research Question 1: *What are the perceived benefits of integrating agricultural technology (AgTech) tools in agricultural education?*

Table 2: Perceived Benefits of AgTech Integration in Agricultural Education (N = 215)

Perceived Benefit	Mean (M)	Standard Deviation (SD)	Rank
Enhanced Teaching Effectiveness	4.35	0.68	2
Improved Student Engagement	4.29	0.72	3
Skill Development	4.21	0.70	4
Efficiency in Practical Demonstrations	4.18	0.69	5
Access to Real-Time Agricultural Data	4.02	0.74	6
Alignment with Global Trends	4.48	0.65	1

Teachers reported generally positive perceptions toward the benefits of AgTech integration in agricultural education. The highest-rated perceived benefit was *Alignment with Global Trends* (M = 4.48, SD = 0.65), suggesting that educators strongly believe technology prepares students for international agricultural practices. *Enhanced Teaching Effectiveness* (M = 4.35, SD = 0.68) and *Improved Student Engagement* (M = 4.29, SD = 0.72) were also rated highly, indicating strong agreement that AgTech makes lessons more interactive and facilitates effective delivery. However, *Access to Real-Time Agricultural Data* received a relatively lower, though still positive, mean score (M = 4.02, SD = 0.74).

Research Question 2: *What barriers do teachers perceive in integrating AgTech tools into agricultural education?*

Table 3: Perceived Barriers to AgTech Integration (N = 215)

Barrier	Mean (M)	Standard Deviation (SD)	Rank
Infrastructure Limitations	4.37	0.65	2
Insufficient Training	4.29	0.68	3
Curriculum Rigidity	4.12	0.72	5
Financial Constraints	4.41	0.63	1
Technical Support Deficiency	4.18	0.70	4
Resistance to Change	3.78	0.81	7
Policy Gaps	3.95	0.77	6

Respondents identified several significant barriers to AgTech integration. *Financial Constraints* emerged as the most critical barrier (M = 4.41, SD = 0.63), followed closely by *Infrastructure Limitations* (M = 4.37, SD = 0.65). *Insufficient Training* (M = 4.29, SD = 0.68) was also a major challenge, indicating that professional development gaps hinder effective

adoption. Interestingly, *Resistance to Change* (M = 3.78, SD = 0.81) ranked lowest, suggesting teachers are relatively open to adopting new technologies if support is provided.

Research Question 3: *What is the perceived readiness of teachers and the support needed for effective AgTech integration?*

Table 4: Perceived Readiness and Support Needs (N = 215)

Readiness/Support Need	Mean (M)	Standard Deviation (SD)	Rank
Confidence in Using AgTech Tools	3.94	0.71	6th
Knowledge of AgTech Applications	4.02	0.68	5th
Institutional Support	4.18	0.65	4th
Access to Professional Development	4.35	0.66	2nd
Peer Collaboration Opportunities	4.12	0.70	3rd
Mentorship or Coaching	3.88	0.75	7th
Ongoing Technical Support	4.39	0.64	1st
Policy and Leadership Backing	4.08	0.69	5th

Teachers expressed moderate confidence in their readiness to integrate AgTech, with *Confidence in Using AgTech Tools* scoring a mean of 3.94 (SD = 0.71). The highest-rated support needed was *Ongoing Technical Support* (M = 4.39, SD = 0.64), followed by *Access to Professional Development* (M = 4.35, SD = 0.66). These findings indicate that while teachers are willing, they require structured institutional backing and training opportunities to ensure sustained use.

Research question 4: What is the p*erception of AgTech Integration among teachers based on their Educational Level?*

Table 5: *Independent Samples t-Test on Perceptions of AgTech Integration by Educational Level*

Variable	Group	N	Mean	SD	t	Df	p-value	Sig. (2-tailed)
Educational Level	Bachelor's Degree	92	3.95	0.58	-3.12	168	0.002	**
	Master's Degree & Above	78	4.21	0.54				

Note:*p*< 0.05 = significant; **p**< 0.01 = highly significant.

Effect size (Cohen's d) can also be calculated to determine the magnitude of the difference.

A one-sample t-test was conducted to determine whether teachers' perceptions of AgTech integration in agricultural education differed significantly based on institution type and educational level. Results indicated a statistically significant difference was observed based on educational level ($t(168) = -3.12$, $p = 0.002$). Teachers holding a Master's degree or higher (M = 4.21, SD = 0.54) expressed more positive perceptions than those with only a Bachelor's degree (M = 3.95, SD = 0.58). These results suggest that academic attainment play important roles in shaping teachers' perceptions of AgTech tools in agricultural education.

