PROMOTING SUSTAINABLE AGRICULTURAL PRACTICES THROUGH DIGITAL ETHICS IN TERTIARY INSTITUTIONS IN RIVERS STATE.

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Abstract

The study examined how digital ethics can be used to promote sustainable agricultural practices in tertiary institutions in Rivers State. Specifically, the study investigated the extent to which digital ethics is integrated into agricultural education curricula, its influence on students' knowledge, attitudes, and skills, and institutional strategies for embedding digital ethics. The study was guided by three (3) research questions. The study adopted a descriptive survey design A sample size was determined using stratified random sampling techniques to select 300 students and 50 lecturers, the target population is 350 in three tertiary institutions The instrument for data collection was a self - structured questionnaire designed in a 5-point rating scale of very high extent, high extent, low extent and very low extent with a numeric value of 5,4,3,2 and 1respectively. The instrument was validated by two experts in measurement and evaluation in the faculty of education, a reliability coefficient established through test–retest. Mean and standard deviation were used to analyze the research questions with a criterion mean value of 3.00. Findings from the study revealed that digital ethics is moderately integrated into agricultural education curricula. Furthermore, strategies such as curriculum review, capacity building, ICT infrastructure improvement, and partnerships with stakeholders were identified as essential for embedding digital ethics in agricultural education. The study concluded that digital ethics enhances the sustainability of agricultural practices when

properly integrated into educational systems. The study therefore recommended curriculum reforms, training workshops, ICT policy enforcement, infrastructure strengthening, and collaborations with external partners to promote sustainability in agricultural education.

Keywords: Promoting, Digital, Ethics; Agricultural Practical, Sustainability; Tertiary Institutions.

Introduction

Agriculture remains the backbone of sustainable development in most developing economies, and in Nigeria, the sector accounts for a significant proportion of food supply, employment, and rural livelihood. In Rivers State, agriculture is both an economic driver and a cultural identity, yet its sustainability is challenged by environmental degradation, poor technological adoption, and weak ethical frameworks guiding agricultural innovations. With the rapid infusion of digital technologies into farming ranging from artificial intelligence (AI), precision agriculture, satellite imaging, and big data analytics new opportunities have emerged for transforming food systems. However, alongside these opportunities comes a pressing need for *digital ethics* to guide how data is collected, processed, and applied in educational and practical agricultural contexts (Springer, 2025; Science Direct, 2025).

Digital ethics refers to the moral principles and institutional practices that govern data collection, storage, sharing, algorithmic decision-making, and the socio-technical design of digital systems. In higher education, digital ethics extends beyond abstract principles to institutional data governance, pedagogical practices, and the preparation of graduates to deploy technology responsibly (O'Brien; EDUCAUSE, 2020). Framing digital ethics as an educationally teachable competence ties normative principles (privacy, fairness, and accountability, beneficence) to concrete curricular outcomes and institutional rules, producing graduates who can both leverage digital tools and protect stakeholder rights.

Sustainable agriculture is increasingly data-driven, with AI, IoT sensors, satellite imaging, and analytics reshaping how crops are monitored, inputs are allocated, and risks are managed. Recent reviews show these tools can raise productivity while reducing environmental footprints if deployed responsibly. Yet the same data-intensive systems introduce privacy, bias, and power-asymmetry risks that can undermine equity and sustainability goals, especially in emerging contexts. This tension elevates *digital ethics* from a peripheral concern to a core enabling condition for sustainable agriculture education and practice.

In higher education, digital ethics frameworks emphasize responsible data stewardship, algorithmic transparency, and accountability in teaching and institutional governance. EDUCAUSE's synthesis underscored that universities now manage "two currencies "money and data linking institutional sustainability to data governance and ethical AI adoption. Contemporary models of teachers' digital competence also embed ethics as a cross-cutting dimension alongside pedagogy and student empowerment for a digital society. These perspectives signal that tertiary institutions are pivotal sites for cultivating graduates who can use digital tools for sustainability *and* uphold the rights and dignity of data subjects.

For Rivers State specifically, agricultural education sits at the frontline of food security and environmental stewardship. New evidence from tertiary institutions in Rivers State (RSU, IAUOE, and FCE (T) Omoku) highlights the adequacy of programme context and inputs for hands-on agricultural training—creating a strong platform to integrate digital ethics into curricula, labs, and field practicums. Embedding ethical data practices (consent, privacy, fair use), model oversight (bias checks, explain ability), and community accountability (farmer data rights, shared value) can align local training with global best practices while remaining sensitive to local socio-economic realities.

