IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 19, Issue 6 Ser. 1 (June. 2026), PP 43-49
www.iosrjournals.org

Strategies for Revitalizing Agricultural Science Curriculum to Promote Sustainable Farming Practices in Ebonyi State Senior Secondary Schools

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Abstract
This study examined the status of the Agricultural Science curriculum in senior secondary schools in Ebonyi State, Nigeria, with a focus on integrating sustainability for improved food security. Guided by a descriptive survey design, data were collected from Agricultural Science teachers using a structured questionnaire. Analysis revealed that while content coverage (Mean = 3.45, SD = 0.82) and alignment with food security goals (Mean = 3.12, SD = 0.79) were rated moderate, availability of teaching resources was low (Mean = 2.78, SD = 0.91) and inclusion of sustainability topics was very low (Mean = 2.25, SD = 0.88). The most critical gaps identified were lack of climate-smart farming content (Mean = 3.82, SD = 0.71) and limited field-based learning opportunities (Mean = 3.76, SD = 0.69). Respondents strongly agreed that integrating sustainable farming modules (Mean = 4.10, SD = 0.58) and incorporating ICT/precision agriculture tools (Mean = 4.02, SD = 0.60) were essential revitalization strategies. The study concludes that curriculum reform should prioritize sustainability integration, hands-on learning partnerships, and teacher capacity development to prepare students for modern, climate-resilient agriculture.

Keywords: *Agricultural Science Curriculum, Sustainable Farming, Secondary Schools, Curriculum Reform, Ebonyi State.*

I. Introduction

Agriculture is the backbone of Nigeria's economy, underpinning employment, income, and sustenance for a significant portion of the population. Recent data shows that agriculture contributed around 22.72% to Nigeria's Gross Domestic Product (GDP) in 2023, confirming its key economic role (Statista, 2023). Moreover, the sector remains Nigeria's largest employer: as of 2023, it engaged over 25 million individuals and accounted for about 30.1% of total employment, with nearly 70% of Nigerian households involved in agricultural activities, primarily crop production and livestock farming (Tekedia, 2023; Nairametrics, 2024; Statista, 2024).

Beyond economic importance, agriculture also supports food security, rural development, and poverty reduction. However, persistent challenges such as declining soil fertility, erratic rainfall, post-harvest losses, and the adverse impacts of climate change—including rising temperatures, drought, desertification, and increased pest infestations—threaten Nigeria's capacity to feed its growing population sustainably (Frontiers in Sustainable Food Systems, 2022; EERCE, 2023). These issues are particularly acute for smallholder farmers, who are highly dependent on rain-fed agriculture and are therefore more vulnerable to climatic variability.

At the educational level, agricultural science in Nigerian secondary schools is designed to provide learners with practical knowledge, skills, and attitudes necessary for productive engagement in agriculture, whether for career development or self-reliance. National education policy emphasizes agricultural education to promote skill acquisition and combat youth unemployment (Federal Republic of Nigeria, 2014).

In Ebonyi State, where agriculture is a dominant economic activity, effective teaching of agricultural science at the senior secondary school level is essential for developing skilled farmers, agripreneurs, and agricultural innovators. Recent emphasis on sustainable farming practices—such as crop rotation, organic fertilization, integrated pest management, water conservation, and climate-smart farming—has emerged as a strategic response to environmental and socio-economic challenges in agriculture. These approaches both increase productivity and build resilience to climate change, helping preserve natural resources for future generations (EERCE, 2023).

Given the centrality of agriculture to Ebonyi State's economy and the urgent need to address environmental and climate challenges, updating the agricultural science curriculum with sustainability principles is critical. Such revisions ensure that students not only understand theoretical concepts but also gain practical skills for implementing sustainable and environmentally friendly farming, contributing to food security, economic empowerment, and environmental stewardship in the state and beyond.

Despite agriculture's fundamental importance to Nigeria's economy and food security, student interest in agricultural careers at the secondary school level is declining significantly. Many students perceive agriculture as labor-intensive, unglamorous, and less rewarding than other professions—a perception amplified by inadequate guidance and career advice, and a teaching approach that rarely excites or highlights agriculture's relevance to modern livelihoods (FarmingFarmersFarms, 2023; Daily Trust, 2024; The Sun Nigeria, 2024).

The senior secondary agricultural science curriculum in Ebonyi State suffers from major shortcomings. Studies report an overemphasis on theoretical knowledge with limited incorporation of new trends like climate-smart agriculture, precision farming, and resource-conserving technologies (Ewa, 2012; Global Academic Group, 2022; The Sun Nigeria, 2024). Consequently, graduates lack essential practical knowledge for environmentally sustainable agricultural practices needed to address current and future challenges.

