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INFLUENCE OF GENDER ON THE EFFECTIVENESS OF BLENDED TEACHING STRATEGY IN ENHANCING AGRICULTURAL SCIENCE STUDENTS' ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCHOOLS IN SOUTHWEST ,NIGERIA

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Abstract

Academic achievement in Agricultural Science among senior secondary students in Southwest Nigeria remains suboptimal, primarily due to reliance on traditional lecture methods that neglect diverse learning needs and gender dynamics. This study examined how gender influences the effectiveness of Blended Teaching Strategy (BTS) in enhancing students' academic performance. Using a quasi-experimental 2x2 factorial design, 660 SSII students from 11 Federal Unity Colleges were assigned to BTS (experimental) or traditional lecture (control) groups. Data from the validated 25-item Animal Nutrition Achievement Test (ANAT) were analyzed via ANCOVA at α=0.05. Results showed no significant gender influence on BTS effectiveness (F=1.81, p=.179), with adjusted post-test means of males (67.92) and females (68.54) being nearly identical. BTS significantly outperformed traditional methods overall (F=117.11, p<.001), with BTS students averaging 68.24 versus 54.62 for controls. Crucially, the interaction between gender and teaching strategy was not significant (F=0.92, p=.339), indicating BTS benefits both genders equally. The study concludes that BTS is a powerful, gender-neutral pedagogical tool for improving Agricultural Science outcomes and recommends its curriculum integration, supported by equitable digital access and teacher training to ensure inclusive, effective learning across Southwest Nigeria's secondary schools.

Keywords: *Gender Blended teaching strategy, Agricultural science, Students and Academic achievement*

Introduction

The educational landscape in Nigeria has witnessed significant transformations in recent years, particularly with the integration of digital technologies into teaching and learning processes. The shift towards technology-enhanced instruction has been driven by the need to improve instructional delivery, learner engagement, and academic outcomes in secondary education (Adebayo & Adu, 2015; Yusuf & Balogun, 2011). One notable innovation emerging from this transformation is the Blended Teaching Strategy (BTS), which combines traditional face-to-face instruction with online learning components. This hybrid approach has been widely recognised for its capacity to enhance student engagement and academic achievement, particularly in subjects such as Agricultural Science that require both theoretical grounding and practical application (Graham, 2013; Horn & Staker, 2015).

Gender, as a socially constructed concept, encompasses the roles, behaviours, and expectations assigned to males and females within a given society. In the Nigerian educational context, persistent gender disparities continue to shape access to learning opportunities and educational resources, often to the disadvantage of female students (Ezeh, 2017; UNESCO, 2020). At the same time, Blended Teaching Strategy (BTS) offers a flexible and personalised instructional model that accommodates diverse learning styles and paces, potentially mitigating some of these disparities if equitably implemented (Means et al., 2013; Okojie et al., 2020).

Agricultural Science remains a core subject within the Nigerian secondary school

curriculum, focusing on essential areas such as crop production, animal husbandry, soil science, and agricultural economics. The subject plays a critical role in equipping learners with practical skills and knowledge necessary for national development, particularly in an agrarian economy like Nigeria (Federal Republic of Nigeria, 2014; Nwachukwu, 2018). Effective teaching strategies are therefore essential to ensure that students not only understand theoretical concepts but also develop applicable competencies.

Student academic achievement, typically measured through examination scores and continuous assessment outcomes, serves as a key indicator of educational effectiveness. It reflects the extent to which instructional objectives are achieved and learning outcomes realised (Adeyemi, 2010; Ibrahim, 2019). Consequently, identifying instructional strategies that significantly enhance academic achievement remains a central concern for educators and policymakers.

Globally, Blended Teaching Strategy has gained prominence as an effective instructional approach capable of improving learning outcomes. Research indicates that BTS enhances flexibility, promotes self-directed learning, and supports the development of digital competencies among students (Garrison & Kanuka, 2004; Means et al., 2013). In Agricultural Science education, BTS facilitates the use of virtual simulations, multimedia resources, and interactive platforms that can deepen students' understanding of complex agricultural processes (Alabi & Okemakinde, 2020; Udo & Udofia, 2014).

In Nigeria, however, the adoption of BTS in secondary education remains at a developmental stage. Structural challenges such as inadequate technological infrastructure, limited internet access, and insufficient teacher training continue to constrain its widespread implementation (Aduwa-Ogiegbaen & Iyamu, 2005; Okebukola, 2015). Nonetheless, empirical studies suggest that when properly implemented, BTS can significantly improve student engagement and academic performance (Ogunleye & Babajide, 2011; Yusuf et al., 2020).

Gender dynamics further complicate the effectiveness of BTS implementation. Socio-cultural norms and economic constraints often limit female students' access to digital tools and learning opportunities, thereby affecting their ability to benefit from blended learning environments (Ezeh, 2017; UNESCO, 2020). Addressing these inequalities is essential to ensure that technological innovations in education do not reinforce existing disparities but rather promote inclusivity.

The debate surrounding the adoption of Blended Teaching Strategies in Agricultural Science education presents both opportunities and challenges. Proponents argue that BTS enhances student engagement through interactive content, supports differentiated instruction, and provides access to diverse and up-to-date learning materials (Graham, 2013; Horn & Staker, 2015). In contrast, critics highlight the constraints posed by infrastructural deficiencies, digital inequality, and inadequate teacher preparedness, all of which can undermine the effectiveness of BTS (Aduwa-Ogiegbaen & Iyamu, 2005; Okebukola, 2015).

Empirical literature provides further support for these arguments. For instance, Adeyemi and Bolarinwa (2013) found that participatory and innovative teaching approaches significantly improve student academic achievement in Nigerian secondary schools. Similarly, Okeke et al. (2023) emphasised the role of transformational leadership in enhancing teacher effectiveness, which is critical for the

successful integration of blended learning strategies.

Despite these insights, some studies caution against the premature adoption of BTS without addressing systemic challenges. They argue that without adequate infrastructure, capacity building, and policy support, blended learning initiatives may fail to yield meaningful improvements, particularly in under-resourced educational settings (Aduwa-Ogiegbaen & Iyamu, 2005; Yusuf & Balogun, 2011).

Notwithstanding the growing body of research on blended learning, there remains a notable gap in literature regarding the influence of gender on the effectiveness of BTS in Agricultural Science within the Nigerian context. This gap highlights the need for focused empirical investigation to inform gender-responsive educational policies and practices (Ezeh, 2017; UNESCO, 2020).

Reliance on conventional teaching methods alone often results in passive learning, limited student engagement, and inadequate preparation for the demands of a digitalised world (Garrison & Kanuka, 2004; Ibrahim, 2019). In Agricultural Science, this limitation may hinder the development of practical competencies and reduce students' readiness for real-world agricultural challenges.

In light of these considerations, the integration of Blended Teaching Strategy into Agricultural Science education presents a viable pathway for enhancing student academic achievement in Nigerian secondary schools. However, achieving optimal outcomes requires deliberate efforts to address gender disparities, improve infrastructural capacity, and strengthen teacher competence. Such measures are essential for fostering an inclusive, effective, and future-oriented educational system.

Statement of the Problem

Despite sustained efforts by educational stakeholders to improve instructional effectiveness in Nigerian secondary schools, students' academic achievement in Agricultural Science remains persistently low, particularly in senior secondary schools across Southwest Nigeria. This situation raises concerns, given the strategic importance of Agricultural Science in driving national food security, employment, and economic development. A major contributing factor to this underperformance is the continued reliance on conventional teaching methods that are predominantly teacher-centred, theory-driven, and insufficiently aligned with the practical and skill-oriented nature of the subject. Such approaches often limit students' engagement, critical thinking, and application of knowledge in real-life agricultural contexts.

In response to these limitations, Blended Teaching Strategy (BTS) has emerged as an innovative instructional approach that integrates face-to-face teaching with digital learning tools. BTS has been widely acknowledged for its potential to enhance learner engagement, promote self-directed learning, and improve academic achievement. However, within the Nigerian secondary school system, particularly in Agricultural Science education, the application of BTS remains inconsistent, underdeveloped, and insufficiently evaluated. More critically, existing studies on blended learning in Nigeria have largely focused on general subjects or overall academic performance, with limited attention to subject-specific outcomes such as Agricultural Science.

Beyond this, an even more critical gap lies in the absence of gender-disaggregated analysis in most existing studies on BTS. In the Nigerian context, gender disparities in education persist due to socio-cultural norms, unequal access to technological resources, and differing levels of digital literacy. These disparities have the potential to influence how male and female students interact with

and benefit from blended learning environments. Yet, empirical studies that explicitly examine how gender moderates the effectiveness of BTS on students' academic achievement—particularly in Agricultural Science—are scarce or non-existent within Southwest Nigeria.

Consequently, there is a lack of context-specific, empirical evidence to determine whether BTS equally benefits both male and female students or whether it inadvertently reinforces existing educational inequalities. This represents a significant gap in knowledge, as the success of any instructional innovation depends not only on its overall effectiveness but also on its inclusiveness and equity across different learner groups.

It is against this backdrop that the present study is undertaken to investigate the influence of gender on the effectiveness of Blended Teaching Strategy in enhancing students' academic achievement in Agricultural Science in senior secondary schools in Southwest Nigeria. By addressing this gap, the study seeks to provide evidence-based insights that will inform instructional practices, educational policy, and the equitable integration of technology in teaching and learning.

Purpose of the Study

The main purpose of this study is to determine the influence of gender on the effectiveness of blended teaching strategy in enhancing Agricultural Science students' academic achievement in Senior Secondary Schools in Southwest, Nigeria.