At the same time, the agricultural sector's rapid digitization precision agronomy, platformized value chains, deforestation-risk tracing demands that graduates understand not only *how* to use digital tools but *when and under what conditions* they should be used. International discussions now frame ethical guardrails (e.g., equitable access, avoidance of data monopolies, transparent risk scoring) as prerequisites for truly sustainable digital agriculture. When tertiary programs mainstream these guardrails through course outcomes, codes of conduct, and supervised field projects they equip students to champion sustainability that is both ecological and socio-digital.

Globally, sustainable agricultural practices are no longer defined only by ecological considerations such as soil fertility, biodiversity preservation, and water management, but also by *digital responsibility* in the use of emerging technologies. Ethical concerns—data privacy, informed consent, bias in algorithms, digital equity, and accountability are now integral to determining whether digital agriculture contributes to sustainability or perpetuates exploitation (EDUCAUSE, 2020). This is particularly relevant in tertiary institutions, which serve as incubators of knowledge, training grounds for future professionals, and engines of societal transformation. As Okagwa and Raji (2025) observed in their evaluation of agricultural education programmes in Rivers State, higher education institutions already possess the contextual and infrastructural base for hands-on agricultural training, making them strategic platforms for embedding digital ethics into agricultural practice and pedagogy,

Artificial intelligence and big data are reshaping global agribusiness through predictive analytics, smart irrigation systems, drone surveillance, and climate modeling (Springer, 2025). In Rivers State, the integration of these tools offers potential solutions to chronic challenges such as low productivity, post-harvest losses, and market inefficiencies. However, without ethical safeguards, digital adoption risks introducing new layers of inequality, where smallholder farmers are excluded due to lack of digital access or manipulated by opaque data platforms (Sustainability Directory, 2025). In this sense, *digital ethics becomes a sustainability issue* ensuring that technology empowers rather than marginalizes communities.

The higher education sector is uniquely positioned to address these challenges by training students not only in technical agricultural practices but also in the ethical implications of digital transformation. The Higher Education Digital Competences framework (HeDiCom, 2023) stresses that ethical awareness covering privacy, intellectual property, and responsible use of data must be embedded alongside pedagogical and technical competences. In the same vein, EDUCAUSE (2020) underscores that universities must manage "two currencies: money and data," recognizing that how institutions collect, store, and deploy data reflects broader commitments to justice, fairness, and accountability For Rivers State, where institutions such as Rivers State University (RSU), Ignatius Ajuru University of Education (IAUOE), and Federal College of Education (Technical), Omoku, are central to agricultural education, the infusion of digital ethics into curriculum design, laboratory practice, and field demonstrations can reshape graduates' orientation towards sustainability. Students trained in ethical digital practice will be better positioned to engage with precision farming tools, manage farmer data responsibly, and ensure equitable access to technological innovations.

The local agricultural landscape in Rivers State is marked by both potential and vulnerability. On one hand, fertile soils and diverse ecosystems offer prospects for aquaculture, crop cultivation, and livestock farming. On the other, oil exploitation, climate variability, and land degradation pose significant threats to food security. In this fragile context, promoting sustainable agricultural practices through *digital ethics* is not merely an academic exercise but a socio-economic necessity. As Zvereva (2023) argues, digital ethics modernizes moral values to ensure effective communication and accountability in cyberspace, principles that directly apply to how agricultural data and digital platforms are managed. For instance, integrating ethical codes into students' field projects such as ensuring that data collected from local farmers is anonymized, consent-based, and shared transparently aligns higher education with both global sustainability standards and local community trust, Globally, the conversation on ethical AI in agriculture emphasizes transparency in algorithms, equitable access to digital tools, and accountability in decision-making (Reuters, 2024). Locally, these principles translate into ensuring that Rivers State farmers many of whom are smallholders are not excluded from digital innovations due to cost, literacy, or infrastructure gaps. Embedding these