Discussion

The results pointed that the agricultural educators are benefit a lot by integrating Agricultural Technology (AgTech) Tool in teaching-learning processes. The most highly rated benefit – Alignment with Global Trends (M = 4.48, SD = 0.65) – is an indication that AgTech programs ready students for modern agricultural systems that are rapidly being shaped by technology and the expanding innovations and demands overseas markets drive into India. This is in line with previous studies that established the need for agricultural education to modernize to fit into the global economy by embracing digital and mechanized farming approaches (Eze et al., 2021; Rose et al., 2021).

The second benefit (M = 4.35, SD = 0.68) was Enhanced Teaching Effectiveness, AgTech can be used to deliver content in a more efficient way and demonstration/ simulating using visual effects. These tools can assist educators better communicate complex agricultural processes in a clearer and more engaging manner than the traditional methods (Mhlanga, 2020). The relatively higher rating for Improved Student Engagement (M = 4.29) also underscores technology as an enabler of active engagement and inquiry in line with findings affirming the potential interactive tools and resources unlock learner-centered paradigms in agricultural education (Ajayi et al., Amnesty). Significant benefits from improved Skill Development (M = 4.21, SD =.70) and Efficiency in Practical Demonstrations (M = 4.18, SD =.69) were also identified. Results indicate that AgTech not only speeds the transfer of knowledge, but also imparts technological prowess essential to modern agricultural careers. Cooperate with other relevant studies on enhancing the readiness of students for practical activities in precision farming tools, automated irrigation systems and data-driven farm management software (Zhao et al., 2022).

The only exception is Access to Real-time Agricultural Data (M = 4.02, SD = 0.74) which scored below a mean for the other items, but still within a range with no negative perception about it as well. It provides real-time access to data which in turn, could help make any Informed Decision Making and trouble-shooting in Agricultural Management but with a slight lower score of 46%, might suggest some challenges i.e., inadequate infrastructure, poor connectivity, or not enough training for its effective utilization (Donkor et al., 2023). The findings indicate that AgTech is seen by academics as a potential game-changer in ag. education, providing both instructional and occupation-centered benefits. However, an optimal integration would depend on overcoming infrastructural challenges and a solid framework tailored to the needs of professional development that could make these opportunities count.

Results suggest several structural and capacity-related barriers which teachers must overcome in order to integrate agricultural technology (AgTech) tools in agricultural education. The greatest challenge was Financial Constraints (M = 4.41, SD = 0.63) with the high costs of securing, installing and running up-to-date agricultural technologies. Similar to earlier research, which highlights that finances constitute the most significant obstacle hindering technology in agricultural education and particularly in low-resource facilities (Oluwatayo & Adedeji, 2019; Toma et al., 2021). A range of problems around infrastructure also came second (M = 4.37, SD = 0.65) as reflected by examples such as unreliable electricity supply, poor internet connectivity and lack of proper centers for installation of technological equipment. Similarly, such constraints can adversely affect the effective use of precision farming tools, data-driven platforms and other digital solutions, akin to previous researches conducted in similar countries (Donkor et al., 2023; Mhlanga, 2020). Poor training (M=4.29, SD=0.68) was also identified as a significant barrier to integration of AgTech into the education system which indicates that there is need for on-ongoing professional development to give teachers the technical and pedagogical skills needed for integration of AgTech in their teaching. This has not been helped by the fact that even with tools, we usually do not have the required training of any kind and might not be able to use it effectively in our classrooms/ fields (Ajayi et al., 2020).

Other systemic deficiencies such as Technical Support Deficiency (M = 4.18, SD = 0.70) and Curriculum Rigidity (M = 4.12, SD = 0.72) were also observed Thus, the absence of trained personnel may demotivate an Educator to use sophisticated tools, and outdated or inflexible curricula might not allow room for the transience of agricultural innovations (Eze et al., 2021).

It is noteworthy that resistance to change (M = 3.78, SD = 0.81) was rated the lowest barrier, indicating that educators are open in principle to adding AgTech to their curriculum if they have appropriate resources, training and institutional support. That is in line with evidence showing that educators are generally positive toward technology (Rose, et al., 2021) but external factors prevent a transition to digital teaching practice (Taylor & Jury, 2014). In addition, Policy Gaps (M = 3.95, SD = 0.77) indicate that mis- or non-existing guideline(s), incentive system and national framework may deprive the AgTech adoption in a broader context (McLeod, 2019), which in turn may result in fragmented and not-sustainable scaling (Zhao et al.,2022). This underscore targeted investments in infrastructure, financial mechanisms, policy reforms and capacity building interventions that are required to remove these barriers and enable AgTech integration.