Specifically, the study seeks to:

i. examine the influence of gender on the academic achievement of Agricultural Science students exposed to blended teaching strategies in senior secondary schools in Southwest Nigeria;
ii. determine the comparative effectiveness of blended teaching strategies over traditional teaching methods in enhancing Agricultural Science academic achievement across male and female students.

Hypotheses

The following hypotheses guided the study at 0.05 level of significance.

1. There is no significant influence of gender on the academic achievement of Agricultural Science students exposed to blended teaching strategies in senior secondary schools in Southwest Nigeria;
2. There is no significant comparative effectiveness of blended teaching strategies over traditional teaching methods in enhancing Agricultural Science academic achievement between male and female students and

Literature Review

Concept of Blended Teaching Strategy

Blended Teaching Strategy (BTS), often referred to as blended learning, represents a pedagogical approach that systematically integrates traditional face-to-face instruction with online and technology-mediated learning experiences. It is not merely the coexistence of physical and digital learning environments, but a deliberate and structured combination designed to optimise instructional effectiveness. According to Charles R. Graham, blended learning involves the thoughtful fusion of in-person and online modalities to enhance learning outcomes and instructional flexibility. Similarly, D. Randy Garrison and Heather Kanuka conceptualise it as a transformative approach capable of redefining the teaching–learning relationship through meaningful integration of technology and pedagogy. Empirical evidence further suggests that BTS enhances student engagement, promotes

active learning, and supports differentiated instruction across diverse learner populations (Means et al., 2013; Horn & Staker, 2015).

From a pedagogical perspective, BTS is grounded in constructivist learning theory, which emphasises learner-centred instruction, knowledge construction, and interactive engagement. The approach typically combines synchronous methods (such as live virtual classes and face-to-face interaction) with asynchronous tools (including recorded lectures, discussion forums, and digital resources), thereby creating a flexible and dynamic learning environment (Hrastinski, 2019; Garrison & Vaughan, 2008). This dual-mode structure allows learners to control the pace, time, and sequence of their learning while still benefiting from guided instruction. Studies have shown that such integration fosters deeper cognitive processing, critical thinking, and long-term knowledge retention, particularly in science-oriented disciplines where conceptual understanding must be complemented by practical application (Bonk & Graham, 2006; Means et al., 2013).

The global adoption of BTS has accelerated significantly due to advancements in information and communication technologies and the increasing demand for flexible learning systems. In both developed and developing educational systems, BTS has been associated with improved academic performance, enhanced learner autonomy, and increased access to educational resources (Graham, 2013; Horn & Staker, 2015). Within science education, including Agricultural Science, BTS enables the use of simulations, virtual laboratories, multimedia demonstrations, and real-time data analysis, thereby bridging the gap between theoretical knowledge and practical experience (Alabi & Okemakinde, 2020; Udo & Udofia, 2014). This makes it particularly relevant for subjects that require experiential learning and skill acquisition.

In the Nigerian educational context, the implementation of Blended Teaching Strategy is still at a developmental stage, largely constrained by infrastructural deficits, inadequate digital literacy, and limited institutional support. Research indicates that while some secondary schools have begun to adopt elements of blended learning, its application remains inconsistent and often lacks strategic coordination (Aduwa-Ogiegbaen & Iyamu, 2005; Okebukola, 2015). Nevertheless, emerging studies reveal that schools that effectively integrate BTS report notable improvements in student engagement, participation, and academic achievement (Alabi & Ajayi, 2021; Yusuf et al., 2020). These findings suggest that BTS holds significant promise for enhancing instructional delivery in Nigerian secondary education if systemic challenges are adequately addressed.

Despite its potential, the effectiveness of BTS is influenced by several moderating factors, including access to technology, teacher competence, and student characteristics. Among these, gender has emerged as a critical variable in determining how learners interact with blended environments. Socio-cultural norms, economic inequalities, and differential access to digital tools often shape the learning experiences of male and female students in Nigeria (Ezeh, 2017; UNESCO, 2020). Studies have shown that disparities in digital access and confidence can affect participation levels, engagement patterns, and ultimately academic outcomes in blended learning settings (Adegbija & Fasiku, 2022; Yusuf & Balogun, 2011). Consequently, understanding the gendered dimensions of BTS is essential for evaluating its inclusiveness and long-term sustainability.

In sum, Blended Teaching Strategy represents a significant shift from traditional instructional approaches towards a more flexible, interactive, and learner-centred model of education. While extensive literature supports its effectiveness globally, there remains a need for context-specific and gender-sensitive investigations, particularly within Agricultural Science education in Nigerian secondary schools. Such inquiry is necessary to ensure that the adoption of BTS not only improves academic achievement but also promotes equitable learning opportunities across all student groups.

Methodology

This study adopted a quasi-experimental research design using a pre-test, post-test control group structure within a 2x2 factorial matrix. The independent variable was the teaching strategy (Blended Teaching Strategy vs. Traditional Lecture Method), the moderating variable was gender (male and female), and the dependent variable was students' academic achievement in Agricultural Science, specifically focusing on animal nutrition and feed formulation.

The population consisted of 3,600 SSII students offering Agricultural Science across 18 Federal Unity Colleges in Southwest Nigeria. Through stratified random sampling, 11 co-educational Unity Schools were selected ensuring geographical spread across Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti States. From each school, 60 students were randomly sampled and grouped into experimental (BTS) and control (lecture method) groups, yielding a total sample size of 660 students.

The research instrument was the *Animal Nutrition achievement Test (ANAT)*, a 25-item test administered pre- and post-intervention. Validity was ensured through expert review and alignment with the national curriculum. Reliability was confirmed with a Cronbach's Alpha of 0.935 and test-retest correlation of 0.853.

Data were collected over eight weeks in three stages pre-treatment, treatment (with Zoom-based instruction for the experimental group), and post-treatment. Students independently completed post-tests via a computer-based system.

Data were analyzed using ANCOVA to assess the main and interaction effects of gender and teaching strategies on academic achievement, with hypotheses tested at a 0.05 significance level.

Results and Findings

This section presents the analysis of data collected from the 660 sampled SSII Agricultural Science students across 11 Federal Unity Colleges in Southwest Nigeria. Results are presented according to the research hypotheses. Descriptive statistics, followed by inferential statistics using Analysis of Covariance (ANCOVA), were employed in line with the study's methodological framework.

Table 1: Summary of Demographic Information of Participants (N = 660)

Variable	Category	Frequency	Percentage (%)
Gender	Male	332	50.3
	Female	328	49.7
Age Group	14–15	218	33.0
	16–17	326	49.4
	18+	116	17.6
Treatment Group	BTS	330	50.0
	Lecture	330	50.0
Location (State)	Lagos	110	16.7
	Ogun	102	15.5
	Oyo	98	14.8
	Osun	118	17.9
	Ondo	114	17.3
	Ekiti	118	17.9

Source: Field Report, 2025

Test of Hypotheses

Hypothesis One

There is no significant influence of gender on the academic achievement of Agricultural Science students exposed to blended teaching strategies in senior secondary schools in Southwest Nigeria.

Table 2 presents the adjusted mean scores of male and female students in the experimental group (BTS).

Table 2: Adjusted Post-Test Mean Scores by Gender (BTS Group)

Gender	N	Pre-test Mean	Post-test Mean	Adjusted Mean (Post-test)
Male	168	32.41	68.35	67.92
Female	162	31.89	69.12	68.54

Table 3 shows the ANCOVA results for gender differences in the BTS group.

Table 3: ANCOVA Summary of Gender Influence in BTS Group

Source	SS	Df	MS	F	p-value	Partial η²
Pre-test (cov)	412.53	1	412.53	5.84	.016*	.009
Gender	128.14	1	128.14	1.81	.179	.003
Error						
Total						

*Significant at $p < .05$

The results reveal no significant effect of gender on academic achievement among students exposed to BTS, $F(1, 326) = 1.81$, $p = .179$. Thus, Hypothesis One is **not rejected**. Both male and female students benefited equally from the blended teaching strategy.

Hypothesis Two

There is no significant comparative effectiveness of blended teaching strategies

over traditional teaching methods in enhancing Agricultural Science academic achievement between male and female students.

Descriptive statistics of post-test mean scores across treatment groups are shown in Table 4.

Table 4: Adjusted Post-Test Means by Teaching Strategy and Gender

Group	Gender	N	Pre-test Mean	Post-test Mean	Adjusted Mean
BTS (Experimental)	Male	168	32.41	68.35	67.92
	Female	162	31.89	69.12	68.54
Lecture (Control)	Male	164	32.08	54.76	54.21
	Female	166	31.77	55.48	55.02

Table 5 shows the ANCOVA results for the interaction of teaching strategy and gender.

Table 5: ANCOVA Summary of Teaching Strategy × Gender

Source	SS	Df	MS	F	p-value	Partial η²
Pre-test (covariate)	920.48	1	920.48	13.21	.000***	.020
Teaching Strategy	8205.16	1	8205.16	117.11	.000***	.152
Gender	134.72	1	134.72	1.92	.166	.003
Strategy × Gender	64.38	1	64.38	0.92	.339	.001
Error	45721.44	654	69.92			
Total	55120.18	659				

***Significant at $p < .001$

The results show a significant main effect of teaching strategy, $F(1, 654) = 117.11$, $p < .001$, indicating that students exposed to BTS outperformed those taught with the lecture method. However, there was no significant interaction between teaching strategy and gender, $F(1, 654) = 0.92$, $p = .339$, suggesting that the comparative effectiveness of BTS over traditional lecture methods did not differ significantly between male and female students. Thus, Hypothesis Two is not rejected.