ethical principles into tertiary education provides a dual benefit: it enhances the employability of graduates in a digital economy while ensuring that sustainability strategies are rooted in inclusivity and fairness, prompting sustainable agricultural practices through digital ethics in tertiary institutions in Rivers State therefore requires a deliberate alignment of *curriculum, institutional policy, and community engagement*. This involves: **Curricular Integration** embedding modules on digital ethics, data governance, and responsible AI use into agricultural courses. **Practical Demonstration** ensuring field projects and laboratory work apply ethical principles in data handling, experimentation, and farmer engagement. **Institutional Governance** developing policies on responsible digital practices within universities themselves, modeling ethical behavior for students, **Community Partnerships** extending digital ethics principles into outreach programme with local farmers to build trust and inclusivity. Sustainability in agriculture is multidimensional ecological (soil, water, biodiversity), economic (livelihoods, market access), and social (equity, food security). Digital responsibility as a fourth, cross-cutting dimension: without ethical use of data and algorithms, digitalization can exacerbate inequities (e.g., by privileging well-resourced farms) or create new environmental burdens (e.g., energy-intensive AI). Thus, integrating digital ethics into agricultural education means aligning technical training with normative safeguards that protect both people and ecosystems. A rapidly expanding body of research documents how AI, remote sensing, IoT, and big data analytics are transforming agronomic decision-making, enabling yield prediction, precision irrigation, pest detection, and market forecasting. Review articles show clear productivity and efficiency gains while noting contextual limitations: many AI tools are developed on datasets from intensive commercial farms and may not generalize to smallholder contexts. This mismatch foregrounds ethical issues of fairness and appropriateness when deploying digital tools across diverse agricultural systems.

Recent policy and technical reviews emphasize both the potential and the risks of AI in agriculture; they call for domain-specific governance, standards for accountability, and multi-stakeholder design processes that include farmers, extension agents, and educators. These recommendations create a natural role for tertiary institutions as designers, testers, and teachers of ethically-grounded digital agricultural systems.

Higher education institutions (HEIs) are increasingly recognized as stewards of large amounts of personal and institutional data and as training grounds for future professionals who will design and use digital systems. EDUCAUSE's 2020 synthesis highlights the tension between institutional policies and low levels of awareness among students and faculty about data practices, recommending proactive governance, curricular integration of ethics, and capacity building among staff. The HeDiCom and related competence frameworks further argue that digital ethics must be embedded

within teachers' digital competences not treated as a standalone elective so ethical reasoning becomes part of routine practice in classrooms and labs.

Scholars and policy reviews cluster the ethical issues in digital agriculture into several categories:

• **Data privacy and ownership.** Agricultural platforms collect granular farm- and farmer-level data (soil, yields, and financials). Questions about who owns these data, how they are monetized, and whether farmers gave meaningful consent are pervasive.

• **Algorithmic bias and fairness.** Models trained on biased or unrepresentative datasets can produce recommendations that disadvantage smallholders or particular cropping systems. Fairness audits and inclusive dataset strategies are frequently recommended mitigation measures. **Transparency and accountability.** Opaque "black box" models undermine farmers' ability to understand or contest automated recommendations; explain ability and human-in-the-loop design are proposed remedies. **Cybersecurity and data integrity.** Connected devices and cloud services expand attack surfaces; manipulation or corruption of farm data could have physical and economic consequences. Safeguarding data integrity is therefore an ethical as well as technical priority. Some AI tools increase energy use and carbon footprints; observers recommend lifecycle assessments and greener computational practices. These ethical categories indicate that digital ethics for agriculture must be multidisciplinary, combining law, computer science, agronomy, and pedagogy. Scholarly work in Rivers State specifically has explored integration of smart farming, IoT, and precision agriculture into tertiary agricultural education, finding that respondents (students, lecturers, extension officers) generally support integration but emphasize the need for real-life demonstrations, infrastructural investment, and curricular alignment. Other local studies highlight the limited utilization of open agricultural databases by extension professionals and farmers, pointing to gaps in data literacy and access. These empirical findings underscore the practical challenges of mainstreaming both digital skills and ethical practices in local agricultural education. **Synthesis of gaps and implications for the study**, **HEIs must do more than teach technical skills** they must institutionalize digital ethics through governance, curricula, and practice-based learning. **Digital agriculture offers productivity gains but introduces context-specific risks** (bias, data ownership, environmental cost) that require localized ethical policies and farmer inclusion. **Local realities (infrastructure, digital literacy, institutional capacity) constrain adoption**, meaning curricular and extension interventions must be paired with policy and resource investments.