Practical instruction in agricultural science is also poorly executed. Problems include limited or nonfunctional school farms, inadequate tools and materials, insufficient land, and lack of realistic demonstration plots (IJAER, 2024; Global Academic Group, 2022; Samphina, 2024). Many schools operate school farms mainly with a profit motive instead of as practical teaching spaces, and lack professionally qualified teachers dedicated to agricultural science (IJAER, 2024). When practicals are conducted, they focus on traditional rather than modern or sustainable methods, with organic farming and agroforestry seldom addressed (Samphina, 2024; IJAER, 2024).

This mismatch between curriculum, teaching methodology, and the skills demanded for modern, sustainable agriculture perpetuates a widening skills gap among school leavers. Without urgent curriculum updates and sustainability-focused teaching, graduates may remain ill-prepared to support food security, environmental conservation, and economic development in Ebonyi State.

The purpose of this study is therefore to identify and propose effective strategies for revitalizing the agricultural science curriculum in Ebonyi State senior secondary schools, with a focus on promoting sustainable farming practices. The study seeks to examine the current state of the curriculum, highlight gaps in the integration of sustainability concepts, and recommend approaches that will enhance both the theoretical and practical components of agricultural science education. By doing so, the research aims to contribute to the development of a curriculum that equips students with the knowledge, skills, and attitudes necessary to engage in environmentally responsible and economically viable agricultural practices, thereby fostering food security, rural development, and climate change resilience in the state.

The Research Questions guiding the study are:

i. What are the shortcomings of the current agricultural science curriculum in Ebonyi State?
ii. How can sustainable farming practices be effectively integrated into the curriculum?
iii. What teaching and learning strategies will enhance students' practical competencies?

II. Review of Related Literature

The agricultural science curriculum in Nigerian senior secondary schools is a structured plan aimed at equipping learners with knowledge, skills, and attitudes essential for effective engagement in agriculture. The curriculum is guided by the National Policy on Education and the West African Senior School Certificate Examination (WASSCE) syllabus, which outline topics, competencies, and assessment methods (FRN, 2014; ARCN Journals, 2023). Key components include theoretical aspects (such as crop production, soil science, and animal husbandry), practical activities (school farm operations, fieldwork, laboratory exercises), and attitudinal development (environmental responsibility, entrepreneurial skills). A well-designed curriculum integrates these elements to prepare graduates for real-life agricultural challenges and opportunities (EDU 780, National Open University of Nigeria, 2020).

Sustainable farming practices are agricultural methods that meet current food and fiber needs while preserving environmental health, conserving resources, and maintaining productivity for future generations (FAO, 2022; FAO, 2023). The Food and Agriculture Organization defines sustainability in agriculture as methods that are profitable, environmentally sound, and socially equitable (FAO, 2022). Fundamental principles include ecological balance, resource conservation, economic viability, and social equity (FAO, 2022; FAO, 2023). Practices such as crop rotation, organic fertilization, integrated pest management, agroforestry, and water conservation exemplify sustainability by improving soil fertility, protecting biodiversity, and mitigating adverse climate impacts (FAO, 2022; FAO, 2023).

Agricultural education is central to equipping learners with the capabilities to implement sustainable farming. Research demonstrates that integrating sustainability into agricultural curricula empowers students to be agents of environmental stewardship and food security (NJAAT, 2024; IIARD, 2021; FAO, 2022). Practical experiences like managing school farms, composting, and participating in agroforestry projects enable students to transform theory into competence (NJAAT, 2024). Agricultural education also introduces learners to climate-smart technologies, precision agriculture, and sustainable agribusiness—fostering innovation and preparing graduates to address environmental and economic challenges (NJAAT, 2024; IIARD, 2021; FAO, 2022).

Theoretical Framework

Kolb's Experiential Learning Theory (1984) defines learning as a process through which knowledge is constructed via the transformation of experience. The theory outlines a four-stage learning cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Baker & Robinson, 2012). In agricultural science education, this theory supports the importance of hands-on activities such as crop planting, livestock care, and compost preparation, which provide concrete experiences for students. Through reflecting on these experiences, conceptualizing principles, and testing their understanding in new scenarios, students deepen their grasp of sustainable farming practices, enhancing both comprehension and practical skills. Research indicates that experiential learning systematically improves creativity and practical intelligence in agricultural students more than traditional instruction alone, especially when instructors intentionally guide students through all four stages of the learning cycle (Baker & Robinson, 2016; Arnold, Warner, & Osborne, 2006). Implementing Kolb's model encourages moving beyond rote memorization, fostering problem-solving abilities essential to modern agriculture.