Discussion of Findings

The present study sought to examine the influence of gender and teaching strategy on the academic achievement of Agricultural Science students in Southwest Nigerian secondary schools. The findings revealed no significant influence of gender on achievement in the blended teaching strategy (BTS) group, $F(1, 326) = 1.81$, $p = .179$, with adjusted post-test means showing males ($M = 67.92$) and females ($M = 68.54$) performing almost equally. This suggests that both genders benefitted comparably from BTS, reinforcing the pedagogical neutrality of the approach. Furthermore, the study found a significant main effect of teaching strategy, $F(1, 654) = 117.11$, $p < .001$, indicating that BTS ($M = 68.24$) was substantially more effective than the traditional lecture method ($M = 54.62$) in enhancing achievement. However, the interaction between gender and teaching strategy was not significant, $F(1, 654) = 0.92$, $p = .339$, confirming that BTS is equally effective across male and female learners.

These results align with the findings of Alabi and Ajayi (2021), who reported that BTS improved student engagement and academic performance in Nigerian secondary schools, regardless of gender. Similarly, Graham et al. (2020) highlighted that blended learning provides balanced opportunities for both male and female learners by combining digital autonomy with structured teacher guidance, thereby reducing gender-related disparities in achievement. The near-identical adjusted mean scores of male and female students in this study further reinforce the notion that BTS minimizes the gender gap in science-related subjects.

Contrarily, some studies suggest otherwise. For instance, Adegbija and Fasiku (2022) found that male students were more likely to benefit from technology-mediated learning due to higher levels of digital literacy and confidence, creating achievement gaps in blended learning environments. Likewise, Okonkwo and Eze (2020) argued that socio-cultural factors, including gender expectations and access to digital resources, often result in male students outperforming females in blended and e-learning contexts. These contrasting perspectives underscore that contextual factors—such as digital access, socio-cultural attitudes, and infrastructural disparities—can mediate the extent to which BTS benefits learners equitably.

Nevertheless, the statistical values in this study show clearly that gender had a negligible effect on student achievement within BTS (Partial $\eta^2 = .003$), while the teaching strategy itself accounted for a substantial proportion of variance in outcomes (Partial $\eta^2 = .152$). This indicates that BTS as an instructional model is a stronger determinant of learning outcomes than gender differences. Thus, the evidence suggests that the adoption of BTS holds significant potential for improving academic achievement in Agricultural Science across genders in Nigeria.

Conclusion

This study investigated the influence of gender and teaching strategy on the academic achievement of Agricultural Science students in senior secondary schools in Southwest Nigeria. The findings demonstrated that gender had no significant effect on students' academic performance within the blended

teaching strategy (BTS) environment, with adjusted post-test mean scores of males (67.92) and females (68.54) showing almost equal performance levels. However, teaching strategy had a significant main effect, with students exposed to BTS (M = 68.24) performing better than their counterparts taught with the lecture method (M = 54.62). The interaction between gender and teaching strategy was not significant, indicating that the effectiveness of BTS was consistent across male and female learners. These results emphasize that the mode of instruction exerts a stronger influence on student outcomes than gender differences. Consequently, the adoption of BTS emerges as a viable and equitable pedagogical tool for enhancing learning in Agricultural Science. If widely implemented, BTS could improve academic achievement, foster inclusiveness, and bridge performance gaps among diverse learners.

Recommendations

1. There is need to adopt BTS broadly across secondary schools to improve achievement in Agricultural Science and other science-related subjects.
2. There is need to provide teacher training on blended instructional design to ensure effective integration of technology with traditional teaching.
3. School Management needs to invest in digital infrastructure in schools to support equitable access for both male and female learners.
4. Curriculum planners need to incorporate BTS in curriculum policies to standardize its use and ensure long-term sustainability in instructional delivery.
5. There is need to monitor and evaluate BTS implementation through continuous assessment and research to ensure it maintains effectiveness across diverse contexts.

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Training Agricultural Educators for Emerging Challenges and Food Security in Nigeria

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Abstract

Training agricultural educators (AE) for emerging challenges and food security in Nigeria is one way to address global food security and economic hardship through agricultural education and training. Training is the process of learning, being taught a skill or knowledge through practice and instruction. The AEs include agricultural extension officers, vocational agriculture teachers, research and training specialists, NGO and development workers, and private sector agronomists and advisors. The AEs are trained in agricultural knowledge, teaching skills, extension education, leadership and communication, and curriculum development skills to enable them train farmers, youths, women and students, provide extension services to farmers in rural communities where they live and farm; and develop curriculum for teaching various aspects of agriculture like crops production, animals production, soil management, irrigation, fertilizer application et cetera) to students and farmers. The AEs disseminate technology and strengthen food systems to enhance food production, processing, distribution, storage/marketing and utilization. The training of AEs enables them to bridge the gap between scientific knowledge and practical farming to improve agricultural production and food systems in Nigeria especially in the face of daunting challenges militating against food security in Nigeria such as economic challenges, climate change, floods, desertification, insecurity and conflicts in different parts of the country especially in the north east, north west and north central zones of Nigeria. For AEs to perform their roles under these conditions, they will require continuous trainings to enhance their capacities to transfer knowledge about modern farming technologies, abilities to build resilience and manage crises to strengthen the food systems to achieve food security in Nigeria.

Keywords: Training, Agricultural Educator, Emerging Challenges, Food Security

Introduction

Food security is the state in which all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Program (WFP), 2024). There are 4 key dimensions for measuring food security, they are: **availability; access; utilization and stability**. Food security in terms of availability implies having enough food produced and supplied to consumers; access implies having resources (money, land *et cetera*) to obtain appropriate food; utilization implies proper use of food based on knowledge of nutrition and care, and adequate water and sanitation; while stability implies reliable access to food overtime, without risk of losing it to shocks (conflict, price spikes, natural disasters *et cetera*).

According to Food and Agricultural Organization (FAO) (2024), food security in Nigeria is a critical and escalating issue with projections indicating 33.1 million people will face acute food insecurity during the June – August 2025 rainy season as a result of a combination of economic challenges, climate related disasters and ongoing conflicts in northeast, northwest and north central zones of Nigeria.

Some of the key drivers of food insecurity include economic hardship and inflation, climate change and flooding; and conflicts and insecurity. Economic hardships caused by government policies like devaluation of the naira and removal of fuel subsidies add to the hardships of Nigerians in obtaining food. Also, inflation increases food prices by more than 40% in June 2024 alone; beans price increased by 282% and rice by 153% (WFP, 2024). Floods affected 9.2 million people in Nigeria, submerged 4.5 million hectares of land, and submerged 1.6 million hectares of farmland; leading to loss of 1.1 million tons of maize, sorghum and rice, enough to feed 13million people for one year (NiMet, 2024). Conflicts in Borno, Yobe and Adamawa states in northeast Nigeria, armed bandits, farmers-herders clashes in northwest and north central zones of Nigeria jointly disrupted production and distribution of food in Nigeria; displaced and hindered access to food for millions of Nigerians in recent years.

The most vulnerable populations of food insecurity are children and women (FAO, 2025); FAO reported 5.4 million children and 800, 000 pregnant and breast feeding women are at acute risk of malnutrition in Nigeria; while 1.8 million children are facing severe acute malnutrition that will require critical nutrition treatment. The levels of food insecurity in Nigeria have reached an emergency level as availability, access, utilization and stability of food is not guaranteed to a large number of the populace (World Food Safety, 2024). In response to this challenge, the Nigerian government launched some multi sector approaches and the Senate passed a bill to criminalize export of large quantities of unprocessed grains and suspension of food import taxes on wheat and maize to curb food insecurity (Vanguard News, 2024).

According to Nigerian Television Authority (NTA) News (2025) the Nigerian government planned to launch the establishment of National Food Production City in different geographical zones of Nigeria; the first city was launched in Oturkpo on 8/5/2025, with 31 hectares of land to produce cereals and root crops for food and export, and generate employment for small medium enterprises (SMEs) and other people in the host community. Leap (2025), reported some other multi sector approaches launched by the Nigerian government viz: National Multi-Sector Plan of Action for Food and Nutrition (2021 - 2025); Agricultural Sector Food Security and Nutrition Strategy (2016 – 2025); and

National Policy on Food and Nutrition (2016 – 2025); all these were established in bid to curb food insecurity but the actions were not enough because Nigeria's food security situation is dire, millions are facing hunger due to a complex interplay of economic, environmental and security factors. Urgent and coordinated action is needed to address the root causes and provide relief to those affected. One of such actions is training agricultural educators for emerging challenges and food security in Nigeria.

Training refers to the process of learning or being taught a skill or acquiring knowledge through practice and instruction. Training may have varying contexts or meanings viz:

a. In education or job setting, training helps individuals to gain proficiency skills needed for a specific task, job or profession.
b. In sports or fitness, training means doing exercises or activities to improve physical performance, while
c. In music, training means rehearsing to improve proficiency in vocal or instrument dexterity skills display.

Training an agricultural educator involves preparing someone to effectively teach and support others especially farmers, students or rural communities in farming or agricultural related subject. This type of training includes but not limited to:

I. Agricultural knowledge
II. Teaching skills
III. Extension education
IV. Leadership and communication
V. Curriculum development

Agricultural knowledge has to do with understanding crops, livestock, soil science, agribusiness, sustainable farming and technology use in agriculture; teaching skills involves learning how to communicate, present, or educate effectively, often using both classroom and field methods; training in extension education techniques pertains to agricultural educators working in agricultural extension, they are trained to work directly in communities, sharing research based practices; leadership and communication involves helping others to adopt innovations, solve problems and make informed decisions; while curriculum development deals with the design of lessons or workshops tailored towards different audiences – students, farmers, youths, women groups *et cetera;* but who is an agricultural educator and what are their roles?