Agriculture in Rivers State, is at a crossroads. On the one hand, the sector faces mounting sustainability challenges: declining soil fertility, environmental degradation from oil exploration, climate variability, low productivity, and limited market integration. On the other hand, advances in

digital technologies such as artificial intelligence, big data analytics, drones, and Internet of Things (IoT) devices present unprecedented opportunities to enhance efficiency, monitor resources, and improve decision-making in farming systems (Springer, 2025; Science Direct, 2025). For tertiary institutions mandated to produce the next generation of agricultural professionals, these technologies hold promise for reshaping agricultural education and practice.

However, the adoption of digital innovations in agriculture also raises critical **ethical concerns**. Issues of data ownership, farmers' consent, algorithmic bias, unequal access to digital platforms, cyber security risks, and the marginalization of smallholders have been widely reported in the global literature (Klerkx 2021; Sustainability Directory, 2025). In Nigeria, where many farmers already contend with structural disadvantages such as low digital literacy and poor infrastructure, the absence of ethical safeguards may worsen inequalities rather than support sustainability. If students in tertiary institutions are trained to use digital agricultural tools without an accompanying ethical orientation, they risk reproducing these harms when they enter the field as extension workers, educators, or agripreneurs.

Although the discourse on sustainable agriculture in Rivers State has gained attention, **digital ethics has not been systematically integrated into agricultural education**. Local studies have shown that agricultural education programs in Rivers State institutions possess adequate contextual and infrastructural bases for hands-on training (Okagwa & Raji, 2025), yet gaps remain in aligning this training with digital ethics principles such as transparency, accountability, and data justice. Curricula often emphasize technical skills such as pond construction, crop production, and farm mechanization without sufficient attention to the ethical dilemmas of digitalization. This disconnect leaves graduates ill-prepared to navigate the socio-ethical dimensions of digital agriculture.

Furthermore, existing institutional policies in many tertiary institutions lack clear frameworks for responsible digital practices in teaching, research, and community engagement. As EDUCAUSE (2020) notes, universities now operate in an era where "data is a second currency," yet without robust governance structures, both institutional credibility and stakeholder trust may be compromised. This problem is particularly pressing in Rivers State, where tertiary institutions serve not only as centers of learning but also as agents of rural extension, often interfacing directly with farming communities. The **problem, therefore, is twofold**, While digital technologies are being gradually introduced into agricultural education and practice, there is limited attention to the ethical implications of their use, Tertiary institutions in Rivers State, though strategically positioned, have not sufficiently embedded digital ethics into agricultural curricula, institutional policies, or student training, leaving a critical gap in preparing graduates to foster sustainable and equitable agricultural practices. Unless this gap is addressed, efforts to promote sustainability through digital agriculture risk being undermined by

ethical lapses that could erode farmer trust, exacerbate inequalities, and compromise the long-term viability of the agricultural sector. The study is therefore concerned with how tertiary institutions in Rivers State can **prompt sustainable agricultural practices through the systematic integration of digital ethics** into their teaching, training, and community engagement functions. The purpose of the study is to examine how tertiary institutions in Rivers State can promote sustainable agricultural practices through the integration of digital ethics into agricultural education. Specifically, the study seeks to:

3. Assess the extent to which digital ethics is currently integrated into agricultural education curricula in tertiary institutions in Rivers State.
4. Determine the influence of digital ethics on students' knowledge, attitudes, and skills in adopting sustainable agricultural practices.
5. Identify institutional strategies and policies through which tertiary institutions can effectively embed digital ethics to enhance sustainability in agricultural education and practice

For the purpose of the study, the following research questions were considered to aid the study:

16. To what extent is digital ethics currently integrated into agricultural education curricula in tertiary institutions in Rivers State?
17. How does the inclusion of digital ethics influence students' knowledge, attitudes, and skills in adopting sustainable agricultural practices?
18. What institutional strategies and policies can tertiary institutions implement to effectively embed digital ethics for enhancing sustainability in agricultural education and practice?

The following null hypotheses were postulated and tested at 0.05 level of significance to guide the study.

1. There is no significant difference between digital ethics currently integrated into agricultural education curricula in tertiary institutions in Rivers State.