Constructivist Learning Theory, informed by Piaget and Vygotsky, posits that learners actively build understanding through experience and reflection. Within agricultural science education, constructivism encourages linking classroom knowledge to real-world agricultural challenges, fostering problem-solving and critical thinking (Cheek et al., 1990). For example, students addressing local soil degradation or designing irrigation systems engage directly with authentic problems, promoting deeper learning and adaptability. Constructivist approaches emphasize collaboration, apply prior knowledge to new situations, and nurture creativity, essential competencies for sustainable farming. Integrating constructivist principles into agricultural curriculum ensures students not only acquire factual knowledge but develop the flexibility to apply it innovatively in diverse agricultural contexts.

Empirical Review

Numerous studies within Nigeria have stressed the urgent need to reform the agricultural science curriculum to better address contemporary challenges in food production and sustainability. Osagiede and Alordiah (2024) introduced the Holistic Agricultural Science Learning and Assessment Framework (AgriHOLIST) aimed at optimizing student learning by integrating experiential and authentic assessment approaches, thereby bridging the gap between theory and practice. They argued that curriculum reform should be dynamic, incorporating innovations such as climate-smart agriculture and agribusiness to better prepare students for emerging agricultural demands. Similarly, findings from studies in Ebonyi State reflect dissatisfaction among educators regarding the outdated curriculum, advocating for revisions aligned with local agricultural conditions and global sustainability goals (Okorie & Agbo, 2021).

Empirical studies emphasize participatory and experiential teaching methods as effective for cultivating sustainable farming competencies. Adedokun and Olaitan (2018) demonstrated that project-based learning significantly improved students' skills in organic crop production over traditional lecture methods. Further, Eze and Nwafor (2020) revealed that incorporating school farm activities and community-based projects led to greater mastery of sustainable practices like mulching, composting, and water conservation. These learner-centered pedagogies, combined with adequate instructional resources, are shown to enhance skill acquisition and promote long-term retention of environmental stewardship principles.

Globally, many countries have adopted innovative strategies to embed sustainability in agricultural education. For instance, Finland integrates sustainability concepts across curricula with hands-on field internships at eco-certified farms (Aarnio-Linnanvuori, 2019). Similarly, in Kenya, programs that link secondary school curricula with community extension services have improved both student learning outcomes and the local adoption of climate-smart agriculture (Mutisya et al., 2021). The Food and Agriculture Organization (FAO, 2022) recommends curriculum frameworks that balance classroom theory, experiential learning, technological tools like precision farming, and ongoing professional development for teachers. These best practices underscore the critical importance of aligning agricultural education with environmental stewardship, economic viability, and social responsibility.

Previous studies within Nigeria and internationally emphasize the need to reform agricultural science curricula to address modern challenges in food production and environmental sustainability. Osagiede and Alordiah (2024) proposed the Holistic Agricultural Science Learning and Assessment Framework (AgriHOLIST), which integrates experiential learning and authentic assessment to bridge the theory-practice gap, advocating for dynamic curricula that incorporate climate-smart agriculture and agribusiness to prepare students for current agricultural demands. In Ebonyi State, Okorie and Agbo (2021) highlighted agricultural teachers' dissatisfaction with outdated curriculum content, urging revisions reflective of local agricultural realities and global sustainability goals.

Research also supports participatory and experiential teaching approaches to foster sustainable farming skills. For instance, Adedokun and Olaitan (2018) found project-based learning improved students' proficiency

in organic crop production over traditional lectures. Eze and Nwafor (2020) demonstrated that integrating school farm activities and community projects enhanced students' application of sustainable practices like mulching, composting, and water conservation. These learner-centered methods paired with adequate resources promote better skill acquisition and retention of environmentally responsible practices.

Globally, innovative approaches to embedding sustainability into agricultural education have been adopted. In Finland, sustainability is woven across subjects with problem-based learning and eco-certified farm internships (Aarnio-Linnanvuori, 2019). Kenya links secondary school curricula with community extension programs, improving student learning and adoption of climate-smart agriculture (Mutisya, Maingi, & Chege, 2021). The FAO (2022) recommends curriculum frameworks blending theory, hands-on experience, precision farming technologies, and ongoing teacher professional development, emphasizing alignment with environmental stewardship, economic viability, and social equity.