Who is an agricultural educator?

Agricultural educators are professionals who teach, train and support individuals especially farmers, students and rural communities on agricultural topics and practices, they help people improve farming methods, understand new technologies and make informed decisions that enhance food production and sustainability. There are different types of agricultural educators, they are:

1. Agricultural Extension Officers – they work for government agencies, visit farms and rural areas to teach farmers about modern farming techniques, pests control, irrigation, crop planning *et cetera.*
2. Vocational Agriculture Teachers – they teach in Schools, Colleges and Universities. They educate students about crop science, animal husbandry, agribusiness and agricultural technologies.
3. Research and Training Specialists – they work in research institutions or Universities; they conduct experiments and develop new farming methods, then train others to apply these methods.
4. Non-governmental organizations (NGO) and Development Workers – they deliver agricultural training and food security programs in communities, they focus on

sustainable farming, climate adaptation, nutrition and livelihood supports; and

5. Private Sector Agronomists and Advisors – they work for agricultural companies (seed, fertilizer, equipment supplies *et cetera*), they provide guidance on product use or help farmers improve their farm yields and incomes.

Roles of Agricultural Educators in Nigeria

Agricultural educators in Nigeria play a vital role in strengthening the country's food systems and boosting productivity among farmers. Their roles span education, extension services, policy advocacy and innovation. Here are some of the key roles they perform:

A. Farmer Training and Capacity Building
Agricultural educators educate farmers on modern and climate smart agricultural practices. They demonstrate proper use of tools, fertilizers, improved seeds and irrigation techniques; all these promote sustainable land management and soil conservation.

B. Extension Services and Community Outreach
Agricultural educators serve as a link between research institutions and rural farmers. They translate scientific research into practical, easy to understand guidance for adoption and use by rural farmers. They also provide field demonstrations and advisory services in local languages.

C. Youths and Women Empowerment
Agricultural educators introduce agriculture as a viable career to students and unemployed youths. They train women in home gardening, agribusiness and nutrition to support household food security; they encourage equal participation of youths and women in agricultural programs.

D. Curriculum Development and Teaching
Agricultural educators design and teach agricultural science in Schools, Colleges, Polytechnics and Universities; they develop curriculum materials aligned with modern challenges such as climate change and food insecurity. They also, teach skills to students; mentor them and promote Agri-Tech and entrepreneurship interest in the students.

E. Policy and Advocacy Work
Agricultural educators advice government on agricultural policies and rural development strategies, they advocate for farmer friendly regulations, access to inputs, credit and land for farming; thus, support national food security and nutrition programs.

F. Data Collection and Impact Assessment
Agricultural educators monitor farming activities and evaluate the effectiveness of training programs offered to farmers; they collect field data on yields, inputs use and environmental impacts; and they use the feedback reports to improve agricultural strategies and training modules for the farmers.

G. Technology Dissemination
Agricultural educators introduce digital tools like mobile Apps, weather alerts and market information platforms to farmers; they train the farmers on how to use these tools to improve the planning of their farming activities in order to reduce losses, promote precision agriculture and agribusiness technologies.

H. Strengthening Food Systems
Agricultural educators guide the development of resilient food systems by promoting agro-ecological practices by encouraging local processing of farm produce to improve post-harvest management that ensures food does not go to waste, but contributes to local economies; and reaches the vulnerable populations that needed it most.

I. Fostering Partnerships and Collaboration
Agricultural educators facilitate partnerships between farmers, government agencies, NGOs and private sectors. They coordinate responses to food insecurity; provide training in crop diversification and food preservation.

By their roles, agricultural educators bridge the gap between scientific knowledge and practical farming, making them vital in improving agriculture and food security systems in Nigeria and the world at large; that is why training agricultural educators for emerging challenges for food security in Nigeria is apt and very appropriate, but what are the emerging challenges to food security in Nigeria?

Emerging Challenges to Food Security in Nigeria

Emerging challenges to food security in Nigeria are multifaceted. They are the various contemporary issues that are manifesting in different parts of the country and are directly or indirectly threatening the production, storage, distribution and stability of food in Nigeria. Some of the challenges include: economic challenges, climate change, desertification, floods, increasing population, farmers-herders clashes, banditry, kidnapping, terrorism, insurgency, internally displaced persons, and land tenure, land grabbing, and scramble for Africa's wealth. All these challenges individually and jointly affect performances of agricultural educators' roles to their clienteles reducing farming, schooling and agribusiness activities; thus food production, availability and security. Each of them is discussed briefly as follows:

1. Economic challenges

Economic challenges are multi faceted such as inflation, low living wages, subsidy removal, naira devalue, poverty, slow economic growth, and unemployment. Government policies like devaluation of the naira has made inflation to affect all Nigerians, resulting into high costs of living with reduced and low value wages; rendering and forcing many citizens into poverty; more than 54% of Nigerians will be living in poverty in 2025; the rural population is particularly vulnerable with 75.5% living below the poverty line (World Bank, 2024). Low incomes results into low savings, consequently, low investment and slow economic growth; Nigeria's economic growth rate is 3.5 % (NBS, 2024); this figure is very low compared to Nigeria's population growth and figures. These economic challenges reduce food security.

2. Climate change

This is caused by the depletion of the ozone layer by gases in form of carbon emissions from combustion engines, flaring of fuels and other activities of man including petroleum exploration, heating up the ozone layers. The resultant effects include very high ambient temperatures, low relative humidity, sudden and unpredictable changes in rainfall patterns. All these affect farming planning, crop growth and yields, farmers' income and food security. Climate change causes weather vagaries and can only be managed by mitigating measures such as smart farming and precision agriculture. These require using relevant applications which majority of the farmers in rural areas do not have or are not conversant with such mobile applications

to detect weather and use the generated information to plan farm activities, thus; reducing food security.

3. Desertification

The continuous removal of land covers due to man's activities (like building roads, schools and other social infrastructures), farming and deforestation; by man's actions of depleting the forest and land covers, all types of lands were predisposed to damage as the desert is encroaching and damaging vast agricultural lands which were initially used for farming. This reduces farm size holdings, making the farmers to incur more expenses on soil conservation; resulting into more costs, less food production and consequently more food insecurity. This can be reduced by educating farmers on good soil conservation practices, planting trees (forestation) and using farming systems that can reclaim lands from deserts like cover cropping and contour farming.

4. Floods

This is when rain water especially come in torrential amounts and overflows its normal collecting body. It is a natural disaster that can happen at any time due to climate change, blocking of water flow ways and channels; River overflow and man's pursuit to reclaim land for building from water ways or bodies. Floods can destroy lives, lands especially cultivated farms leading to food loss or damage of valuable properties. Nigeria meteorological (NiMet) agency forecasts and provides information on times and states that may experience flooding; so as to curb, reduce its impact and prepare for it. Flood was one major cause of food loss and insecurity in Nigeria in 2024 because it affected 9.2 million people, submerged 4.5 million hectares of land, including 1.6 million hectares of farmland; leading to food loss of 1.1 million tons of maize, sorghum and rice (NiMet, 2024).

5. Increasing population

The current annual population growth rate of Nigeria is approximately 2.38% (Worldometers.info, 2025). This growth rate is relatively high compared with many other countries like South Africa 1.3%, Egypt 1.7%, and Ghana 1.9% (Globalstatcompare.com, 2025). The population is expected to continue growing, reaching an estimated 234.5 million in year 2025. What are the implications of this population growth rate and figure on demand for land, for farming, housing, other social infrastructures, and food security? Meanwhile, Nigeria's government development planning culture hitherto has left much to be desired. The more the population, the more the food required for food security but our farmers are getting older each day, farming at subsistence levels in rural communities with no ready and willing youngsters to take over from them; as most youths prefer to live in urban areas. When will Nigeria be food secured by this trend and trajectory?

6. Farmers-herders conflicts

The challenge of farmers – herders' conflicts are as a result of herders migration caused by desertification, climate change, increased human population, blocking and cultivation of cattle routes, industrialization, and fragmentation of cultivable lands (Egunsola, *et. al*. 2024) is another emerging trend and threat to food security in Nigeria. The impact of conflicts between farmers and herders on crop production, animal production (pastoralism), fishing and marketing has disrupted and distorted economic activities in the affected communities leading to displacement of households, destruction of properties, burning of stored foods and storage facilities, kept many people from their sources of livelihoods and left hundreds death; consequently causing food crises and insecurity. Agricultural educators have to

teach farmers strategies for peaceful co-existence, strategies for coping in the event of outbreak of conflicts, and measure to mitigate the occurrence of any types of conflicts in their communities.

7. Terrorism

Nigeria is enticing terror and brewing venue of terrorists and religious extremists as demonstrated by the increasing number and activities of terrorists groups in the country. Boko Haram started in 2000, Ansaru in 2005, Islamic West Africa Province (ISWAP) in 2016, Darul Islam, IPOB, Niger Delta Militants, Multi Fulani Militant Groups, and of recent *Lakurawa* from Mali and Niger Republics between 2023/2024; some of these groups are very high profile terror groups, all these numbers surfaced within the space of twenty years in northern Nigeria alone, impacting farming businesses negatively. How can farming activities prosper with insecurity, reckless crimes and anarchy? If farming cannot be done, food cannot be produced, distributed nor made available and accessed for use by the populace at stable prices.