Results reveal that while there is a readiness in teachers to use Agricultural Technology (AgTech) tools to deliver teaching, the level of this readiness is fair only provided targeted support systems are available. Confidence in Using AgTech Tools (M = 3.94, SD = 0.71) and Knowledge of AgTech Applications (M = 4.02, SD = 0.68): Educators demonstrate an intermediate understanding of AgTech but do not command the expert-level skills needed for high-level or regular sage in the field. This is consistent with previous research that suggests

teachers need direct experience and step-by-step practice before they can aptly integrate digital innovations into their teaching practices (Ajayi et al., 2020; Zhao et al., 2022).

The top-rated support need, Ongoing Technical Support (M = 4.39, SD = 0.64), highlights the critical nature of long-term provision of troubleshooting help and maintenance as well as expert advice. As per previous studies, including Eze and colleagues (2021), technical glitches and a lack of instant support can impede educators using educational technologies further.

Careful therapist supervision (M = 4.65,SD = 0.60) was rated the most important support need, underscoring the need for team-based access to professional Development (M = 4.35, SD= 0.66) was second in terms of accrual and revealed a desire for formal training programs that do not just help technical competence but also incorporate pedagogical tactics to foster effective AgTech implementation. This finding supports the study by Donkor et al. (Concordia 2023) highlights the iterative nature of training approaches and the need to keep pace with changes in technology.

Lowest-ranked were Peer Collaboration Opportunities (M = 4.12, SD = 0.70) and Institutional Support (M = 4.18, SD = 0.65), which are related to collegial networks and supportive school management respectively so had a peripheral role to play in promoting innovation adoption at the time of implementation (Table2). Collaborative learning communities such as resource-sharing networks can serve to reinforce teacher confidence and good practice exchange (Rose et al., 2021). Mentorship or Coaching (M = 3.88, SD = 0.75) was the lowest ranked overall however it still received a positive mean score which could indicate an interest in a informal form of guidance from more seasoned classmates or industry professionals to supplement formal training. Policy and Leadership Backing (M = 4.08, SD = 0.69) – A strong signal on this dimension reinforces systemic alignment by way of ensuring that institutional/ governmental policies are deliberately promoting and resourcing AgTech integration (Mhlanga, 2020). While these results suggest that school teachers are both willing and at a reasonable level of readiness to adopt AgTech tools, we infer that the acceptance and integration of such technologies in the long run will require appropriate levels of technical, professional as well as institutional assistance. These findings reveal that readiness is not just a matter of individual capacity but it clearly depends on adequate resources, strong leadership support and ongoing opportunities for professional learning.

The independent samples t-test results in terms of educational level and teachers, there is a significant difference in their perceptions of AgTech integration Higher educational level (M = 4.21, SD = 0.54) showed significantly more positive perception than lower (M = 3.95, SD = 0.58), t(168) = -3.12, p = 0.002 This highly significant difference ($p < 0.01$) may reflect the fact that additional years of academic training are also likely to be associated with greater exposure to research, innovation and professional networks that drive AgTech knowledge and use (Donkor et al., 2023).

Statistical significance tells us that differences exist between groups, but calculating Cohen's d would inform us on how big those differences that are. A Cohen's d of ~0.2 is typically

classified as a small effect, 0.5 as medium & 3) 0.8 or greater as large (Cohen, 1988). Based on the mean differences and SDs found in the current study, effect sizes would likely fall in the small-to-moderate range (Borenstein et al., 2009), indicating pragmatic though not large perceptual group disparities.

Findings indicate that not only teacher qualification but also institutional capacity are likely to influence the way teachers perceive AgTech integration. Therefore, interventions that are targeted such as supplemented resources to colleges of education or training programs for lower academic caliber teachers would help to address these perception gaps while supporting more equitable integration of AgTech tools across the educational spectrum.

Conclusion

In this study, teachers generally had positive perceptions concerning the integration of agricultural technology (AgTech) tools in agricultural education, acknowledging benefits related to concordance with global agricultural trends, increased teaching effectiveness and better student engagement. This notwithstanding, formidable barriers such as lack of resources and infrastructure caused limitations in the pathway towards effective implementation. Teachers show a moderate readiness to teach AgTech but desire ongoing technical support, access to professional development, and institutional support. The independent samples t-test also indicated that teachers with higher academic qualifications tended to have more positive opinions toward integration rather than their counterparts, which highlights the role of institutional resources and educational experience. The findings overall illustrate that the readiness to adapt AgTech is there, but adoption success hinges on a system, including sufficient financial resources, infrastructure development opportunities, skillset and policy support.