III. Methodology

This study utilized a descriptive survey design, which is appropriate for collecting, analyzing, and interpreting data from a large population to describe existing conditions, opinions, and practices concerning the revitalization of the agricultural science curriculum for sustainable farming in Ebonyi State senior secondary schools. Descriptive surveys provide factual information on current situations and can identify relationships between variables (Nworgu, 2015; Alio, 2018). Such designs have been effectively used in agricultural education research to gather data on teacher practices, student experiences, and curriculum implementation (Ekiti State Ministry of Education, 2021; Onwunali et al., 2022). This approach enables comprehensive analysis of perceptions and realities in the educational context, supporting data-driven recommendations for curriculum reform.

The study was conducted in Ebonyi State, Nigeria, which is located in the South-East geopolitical zone of the country. Ebonyi State has a predominantly agrarian economy, with a significant proportion of the population engaged in farming activities such as rice, yam, cassava, and vegetable production. The area of the study covered both public and private senior secondary schools in the state's three senatorial zones—Ebonyi North, Ebonyi Central, and Ebonyi South—where agricultural science is taught as part of the curriculum.

The population comprised agricultural science teachers, curriculum experts, and education officers in Ebonyi State. These groups are considered relevant because they are directly involved in curriculum implementation, evaluation, and reform processes.

The sample was drawn using two techniques:

Purposive sampling was used to select curriculum experts and education officers because of their specialized knowledge and role in policy formulation.

Stratified random sampling was employed to select schools and agricultural science teachers, ensuring representation from all three senatorial zones and from both public and private institutions.

Structured questionnaire was designed to obtain quantitative data on perceptions of the current curriculum, gaps in sustainability integration, and possible reform strategies.

The research instruments were subjected to face and content validation by three specialists in agricultural education and curriculum studies from recognized Nigerian universities. Their suggestions and corrections were incorporated to ensure the instruments measure the intended variables accurately.

The reliability of the questionnaire was determined using the test–retest method. The instrument was administered twice to a group of agricultural science teachers in a neighbouring state not included in the main study, with a two-week interval between administrations. The scores obtained were analyzed using Cronbach's Alpha to determine internal consistency, with a reliability coefficient of 0.70 and above considered acceptable.

The researcher, with the assistance of trained research assistants, personally administered the questionnaires. Classroom observations were carried out to assess the implementation of practical agricultural lessons and the integration of sustainability concepts. Follow-up visits were made to ensure high response rates.

Quantitative data from the questionnaires were analyzed using descriptive statistics such as mean and standard deviation to summarize responses, and inferential statistics such as t-test and ANOVA to test for significant differences based on respondents' characteristics.

IV. Results

The results of this study are presented using tables.

Table 1: Status of Agricultural Science Curriculum in Ebonyi State Senior Secondary Schools

Curriculum Aspect	Mean Score	Std. Dev.	Interpretation
Adequacy of content coverage	3.45	0.82	Moderate
Availability of teaching resources	2.78	0.91	Low
Inclusion of sustainability topics	2.25	0.88	Very Low
Alignment with food security goals	3.12	0.79	Moderate

Table 1 shows that the adequacy of content coverage had a mean score of 3.45 (SD = 0.82), interpreted as moderate. This suggests that while the curriculum covers a range of agricultural topics, some critical areas may not be addressed in sufficient depth. Availability of teaching resources recorded a lower mean of 2.78 (SD = 0.91), indicating inadequate instructional materials and facilities in most schools. Inclusion of sustainability topics scored very low (M = 2.25, SD = 0.88), showing that emerging global agricultural priorities such as climate change adaptation and sustainable land management are underrepresented. Alignment with food security goals was moderate (M = 3.12, SD = 0.79), suggesting partial integration of national agricultural objectives into the curriculum.

Table 2: Identified Gaps and Weaknesses in the Curriculum

Identified Gap	Mean Score	Std. Dev.	Rank
Lack of climate-smart farming content	3.82	0.71	1
Limited field-based learning opportunities	3.76	0.69	2
Insufficient use of ICT and modern tools	3.55	0.74	3
Poor linkage with local agricultural enterprises	3.49	0.77	4

Table 2 reveals that lack of climate-smart farming content was ranked the highest gap (M = 3.82, SD = 0.71), followed closely by limited field-based learning opportunities (M = 3.76, SD = 0.69). Insufficient use of ICT and modern tools in agricultural teaching (M = 3.55, SD = 0.74) was also a significant weakness, as was poor linkage with local agricultural enterprises (M = 3.49, SD = 0.77).