8. Banditry

Bandit groups are non-ideaologically driven criminal organizations engage in various acts including kidnapping for ransom, cattle rustling, extortion and armed robbery. It has become a serious security concern particularly in northwest zone of Nigeria where it has escalated significantly in recent years (Anthony & Ekoja, 2025). According to Kingsley and Lawan (2024), bandits, operate in rural areas and remote forest or enclaves where government presence is limited. Bandits, often organized into groups ranging from 10 to over 1, 000 fighters have been terrorizing communities, targeting civilians, and causing widespread displacement and causing disarray in economic activities. Bandits use quick-strike attacks on motorbikes against communities. Banditry has led to displacement of millions of people; they are responsible for deaths of individuals and the destruction of properties. Banditry has severely impact agriculture productions, created fear and insecurity in the social fabrics of rural lives. Banditry has exacerbated the vulnerability of rural populations already struggling with poverty, unemployment and food security (globalinitiative.net, 2023). Therefore, bandits prevents farming activities, impoverishes rural dwellers majority of who are farmers and kill farmers, thus; they reduce food production and distribution drastically causing more hardship and food insecurity.

9. Kidnapping

According to The AP News (2025), kidnapping is a criminal act whereby one or more persons or group is abducted and held captive until ransom (money) is paid to the kidnappers for their release; it is prevalent in situations of weak law enforcement, political instability or high poverty. Kidnapping is characterized by abduction; demand for payment, threats or coercion and the motivation is money (ransom). The first kidnapping by armed group for ransom in Nigeria started in 2014 when Boko Haram abducted 276 school girls in Chibok, Borno state; Nigeria. Since then, many schools students, villagers, men and women have been kidnapped for ransom in different parts of Nigeria especially in northwest zone of Nigeria. In 2024 alone, on 7th March, in Kuriga village of Kaduna state, 287 primary school pupils were kidnapped for ransom by armed bandits; on March 9th in Gidan Bakuso, Sokoto state, 15 students sleeping in their dormitory in a boarding secondary school were abducted; on 12th March in Kajuru village, Kaduna state 761 people were abducted by gunmen in army uniforms; and in May 2024 at Kakin Dawa, Zamfara state, over 50 women and children were abducted in a night raid on the village (AP News, 2025). Kidnapping inflicts untold pains due to death or and captivities of loved ones,

losses of valuable properties and extortion which distract rural populace from farming; consequently, unable to produce food even for subsistence not to talk of for sale or food security.

10. Insurgency

Insurgency is another emerging trend militating against food security in Nigeria; it has been defined as a violent rebellion or uprising against established government or authority, usually carried out by non-state actors or rebel groups (Jare & Bunu, 2021). It involves armed conflicts and aims to challenge, weaken or overthrow the existing political system of leadership.

According to Abubakar *et al* (2017), the key features of insurgency include: armed resistance, political/ideological goals (political change, independence, religious rule or regime change), support base from immediate communities and asymmetrical warfare (fight against a stronger, more organized state military using unconventional tactics such as Gorilla war). Typical examples in Nigeria include Boko Haram and ISWAP which conduct insurgencies to establish Islamic rule and reject secular government authority (Usman, 2019).

Abubakar (2024) reported several impacts of insurgency on food security from his study; these include: disruption of agricultural activities, displacement of indigenous community people, it hinders trade and access to markets; many farmers are forced to abandon their homes to relocate to reside in internally displaced persons (IDP) camps where farming is impossible! Therefore, insurgency had major detrimental effects on the productivity of farmers because for fear of being killed, they ran for their lives and their productivity has drastically dropped (Agri *et al*, 2019; Ojo *et al*, 2018).

11. **Internally Displaced Persons (IDPs)**

Internally displaced persons leave their homes, lands and communities due to conflicts or natural disasters like flood, land-slides, famine or wild fires disrupting their usual food production modes and methods (George & Adelaja, 2022). This type of displacement disrupts agricultural practices; reduce food production and increases food prices leading to malnutrition, causes acute food shortages and decreased access to safe food in both displaced areas and the host communities.

According to Dooshima *et al* (2023), displacement negatively impacts Food Consumption Scores (FCS) of host communities especially if caused by conflicts. Furthermore, some of the effects of displacement include: disruption of livelihood and reduced productivity of victims; influx of IDPs can strain resources by increasing competition for available food, increase food prices and demand for food in host communities. IDPs face stress of displacement, may experience malnutrition and food insecurity due to reduced access to food, limited/difficult income, because their usual food production methods was disrupted and reduced; and due to conflicts have forfeited their homes, farms and sources of overall food supply; all these add to food insecurity of the IDPs.

12. Land Tenure

In Nigeria, the land is faced with enormous pressure from a very fast growing population. Land for any purpose in Nigeria is acquired through: individual/community land system, communal land system, land tenure by leasehold, rent or purchase. By law, the land use act o 1978 vests land ownership in the state governments, which then lease it to individuals or businesses for various purposes including farming. This is known as centralized ownership, leasehold system is awarded for 99years by the Governor in

urban land areas and Chairman, Local Government Area for rural land areas. The customary land tenure system (inheritance) remains significant in how land is acquired and used for farming in rural areas (inheritance, community allocation for family farming, lease or purchase). In summary land can be acquired for farming in Nigeria by purchase, leasehold, use on rent, use without rent or inheritance but the implications are access to land, tenure security and the issue of women and land ownership.

Traditional practices limit and affect women's access to and control over land, this is crucial in determining women's access and abilities to increase their agricultural productivity and income. Rapid urbanization and resources depletion contribute to loss of agricultural land in Nigeria, thus, decreasing total arable land and land ownership among households. FAO (2025) through Nigeria Bureau of Statistics (NBS) reported that the average Nigerian household owns 0.5Ha (1.2acres) of agricultural land, Ebonyi and Benue with highest hectare (0.6 acres) and Lagos (0.3 acres) is lowest among all the 36 states. Ayorinde (2024) reported that 40.2% of Nigerians practice agriculture, 91% of agricultural households cultivates crops and 23% of crop producing households manage between 0.8 – 1.5 acres of land with male headed households (0.6 acre) and female headed household (0.5 acre). When these farm holdings are compared with those of some few African countries like Ethiopia – 1.4 hectares, Ghana – 2.56 hectares and Niger – 4.57 hectares; Nigeria's low household farm size highlights the constraints on production and yields, and shows the predominance of subsistence agriculture in Nigeria. The high cost of land in Nigeria limits agricultural productivity, one acre of land with formal rights ranges from N8 million in Lagos to N200, 000 in Borno state but varies according to states.

13. Land Grabbing

Land grabbing and occupation refers to land annexation or large scale acquisition of land by individuals, corporations or government, often without the free, prior, and informed consent of the affected communities or persons (chamanlawfirm.com; 2025). By this definition, it is the encroachment and unauthorized occupation or use of land belonging to another party, leading to disputes and potential displacement of rightful owners, land grabbing is the illegal give up of land or disposition and a violation of human rights; it is forceful entry and acquisition of property (land) by force, it involves exploitation of land for commercial purposes like agriculture, mining, real estate development et cetera at the expense of local populations who rely on the land for their livelihoods. Land grabbing and occupation often leads to genocidal killings as was been witnessed in Plateau and Benue states where farming communities are sacked totally by terrorists, bandits and Fulani militant groups; throwing the indigene farmers into abject poverty, led to closure of schools, hospitals, school dropouts, destruction of herds, farms, stored food and standing crop farms; affecting food production, distribution and security in the Nigeria.

It was reported by Akande (2025) that between 2015 and 2025, more than 154 communities have been attacked, sacked from their ancestral lands and occupied by their attackers in Plateau state alone, in Nigeria. Most times the attacks are deliberate, aimed at land grabbing and target planting and harvesting seasons to destroy farms, loot food barns and feed them to cattle (Channels News, One on One with Benue State Governor 22/4/2025). This is why Ondo state law makers sponsored a bill to address stiff penalties for land grabbers on

19/12/2024 (TVC News) – 10 years for illegal takeover of property, violent/fraudulent arrangement about land, threatening original owners.

Land grabbing and occupation is criminal, leading to killings of rural dwellers, farmers lost their animals, farms, stored foods and family members; all these impede them from their normal farming activities leading to gross reduction in their farm productivity, food production and distribution and consequently, leading to food insecurity.

14. Scramble for Africa's wealth

This last but not the least cause of food insecurity in Nigeria is based on the ideas that Africa was a place Europe could see products, get raw materials, and mineral wealth; a place where investors could make money and a place colonies could provide food and space for colonialists (http://oercommons.org; http://ww.wsj.com; and http://cepr accessed 20/5/2025).

This factor singularly contributes to the economic, social and political underdevelopment of colonized states by spurring ethnic tainted civil conflicts and discrimination; and by shaping the ethnic composition, size, shape and landlocked status of the newly independent state. This is why Africa may never have food security because all the colonialists do not want Africa to be truly free in any way including food production, distribution and security.