2. There is no significant difference between the inclusion of digital ethics influence students' knowledge, attitudes, and skills in adopting sustainable agricultural practices,

3. There is no significant difference between institutional strategies and policies that tertiary institutions implement to effectively embed digital ethics for enhancing sustainability in agricultural education and practice.

The study would contribute to the Academic Significance and to existing literature on the intersection of digital ethics and sustainable agriculture, particularly within the Nigerian and Rivers State context, serves as a reference for future researchers exploring digital behavior and agricultural innovation adoption.

2. Institutional Significance:

Helps tertiary institutions understand how ethical use of digital tools (e-learning, digital labs, online platforms, data-sharing systems) can promote sustainability in agricultural training, research, and field practices, provides insights for curriculum designers and administrators on integrating digital ethics into agricultural education.

3. Socioeconomic Significance:

Encourages the development of students who can responsibly use digital technologies (AI, sensors, data systems, GIS, drones) to solve agricultural problems in Rivers State.

Supports the state's agricultural sector by encouraging responsible digital practices that reduce waste, enhance productivity, and protect the environment.

4. Policy Significance:

Offers recommendations for policymakers on ethical frameworks that can guide digital agricultural innovation in institutions.

Supports government and NGOs in designing digital-ethics interventions that can improve sustainable agriculture.

The scope of the study comprises of content scope, geographical scope and unit of analysis. content scope: the content scope of the study Focuses on the relationship between digital ethics (responsible use of digital tools, data privacy, digital integrity, responsible ICT use) and sustainable agricultural practices (soil conservation, organic farming, resource-efficient farming, climate-smart agriculture).

Geographical Scope: the study was basically limited to selected tertiary institutions in Rivers State (e.g., University of Port Harcourt, Rivers State University, Ignatius Ajuru University, etc.).

Population Scope: Agricultural students, lecturers, ICT staff, and researchers in tertiary institutions.

Variable Scope: Independent Variable: Digital Ethics (responsible digital behavior, cyber integrity, data ethics, and ethical use of agricultural tech).

Dependent Variable: Sustainable Agricultural Practices (adoption of sustainable methods, responsible resource use, use of digital farming solutions).

Time Scope: Focuses on contemporary digital trends and current institutional practices.

Methodology

The study was carried out **in Rivers State Nigeria**, with specific focus on selected tertiary institutions that offer agricultural education programme. These include Rivers State University (RSU), Port Harcourt, Ignatius Ajuru University of Education (IAUOE), Port Harcourt, and the Federal College of Education (Technical), Omoku. These institutions were chosen because they provide agricultural training, engage in research and extension services, and play a central role in preparing future agricultural educators, extension officers, and agripreneurs. The area of the study is significant since Rivers State is both agriculturally endowed and environmentally challenged by oil exploitations making it a critical location linking digital ethics to sustainable agricultural practices. The study adopts a descriptive survey research design. The design is appropriate because it allows the researcher to gather data from a large number of respondents to describe existing conditions, opinions and practices regarding digital ethics and sustainable agriculture. The 350 are the target population of the study consist of all **lecturers** and undergraduate students in agricultural education programs across the selected tertiary institutions in Rivers State. This includes Rivers State University (Faculty of Agriculture & related departments), Ignatius Ajuru University of Education (Department of Agricultural Science Education), Federal College of Education (Technical), Omoku (School of Vocational and Technic) a sample random sampling technique was adopted to select 300 students and 50 lecturers. The instrument for data collection was the researchers structured questionnaires designed in a Likert 5 –point rating scale of very high extent, high extent, low extent and very low extent with a numeric value of 5,4,3,2 and 1respectively. the instrument was face and content validated by experts in vocational and technology education, Data was analyzed using **descriptive statistics** (mean and standard deviation) with a criterion mean value of 3.00 and above, while **z-test statistics** was used to test the null hypotheses at 0.05 level of significance. Reliability of the instrument was established using test–**retest method**, and the coefficient method which yielded a reliability of 0.82.

Results

Research Question 1:

To what extent is digital ethics currently integrated into agricultural education curricula in tertiary institutions in Rivers State?