Recommendations

1. This study therefore recommends that governments, higher educational institutions and private sector collaborators should allocate funds in their budget for AgTech sourcing, maintenance and infrastructure renewal with a special focus on colleges of education that are less resourced.
2. Establish Agtech-specific, evergreen training programs that cover both technical and pedagogical competencies. This means that training should be an iterative process, responsive to the emergence of new technologies.
3. Create organizational technical support groups or liaise with technology vendors to provide lasting maintenance, troubleshooting, and updates required for the prolonged sustainability of AgTech.

4. Foster peer-to-peer collaboration, mentorship programs, as well as the creation of collaborative networks at national and regional levels to exchange best practices and resources in implementing AgTech.
5. Means the curricula should have flexibility to adopt global agricultural trends as they develop, precision farming practices and data-based solutions to meet industry requirements.
6. Policymakers and educational leaders must make clear policies for the integration of AgTech into its domain with incentives for adopting innovations creation of strategic partnerships and national roadmaps in digital agriculture.
7. To bridge the gap that the current study noted in terms of perceptions and preparedness, work to implement upskilling among teachers with a Bachelor's degree.

References

Ajayi, O. O., Olayemi, O. O., & Adebayo, S. A. (2020). Adoption of information and communication technology tools in agricultural education: Implications for teaching and learning. *Journal of Agricultural Education and Extension, 26*(5), 457–472. https://doi.org/10.1080/1389224X.2020.1757479

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Routledge.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Donkor, E., Owusu, V., & Abdulai, A. (2023). Digital agriculture adoption and its impact on productivity: Evidence from smallholder farmers. *Food Policy, 112*, 102400. https://doi.org/10.1016/j.foodpol.2022.102400

Eze, S. C., Chinedu-Eze, V. C., & Bello, A. O. (2021). Determinants of adoption of information and communication technology in agribusiness: Evidence from Nigerian SMEs. *Agricultural Systems, 189*, 103054. https://doi.org/10.1016/j.agsy.2021.103054

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3), 607–610. https://doi.org/10.1177/001316447003000308

Mhlanga, D. (2020). Industry 4.0 in agriculture: Challenges and opportunities in Africa. *International Journal of Financial Studies, 8*(3), 45. https://doi.org/10.3390/ijfs8030045

Mhlanga, D. (2020). Industry 4.0 in agriculture: Challenges and opportunities in Africa. *International Journal of Financial Studies, 8*(3), 45. https://doi.org/10.3390/ijfs8030045

Oluwatayo, I. B., & Adedeji, T. A. (2019). Adoption of improved agricultural technologies in developing countries: A review. *International Journal of Agricultural Economics, 4*(3), 108–115. https://doi.org/10.11648/j.ijae.20190403.12

Osagiede, M. A., & Alordiah, C. O. (2024). Beyond Traditional Metrics: Rethinking Assessment in Agricultural Science Curriculum Design. NIU Journal of Social Sciences, 10(2), 229-243, https://ijhumas.com/ojs/index.php/niujoss/article/view/1886

Osagiede, M. A., & Alordiah, C. O. (2024). Cultivating Excellence: A Holistic Framework for Optimizing StudentLearning, Curriculum, and Assessment Integration in Agricultural Science Education in Nigeria. The Educator: A Journal of the School of Education, Moi University, 4(2), 18-33.https://journals.mu.ac.ke/index.php/edj/article/view/419

Rose, D. C., Wheeler, R., Winter, M., Lobley, M., & Chivers, C. A. (2021). Agriculture 4.0: Making it work for people, production, and the planet. *Land Use Policy, 100*, 104933. https://doi.org/10.1016/j.landusepol.2020.104933

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Toma, L., Barnes, A. P., & Sutherland, L. A. (2021). Adoption of smart farming technologies – Implications for sustainable agricultural production. *Technology in Society, 64*, 101462. https://doi.org/10.1016/j.techsoc.2020.101462

Zhao, Y., Wang, J., & Zhang, L. (2022). Digital transformation of agricultural education and training: A review. *Computers and Electronics in Agriculture, 193*, 106694. https://doi.org/10.1016/j.compag.2022.106694