Training Agricultural Educators for Emerging Challenges to Combat Food Insecurity

Training agricultural educators (AEs) to address the emerging challenges can significantly reduce food insecurity in Nigeria by fostering a more informed and resilient agricultural sector; train them to:

i. Improve Knowledge Transfer

Agricultural educators play a key role in disseminating new farming techniques, innovation and best practices. By training agricultural educators, they can better equip farmers with up-to-date knowledge on topics such as:

a. Climate resilient crops and practices
   Agricultural educators can teach farmers about drought resistant crop varieties and more sustainable farming methods to adapt to climate change like flooding, heat waves *et cetera*.
b. Soil health and sustainable farming
   Agricultural educators can promote sustainable agricultural practices such as crop rotation, organic fertilizers use and soil conservation by teaching and demonstrating them to the farmers which can increase long term agricultural productivity.

ii. Promote Modern Farming Technologies

With emerging challenges like climate change and rapid population growth, traditional farming techniques may no longer suffice. Training agricultural educators on modern equipment and technologies like precision farming, irrigation systems, and mobile Apps for weather forecasts will enable them to pass on critical information about innovative methods that can increase productivity while conserving economic resources.

iii. Advocate and Influence Policy

Agricultural educators can influence local and national policies that support food security. They can help push for policies that reduce barriers to food production such as access to

land for farming, credit and even markets; while also advocating for sustainable farming practices that mitigate effects of conflicts and climate change.

iv. Empower Women and Youths
Agricultural educators can foster programs that empower women and youths in agriculture to provide women and youths with better access to resources, education and leadership roles which will directly contribute to reducing food insecurity in the country.

v. Manage Crises and Build Resilience
Training agricultural educators to respond to food crises such as floods, droughts or conflicts will help farmers cope with disasters. These educators can develop and teach effective disaster management and recovery strategies as well as provide emotional and community supports during crises.

vi. Engage Local Community
Agricultural educators can be instrumental in organizing local agricultural extension services where they can directly engage with farmers and offer personalized advice and training where farmers in rural communities reside providing practical-context-specific knowledge which are better able to tackle local challenges and improve food security.

vii. Strengthen Food Systems
Agricultural educators can guide the development of resilient food systems by promoting agro ecological practices like improving post-harvest management to reduce to the barest minimum harvested foods wastages or eliminate totally if possible all types of food wastages so that all harvested foods contribute to economies of the nation.

viii. Foster Partnerships and Collaboration
Agricultural educators can facilitate collaboration and partnerships between farmers, government agencies, NGOs and private sectors which can lead to coordinated responses to food insecurity. For example - they can help farmers to access long term support like training in crop diversification and food preservation or work with organizations to provide emergency food relief to victims facing food crises.

Conclusion

By equipping agricultural educators with the right training and necessary skills to address the evolving challenges in Nigeria's agriculture, we can build a more resilient farming community which can help to ensure a more sustainable future for food production in the country in addition to providing food security; food may even be exported from Nigeria.

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School Garden: A Catalyst to Food Security and National Development

BY

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Abstract

This review explores the potential of school gardens to promote food security, nutrition, and sustainable agriculture practices in Nigeria. By examining the concept of school gardens, their benefits, and challenges, this review highlights the importance of integrating school gardens into education systems to empower students with life skills, improve food security, and promote healthy lifestyles. The review also discusses the strategic elements necessary for successful school garden programs, including political commitment, local adaptation, and educational role, access to water and technical support, and community participation. By providing recommendations for policymakers, educators, and communities, this review aims to contribute to the development of sustainable school garden programs that can improve food security and promote sustainable agriculture practices in Nigeria.

Keywords School gardens, food security, sustainable agriculture, nutrition, education Nigeria.

Introduction

Production of adequate food enough to feed the rapid growing population is considers among the greatest global challenges of nowadays. Presently, nearly one billion people were hungry; they were in condition of chronic lack of food that leads to undernourishment, a weakened immune system, and hindered growth and development (Rachel, 2014). Population increases need to go alone way with increasing food production. If the level of food production is not corresponded with the level of food production, food Insecurity set in (Valentina & Lucy 2023).One of the fundamental needs of humans is food, thus access to an adequate amount of food is considered one of the fundamental human rights (Prosekov and Ivanova 2018). Food security as viewed by the Bruinsma (2017) denotes a state where a nation's food supply can meet all of the needs of its population. If the nation's level of food production is not tally with the corresponding level of population growth, food Insecurity is said to have prevails (Valentina & Lucy 2023). According to the United State Department of Agriculture (2022) food insecurity is said to be a situation where by a household level of economics and social condition limited him from getting an access to adequate food. However, Michael (2023) added that, the condition of food insecurity is trigger by factors likes Poverty/Unemployment, Population growth, Low productivity, Unstable price of food, climate change, Natural disaster, Urbanization, Conflict Polices among others. Food insecurity can result in to economic instability and also lead to other social and political conflict. Food insecurity is a global problem that is striking higher, as numerous nations and organizations, including educational institutions, have expressed concern about it. Agriculture is a critical sector and is serves as a tool for bridging the growing food demand

of the increasing population. Equipping younger generation with the knowledge, skills, and passion for agriculture especially in schools essential. In Nigeria agriculture is taught as subject in school with a lot of practical embedded in the designed curriculum, mandated to be carry- out in school garden and laboratories. It is aims at equipping students with basic agricultural skills and competencies needed to operate and manage a farm in larger community NERDC, (2012).This could help to increase the nation's food supply and subsequently boost the economy and overall food security. School provides an avenue for the next generation to be inculcated with the knowledge, skills, and passion for agriculture, hence it should be equip with functional school garden for practical and demonstration of new techniques for farming. Gardens are an integral part agricultural school programs and is offers a multitude of educational opportunities. They are wonderful instructional tools and engaging spaces in which to explore the entire curriculum. Whether they are container gardens or school farms, fruit trees or herb gardens, greenhouses or other on-site food production, school gardens serve as hands-on, interdisciplinary classrooms for students of all ages (Adedotun, 2023). To recapture the attention of next generation to focus in agriculture for food security, gardening in school agriculture has to be reemphasis. The promotion and encouragement of students in gardening activities will promote vegetable production and increasing the numbers of practical farmers (Bowker & Tearle, 2007). The objectives of the paper is to review;

i).The concept of garden and gardening in school agriculture

.ii). Challenges associated with gardening

iii). The strategic elements necessary for successful school garden programs,.

iv).The role of role school garden in promoting food security and other benefits

Concept of school garden

School garden are used interchangeably with the school farm. Both offers valuable learning experiences for students, promoting agricultural education, hands-on learning environmental awareness and agricultural literacy. But there are key differences in term of **size, scope and purpose.** School gardens are usually smaller than the school farms. It focus on gardening and plant based learning, while school farms encompasses a broader range of agricultural activities. While both promotes agricultural education, school farms may also aims to generate income to school.

The Food and Agriculture Organization (FAO) defines school gardens as cultivated areas around or near schools and tended at least partly by students (FAO, 2010). However, Blair (2015) expanded the scope of the definition to have include both greenhouses and container gardens located both on and off campus as long as the students utilize them for their school's educational activities. In another definition given by FAO (2014) Sees School gardens as cultivated areas around or near to primary and or secondary schools, which can be used mainly for learning purposes but could also generate some food and income for the school. School garden activities usually comprise horticultural crops but may include small-scale animal husbandry and fishery, beekeeping, fruit trees, ornamental plants and shading, as well as small-scale staple food production. The idea of incorporating the natural outdoors as an integral part of children's educational curriculum is not new. The philosophy behind the introduction of school garden is in line with the philosophies of experiential education, ecological literacy and environmental awareness, and agricultural literacy (Aarti, 2002). Early philosophers such as Comenius, Rousseau, Pestalozzi and Froebel were all advocated the

use of school garden as back as (15-17thcentury). They were on the opinion that, education should be universal, optimistic, practical, and innovative and should focus not only on school and family life but also on general social life. According them, school garden should be connected with every school, where children can have the opportunity for leisurely gazing upon trees, flowers and herbs, and are taught to appreciate them (Weed, 1909, cited in Aarti, 2002). On the school garden, children learns about crop rotation, mulching, water conservation, line planting, use of organic manures and pesticides, waste management/utilization and all these good agronomic practices. Gardening has the potential to create opportunities for learning in an environment where children are able to experience nature first hand and to use the shared experience for communication (Bowker & Tearle, 2007). The passing of knowledge and skills on smart and sustainable agriculture from students to their parents is another key aspect of school gardening: trained students replicate what has been learned from school at home, and parents' visits to the school demonstration plot site is an opportunity for exposure to families who never had the opportunity in their life to access such learning. Currently, school garden has been a tool for nature education (Nury et al., 2017). Urban students who have had little exposure to farming can gain a comprehensive understanding of the agricultural production process through school garden Xu, et al. (2025). School garden stimulates students' curiosity and enthusiasm of nature, develops a greater awareness of the environment, fosters students' science literacy, and helps their academic development in preparation for higher education in agriculture.

Major Aims of School Garden Programmes

A review of school garden programmes over the past thirty years as reported by FAO. (2014) shows that the functions of school gardens can be classified as "educational" and "economic/food security.

1. **Educational aims**

i the inculcation of rural mind set in student

ii Teaching students how to establish and maintain home gardens and encourage the

Production and consumption of micronutrient-rich fruits and green leafy vegetables

iii Providing active learning by linking gardens with other subjects, such as

Mathematics, biology, reading and writing

iv Contributing to increasing access to education by attracting children and their

Families to a school that addresses topics relevant to their lives

v Teaching environmental issues, including how to grow safe food without using

Pesticides

2. **Economic aims**

i. Providing students with a tool for survival at times of food shortages

ii. Making students Familiar with methods of sustainable production of food that are applicable to their homestead for household food security

iii. Promoting income-generation opportunities

iv Improving food availability and diversity

v, Reducing the incidence of malnourished children attending school

The outlined above is enough to have provide the basis for developing a frame work open which a nation could survive the dwindling food security. By implication, School gardens play a vital role in promoting food security, nutrition, and sustainable

agriculture practices. By integrating school gardens into education systems, we can empower students with life skills, improve food security, and promote healthy lifestyles. Young and school children are asset and ingredient for building of the strong and self reliant nation. If the school children were equip with necessary and relevant agricultural skill they grow up as agricultural oriented individuals whose can devote their thinking on improving agricultural practices which could result in food sufficient nations.