Table 1: Mean Responses of Students and Lecturers on Integration of Digital Ethics in Agricultural Education Curricula

S/N	Statement	Category	N	Mean ($\bar{x}$)	Std. Dev. (SD)	Decision
1	Digital ethics is included in the current agricultural education curriculum.	Students	300	2.65	1.04	Low extent
		Lecturers	50	2.72	0.98	Very low extent
2	Lecturers emphasize digital responsibility when teaching agricultural technologies.	Students	300	3.18	1.10	High extent
		Lecturers	50	3.26	0.92	Very high extent
3	Students are taught issues of data privacy, security, and ownership in agricultural practices.	Students	300	2.48	1.15	Disagree
		Lecturers	50	2.54	1.09	Low extent
4	Digital ethics is integrated into practical demonstrations such as precision farming or ICT use.	Students	300	3.05	1.21	High extent

S/N	Statement	Category	N	Mean ($\bar{x}$)	Std. Dev. (SD)	Decision
		Lecturers	50	3.12	0.87	Very high extent
5	Institutional policies support embedding ethical principles in agricultural digitalization.	Students	300	2.71	1.07	Low extent
		Lecturers	50	2.80	1.02	Very low extent

Source field work 2025

Table 1 shows that both students and lecturers agreed that lecturers sometimes emphasize digital responsibility ($\bar{x}$ = 3.18, 3.26) and that digital ethics appears in some practical demonstrations ($\bar{x}$ = 3.05, 3.12). However, respondents disagreed that digital ethics is fully included in the curriculum ($\bar{x}$ = 2.65, 2.72), that issues of data privacy and security are taught ($\bar{x}$ = 2.48, 2.54), or that institutional policies support ethical integration ($\bar{x}$ = 2.71, 2.80). This suggests that **digital ethics is only partially integrated** into agricultural education curricula in Rivers State tertiary institutions.

Research Question 2: To what extent does the inclusion of digital ethics influence students' knowledge, attitudes, and skills in adopting sustainable agricultural practices?

Table 2: Mean Responses of Students and Lecturers on the Influence of Digital Ethics

S/N	Statement	Category	N	Mean ($\bar{x}$)	Std. Dev. (SD)	Decision
1	Digital ethics improves students' awareness of responsible ICT use in agriculture.	Students	300	3.42	0.98	High extent
		Lecturers	50	3.56	0.85	Very high extent

S/N	Statement	Category	N	Mean ($\bar{x}$)	Std. Dev. (SD)	Decision
2	Understanding digital ethics improves students' critical thinking in sustainable agriculture.	Students	300	3.28	1.01	High extent
		Lecturers	50	3.41	0.79	High extent
3	Digital ethics enhances practical skills such as precision farming and smart irrigation.	Students	300	3.05	1.12	High extent
		Lecturers	50	3.18	0.93	High extent
4	Ethical awareness influences students' attitudes towards climate-smart agriculture.	Students	300	3.22	1.09	High extent
		Lecturers	50	3.34	0.88	High extent
5	Knowledge of data privacy/security makes students more confident in applying digital tools.	Students	300	2.89	1.07	High extent
		Lecturers	50	3.00	0.91	High extent

Source field work 2025

Table 2: Both students and lecturers generally agreed that digital ethics positively influences knowledge, attitudes, and practical skills in sustainable agriculture. This indicates that the more digital ethics is emphasized, the stronger students' confidence and competence in adopting sustainable practices.

Research Question 3: What institutional strategies can tertiary institutions implement to effectively embed digital ethics for enhancing sustainability in agricultural education and practice?

Table 3: Mean Responses of Students and Lecturers on Institutional Strategies for Embedding Digital Ethics

S/N	Statement	Category	N	Mean ($\bar{x}$)	Std. Dev. (SD)	Decision
1	Curriculum review is needed to include digital ethics modules in agricultural education.	Students	300	3.61	0.84	High extent
		Lecturers	50	3.78	0.66	High extent
2	Institutions should provide training/workshops on digital ethics for students and lecturers.	Students	300	3.47	0.92	High extent
		Lecturers	50	3.60	0.71	Very High extent
3	ICT infrastructure should be strengthened to support ethical digital practices in agriculture.	Students	300	3.29	1.04	High extent
		Lecturers	50	3.50	0.82	Very high extent
4	Policies should enforce responsible use of digital resources in teaching and research.	Students	300	3.34	0.97	High extent
		Lecturers	50	3.46	0.75	High extent
5	Partnerships with tech companies/NGOs can promote ethical digital adoption in agriculture.	Students	300	3.18	1.06	High extent
		Lecturers	50	3.40	0.80	High extent

Source field work 2025

Table 3: Both students and lecturers strongly agreed that curriculum review, ICT infrastructure, policy enforcement, and training are key strategies for embedding digital ethics in tertiary institutions. This implies that institutions need deliberate reforms and partnerships to integrate ethics into sustainable agricultural practices.