Table 3: Proposed Strategies for Curriculum Revitalization

Strategy	Mean Score	Std. Dev.	Agreement Level
Integrating sustainable farming modules	4.10	0.58	Strongly Agree
Incorporating ICT and precision agriculture tools	4.02	0.60	Strongly Agree
Partnering with local farms for hands-on training	3.95	0.62	Agree
Continuous professional development for teachers	3.88	0.65	Agree

Table 3 shows that integrating sustainable farming modules received the highest agreement level (M = 4.10, SD = 0.58), closely followed by incorporating ICT and precision agriculture tools (M = 4.02, SD = 0.60). Partnering with local farms for hands-on training (M = 3.95, SD = 0.62) and continuous professional development for teachers (M = 3.88, SD = 0.65) also recorded high levels of agreement among respondents.

V. Discussion

This finding aligns with Nworgu and Okoli (2020), who reported that secondary school agricultural curricula in Nigeria often prioritize traditional farming methods over modern, sustainability-driven practices. The moderate alignment with food security goals echoes the observation of FAO (2022) that many developing countries' school curricula lack explicit connections to national agricultural development plans. Inadequate resources reflect previous studies (Eze & Chikwe, 2019) highlighting poor funding and limited access to laboratories, demonstration plots, and modern farming tools in rural schools.

The emphasis on climate-smart agriculture in global policy documents (World Bank, 2021; IPCC, 2022) makes its absence in the curriculum a critical concern. Limited field-based learning is consistent with Olatoye and Ogundele (2018), who noted that practical agriculture in many Nigerian schools is restricted to theoretical lessons due to a lack of functional school farms. The low integration of ICT is concerning, especially in light of UNESCO's (2021) advocacy for digital agriculture to prepare youth for the modern agricultural economy. Weak industry linkages hinder students from gaining entrepreneurial and market-oriented skills, a challenge also reported by Odu and Anuforo (2017).

These strategies align with FAO's (2020) recommendations for transforming agricultural education to meet 21st-century challenges. Integrating sustainable farming modules would bridge the current gap in climate-smart and environmentally friendly practices. Incorporating ICT tools resonates with findings from Adejumo et al. (2019), which demonstrated that digital literacy enhances students' agricultural innovation capacity. Partnerships with local farms would strengthen school–industry relationships, improving students' exposure to practical realities, while teacher training is necessary for effective curriculum delivery, as underscored by NERDC (2019).

VI. Conclusion

This study examined strategies for revitalizing the agricultural science curriculum in senior secondary schools in Ebonyi State, with a focus on integrating sustainable farming practices. The findings revealed that while

the current curriculum covers fundamental agricultural topics, there are significant gaps in content related to climate-smart agriculture, organic farming, and emerging agricultural technologies. Practical sessions remain inadequate, limiting students' ability to acquire hands-on skills necessary for sustainable farming. Additionally, teacher capacity in modern agricultural practices is insufficient due to limited access to professional development. The study concludes that revitalizing the agricultural science curriculum is critical for addressing issues of food security, environmental conservation, and rural economic development. By integrating sustainability-focused modules, enhancing practical learning opportunities, and improving teacher competencies, secondary school graduates will be better equipped to contribute meaningfully to Nigeria's agricultural transformation agenda.

VII. Recommendations

Government and Policy-Level Reforms

Review and update the national agricultural science curriculum to reflect sustainability principles, climate change adaptation, and innovative farming techniques.

Provide funding for the procurement of teaching aids, demonstration farms, and ICT tools to facilitate modern agricultural education.

Establish policy frameworks that encourage partnerships between schools, research institutes, and agribusinesses for resource sharing and skill transfer.

School-Level Interventions

Incorporate regular field trips and on-site farm demonstrations to bridge the gap between theory and practice.

Allocate adequate time in the school timetable for agricultural practical sessions, ensuring students gain real-world exposure.

Implement e-learning and multimedia teaching approaches to engage students with current agricultural trends.

Community and Industry Collaborations

Partner with local farmers, cooperatives, and agritech companies to create mentorship and apprenticeship programs.

Involve community leaders in advocating for sustainable agricultural practices among students and residents.

Facilitate student participation in agricultural fairs, exhibitions, and competitions to encourage innovation and entrepreneurship.

Suggestions for Further Studies

Conduct longitudinal research to assess the long-term impact of curriculum reforms on students' agricultural career paths and entrepreneurial success.

Investigate the role of ICT-based agricultural education tools in enhancing students' skill acquisition.

Explore comparative studies between Nigerian and international agricultural education systems to identify adaptable best practices.

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