School garden and food security

The role of education in achieving global sustainability goals has been emphasized in numerous international frameworks, including the United Nations Sustainable Development Goals (SDGs). Specifically, SDG 2 Zero Hunger seeks to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture (Sorooshian, 2024 cited in Umar 2025). Educationally related initiatives especially those focuses on agricultural education, are central to achieving this goal by equipping future generations with the knowledge and skills necessary to ensure sustainable food production. Many countries all over the world has attempted to use School garden as tool for training students in food production related activities (Ohly,et al., 2016). Notable developed countries are; Australia (Jaenke et al., 2012), New Zealand (Utter et al., 2016), Canada (Triador et al., 2015), and the US (Williams et al., 2018). The adoption of SG in multiple developing countries, such as Oman (Ambusaidi, Burkina Faso, Bhutan, and Nepal (Acharya et al. were also been reported (Xu, et al. 2025). In addition, there were certain notable international School Garden projects such as the Gardens for Life, which involved 67 schools in the UK, Kenya, and India from January 2004 to December 2006 (Bowker & Tearle, cited in Xu, et al. 2025) as well as the Vegetables Go to School project, which was implemented in Bhutan, Nepal, and Burkina Faso from 2013 to 2017 (Schreinemachers et al. Cited Xu, et al. 2025). All these programme were proved effectives and yielded much positive result. Studies on school gardens revealed improved nutrition and food preference in children. School gardens are known to increase consumption of fruits and vegetables, bring health and nutrition behaviour change, and have a positive effect on adolescent health. In addition, school gardens have the potential to augment physical activity and dietary intake in children. In Canada, the unfavourable weather condition often makes school gardening is impossible to implement during the school year as reported by (Taniguchi et al., 2022). To overcome this challenge, schools have employed indoor gardening solution which involves the use of container gardens. Container planting allows children to engage in gardening activities within the confines of their classroom, and simultaneously minimizes encroachment on green space. Jean (2007) in his work *The Role of School Garden Program in Food Security and Poverty Reduction* posited that; the success of school garden programs in improving sustainability education and food security is obvious evident from the available literature. Case studies from around the world shows that, scaling up school garden programs can yield significant benefits for sustainability education and food security but success often depends on context-specific factors such as available resources, local agricultural practices, and community engagement (Anunciado, Del Rio, Tamondong, Umali, Monville-Oro, Gonsalves & Mendonce, cited in Umar ,2025). Additionally in countries like the United States, school garden programs have been successfully integrated into formal education systems, with many schools using gardens as a platform for teaching about sustainability, environmental science, and food security (Datta, 2016). Similarly, in sub-

Saharan Africa, school gardens have been used as a tools to address food insecurity and improve nutrition by promoting locally grown, nutrient-dense foods (Merchant, 2023). By strengthening the gardening practices in the curriculum, school gardens would tailor students to adopt the farming practices in their daily activities in respective communities. Moreover, by engaging with local food systems, school gardens create a platform for addressing pressing issues related to food access, nutrition, and climate change, which are integral to achieving food security both locally and globally.

State of gardening activities in schools at present

School gardening refers to the utilization of school grounds, through the collaborative design, establishment, and management (e.g., preparing beds, sowing, transplanting seedlings, watering, fertilizing with homemade compost, weeding, pest control, and harvesting) by teachers, students, volunteers, etc., to create some areas that can cultivate edible plants, cook, socialize, as well as offer recreational sites, and even act as sanctuaries for stress relief among students (Xu, et al. 2025).

Nowadays, Student connection to gardening is diminishing in recent time, evident from the underutilization and disappearance of many gardens in schools which Adedotun, (2023) attributed to increasing urbanization. Urbanization is encroaching upon ecological spaces, leading to a scarcity of natural environments, thus urban students have fewer opportunities to work with nature. In addition Xu, et al. (2025) posited that, the advent of the electronic age has, to some extent, contributing to the raising issue as many are becoming increasingly engrossed in electronic devices. Agricultural science classes are becoming increasingly theoretical, resulting in students having quite limited exposure to the real world. In rural areas where school premises still sprawl across several acres of land, pupils are not engaging in farming as part of their study. As a result, there are more concerns that children have become detached from the nature currently, a serious issue that need to be address (Adedotun, 2023). In the midst of dwindling food security in the country, student in schools has to be made reconnected with nature to rediscover the feet for learning agriculture.

Challenges of school garden

School gardens face several challenges that can hinder their success and the challenges were consistently been reported to have center around the following constraint.

1. **Financial Constraints** which includes funding and Resource Allocation
2. **Logistical Challenges; which include;** Space, Facilities Time and Scheduling
3. **Administrative and Community Challenges** which includes Administrative Approval and Community Engagement.
4. **Curriculum and Educational Challenges**

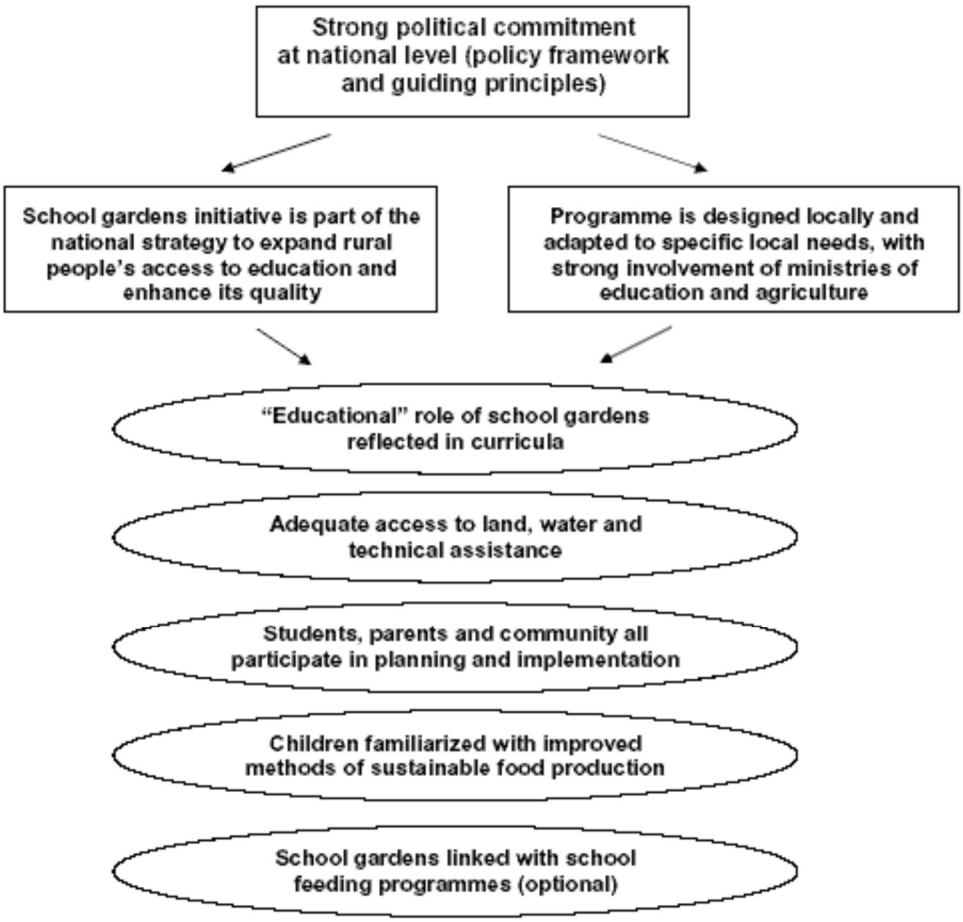
The challenges above were proved to be the most common barrier to school garden program in most school evident from reviewed literature. For example, Obstacles to school garden programs were reported by Peter (2010) in a work title; the status and barriers to the implementation and continuation of the school gardening projects in Germany, Nigeria and United State. The findings of the study shows that, the factors affecting gardening activities are related to lack of project co-ordination, lack of teacher and student motivation, lack of land in cities and absence of funds to purchase the required facilities for gardening.

Okoro, Peter & David (2008) attributed the Obstacles to school garden programs to bureaucratic procedures in the ministries and corresponding delays in funding from the government and non-governmental organizations.

Strategic Elements Necessary for a School Garden Programme

The figure below is provided by FAO (2014) contains the schematic summary of the main policy and strategic elements that need to be taken into consideration in the design and implementation of a school garden programme. These are based on the lessons learnt from past worldwide experience in school gardening.

Fugure1: Strategic Elements Necessary for a School Garden Program



Source: FAO

1. Political commitment and institutionalization: Secure government support and integrate school gardens into national education policies.

2. Local adaptation: Tailor programs to local customs, needs, and environmental conditions.

3. Educational role: Emphasize the educational benefits of school gardens, such as teaching life skills, nutrition, and sustainable agriculture practices.

4. Access to water and technical support: Ensure reliable water sources and provide technical assistance to schools.

5. Link with school feeding programs: Integrate school gardens with school feeding initiatives to enhance nutrition and learning.