Discussion of Findings

From research question 1, To what extent is digital ethics currently integrated into agricultural education curricula in tertiary institutions in Rivers State? The findings revealed that both students and lecturers agreed that digital ethics is only moderately integrated into agricultural education curricula. While elements of responsible ICT use, data security, and online responsibility exist, they are not systematically embedded into formal teaching and learning structures. This is consistent with **Adebayo & Okafor (2019)**, who argued that most Nigerian tertiary institutions adopt digital tools without corresponding ethical frameworks, thereby limiting sustainability outcomes. Similarly, **Uzochukwu (2021)** stressed that without structured ethical guidelines, the misuse of digital platforms in agriculture can undermine innovation. Therefore, the study highlights a gap between digital adoption and ethical integration in curricula.

from research question 2**,** *How does the inclusion of digital ethics influence students' knowledge, attitudes, and skills in adopting sustainable agricultural practices?* The results showed that digital ethics positively influenced students' awareness, attitudes, and practical skills, especially in areas such as precision farming, climate-smart agriculture, and data protection. Both students and lecturers agreed that ethical knowledge boosted confidence in using digital tools responsibly. This aligns with the findings of **Nwankwo & Peters (2020)**, who emphasized that ethical literacy fosters critical thinking and responsible decision-making among agricultural students. Similarly, **Eze & Chukwu (2022)** noted that students trained in digital responsibility are more inclined to adopt sustainable practices such as smart irrigation and waste reduction. Thus, the study suggests that embedding digital ethics strengthens students' readiness to apply sustainable innovations.

From research question3**:** The findings indicated that participants strongly supported strategies such as curriculum review, ICT infrastructure development, training workshops, policy enforcement, and partnerships with tech firms/NGOs. Lecturers especially emphasized curriculum reforms, while students highlighted the importance of capacity building through workshops. This finding supports **Onyema et al. (2020)**, who advocated institutional policies that bridge technology uses with ethical responsibility. Similarly, **Okeke & Ijioma (2023)** highlighted that partnerships with ICT firms can drive digital ethics training and enhance sustainability. Therefore, the study

demonstrates that institutional reforms and external collaborations are key to mainstreaming digital ethics in tertiary agricultural education.

Conclusion

From the background and findings revealed, the study therefore examined how digital ethics can be used to promote sustainable agricultural practices in tertiary institutions in Rivers State. Findings showed that digital ethics is not yet fully embedded in agricultural education curricula, although its inclusion significantly influences students' knowledge, attitudes, and skills toward sustainable practices. Both lecturers and students agreed to a very high extent that integrating ethical considerations into digital learning tools enhances confidence, responsibility, and innovation in agricultural education. Furthermore, institutional reforms such as curriculum review, ICT infrastructure improvement, and partnerships with relevant stakeholders were identified as necessary strategies for embedding digital ethics into educational practices, while digital technologies have become indispensable in modern agricultural education, their impact on sustainability depends on the ethical frameworks guiding their use. Therefore, tertiary institutions in Rivers State must adopt deliberate strategies that integrate digital ethics into agricultural curricula to ensure that future agricultural professionals are well-equipped for sustainable practices.

Recommendations

Based on the findings, the following recommendations are made:

1. Curriculum Reform**:** Tertiary institutions should integrate digital ethics modules into agricultural education curricula to provide structured guidance on responsible technology use.
2. Capacity Building**:** Regular workshops, training, and seminars should be organized for both lecturers and students to improve awareness and practical application of digital ethics in sustainable agricultural practices.
3. Policy Development and Enforcement**:** Institutions should establish clear policies that promote ethical digital practices and ensure compliance in teaching, research, and field demonstrations.
4. Strengthening ICT Infrastructure**:** Investment in digital infrastructure (e.g., precision farming labs, e-learning platforms) should be accompanied by ethical use policies to maximize sustainability outcomes.

5. Collaboration with Stakeholders**:** Partnerships with ICT firms, agricultural extension bodies, and NGOs should be pursued to provide technical support and enhance digital ethics integration in agricultural education.

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