6. Community participation: Engage pupils, parents, and the community in planning and implementing school garden programs.

7. Sustainable food production: Teach students modern, sustainable methods for food production, such as hydroponics and integrated pest management.

By incorporating these elements, school garden programs can improve education quality, promote sustainable agriculture practices, and enhance food security. Power students with life skills, improve food security, and promote healthy lifestyles.

Conclusion

School gardens play a vital role in promoting food security, nutrition, and sustainable agriculture practices. By integrating school gardens into education systems, we can empower students with life skills, improve food security, and promote healthy lifestyles. Despite the challenges associated with school gardens, the benefits they offer make them a worthwhile investment for a sustainable future.

Recommendations

Policymakers should institutionalize school gardens to ensure their sustainability, make a provision for sufficient allocation of fund/ resources to support its development and maintenance and tailor the programs to adapt school to local customs, needs, and environmental conditions.

Educators should develop a clear plan for establishing a step-by-step approach to creating and maintaining a school garden in line with curriculum goals. They should also engage students, parents, and the community in planning and implementing school garden programs and they also offer teachers the necessary training and support to effectively train students on gardening.

Communities should support school garden initiatives by Encouraging community participation through which they can receive education on sustainable agriculture practices and the importance of food security.

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PERCEPTIONS OF GUARDIANS REGARDING THEIR CHILDREN'S CHOICE OF AGRICULTURE CAREERS IN SENIOR SECONDARY SCHOOLS IN ETHIOPE EAST L.G.A, DELTA STATE

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ABSTRACT

This study examined guardians' perceptions of their children's choice of agriculture subject in senior secondary schools in Ethiope East local government area of Delta State in Nigeria. The study was hinged on the theory of planned Behaviour (TPB) by Ajzen propounded in 1991.The theory shows how individuals' involvement in a behavior is influenced by three factors, how good or bad a person sees a behaviour, the pressure to act the behaviour and lastly the person's beliefs in the ease or how hard it is to act the behaviour. This article adopted the survey research design. The items of the instrument were developed based on the research questions. The instrument was vetted by three experts in research methods and agricultural education to meet validity standards, and the reliability was determined by conducting a pilot study. The results were 0.817, and the instrument was considered reliable. A sample of 120 guardians was purposively selected to respond to the instrument. A total of 90(75%) copies of a 20-item questionnaire distributed were filled and used for the study. Data were analyzed with frequency counts, simple percentages, mean, Pearson Product moment correlation (PPMC) and standard deviation. The study revealed that guardians' influence determines whether their children choose to study agriculture and subsequently choose it as a career path. Guardians support agriculture in theory but will not advocate it as a career path to their children, as they prefer their children choosing other white-collar professions against agriculture. Guardians view agriculture as a layman's job and labour that is mainly for people in the villages as it is associated with stress. Also, 17 out of 20 factors listed shape how guardians view agriculture in Ethiope East local Government Area.

Keywords: *Guardians' perceptions, secondary school students, career choice, theory of planned Behaviour.*

Introduction

The place of agriculture in the Nigerian workforce cannot be overly emphasized, before the discovery of Crude oil in 1957, Nigeria had been a country that has survived on agriculture which has served as the mainstay of the economy for decades. After the discovery of crude oil, there was a shift from agriculture to the booming oil business, and this has some negative implications for the country, which have manifested in hunger due to the mass reduction in investment in agriculture.. This is already a severe issue coupled with the recent flood menace, with millions of Nigerians crying for help due to hunger infestation (Reuters, 2024).

Agriculture has contributed immensely to the economy of Nigeria. Agriculture contributed 21.07% to the Nigerian GDP in the first three quarters and 2.18% in 2021 and 2023 respectively (National Bureau of Statistics [NBS], 2024). The sector has also helped ensure the stability of a constant food supply, making sure food products do not go out of stock. This is evident as Nigeria produces the little that can sustain lives; despite the sector's attendant problems, it holds a firm stand in ensuring the stable supply of food from its inception. That is, from the beginning, it has made sure that food supply does not stop (NBS, 2024). According to the Food and Agricultural Organization (n.d). a dominating figure of 70 million Nigerians are employed or are constant participants in agriculture. The sector has succeeded in employing a very large number of the Nigerian population and this will in turn lead to decrease in idleness and help especially the youths to be useful to themselves and society at large. Participation in agriculture is a very lucrative way of generating income, which will in turn pull the majority of the population out poverty.

In Nigeria, Delta State in particular, agricultural education is very important as it does not only provide students with academic knowledge but also provides students with essential skills in agriculture which will help the students during schooling and after graduation to be able to navigate through the harsh economy of Nigeria and thrive in a complex globalized world and also to be self-employed. According to Korir et al. (2022) practical teaching in school is vital as it helps students to be able to solve real-life problems. However, the perception of guardians (parents) regarding the importance and advantages of agriculture may have a lingering effect on children's behavior and participation in the subject.

Guardians' perception of agriculture is a problem because a multitude of guardians lack agricultural awareness, this in turn will impede their children from learning about agriculture in Secondary Schools. The implication is that there would be a sharp reduction in the involvement of agricultural future leaders. The consequence of this process will directly affect food security and sustainability. This problem started when the focus was shifted from agriculture to crude oil business. Everyone wanted a taste of the crude oil money. People no longer wanted to be on farms, many people believe that farming is a stressful adventure. This falls in line with Diaz et al. (2024) when it was reported that farming is associated with fatigue and other stress parameters. Everyone wants his or her child to study oil related courses at the university to be employed after graduation, everyone wants to be in a well ironed suit with big positions at the various oil companies with big salaries at month end. The durability of crude oil in Nigeria may be uncertain so, there is need for economic diversification (Usman, 2022). Different efforts have been put in place, these efforts include; the aspect of Agricultural extension and Management Education which is aimed

at reducing the level of unemployed population in Delta state, and to make agriculture appealing to the youths (Tibi & Adaigho, 2014). According to Oxford Business Group (2024). efforts have been made for the arrangement of cash crops like oil palm production in hectares. In the same bid, Ofuoku and Ugbechie (2020) encouraged youths to have agricultural practical exposure which in turn will motivate their interest to choose and study agriculture related courses in higher schools. The federal Ministry of Humanitarian Affairs, Disaster Management and Social Development (n.d.) noted that various Empowerment programmes have been put in place to curb this problem, one of such programmes is the Government Empowerment Program (GEP), which is a lending agreement to help youth venture into agricultural businesses. Stressing further the need to solve this issue is the work of Ikeoji et al. (2007), where it was recommended that government and school heads are to put in place and maintain well working school farms which will help instill the practical skills in secondary school students. Developing the right attitudes in agriculture will produce a substantial amount of secondary school students who will be willing to choose agriculture in post-secondary schools (Obaruyi et al., 2024). Furthermore, Ikeoji (2017) laid great emphasis on the need for the government to establish special ,agricultural senior secondary schools where students are trained on the real-job. Here,tools and equipment used are similar to that of the real work and students made to learn in the environment that is a replicate of where they would be employed. This seamlessly falls in line with the postulated theorems 1 and 2 of Prosser and Allen (1925) where theorem 1 states that vocational education should be a replicate of the actual work environment and theorem 2 states that vocational education should be carried out with the right tools, the same tools and machines as learners would use in the real work place.

In spite of all these efforts being put in place, this problem of seeing agriculture as a layman's job still persists. This is evident as enrolments in agricultural higher education as well as faculties of agriculture continue to decline compared to their tertiary institutions' counterparts (Okebukola,2023). This seamlessly align with the findings of Ajayi et al. (2021)). Who specifically stated that a diminutive proportion of post-primary school students were consenting to study agriculture in higher institutions.

Understanding guardians' perceptions is important because guardians' perception may influence a student's academic dedication, educational choices and career aspirations. If a guardian is aware of the importance of agriculture or has an insight toward agriculture, it may influence their children's choice of agriculture. The converse is that if the guardians do not have insight into agriculture, it may hinder the children's choice in agriculture. In Delta State today, the Oil and Gas sector overshadows agriculture. Some guardians may consider farmers as people who are poor and dirty, that is if they are not agricultural innovators (Egbule,2004). This view of agriculture indicates that most guardians are not up to date about how commercial farming can make one wealthy. They often may be stuck in the idea where people involved in a traditional or subsistence system generate very low yields and thus, income, and they may believe that their children won't be farmers just like them. As argued by Egbule (2004. a guardian is an innovator in agriculture if that guardian is educated, if he/she reads agricultural journals, if he/she own farms, make money from farms, get information from research institutes, if such is the case this in turn may make such

guardians encourage their children to develop interest in agriculture and eager to choose it and learn it in senior secondary school and consequently choose them as careers.

Ethiope East is among the 25 local government areas in Delta State and it falls under Delta Central Senatorial district. The main occupation in the local government is agriculture, specifically in rubber and oil palm (Soluan, n.d.). The region is specifically known for its farming activities in tree crops and majority of their women involving in cassava production. Also,Ethiope East boasts of a high level of educated people, this is evident as a good number of higher institutions are situated in the area, notable of them is the Delta State University,Abraka. Also educational policies and programs have helped reduce illiteracy in the LGA (Federal Ministry of Education [FME],2018). In Ethiope East parents' perception had influences on their Children's Career Choices. According to Obiunu (2018) parents have some measure of influence on their children's academic work in secondary school. Aghogho et al. (2015) also stated that it is very important to involve career counseling for appropriate career development. This is so because most senior secondary school students do not have a self-felt course in mind to read in higher schools, they choose to read what their friends want to read in school. It was found out from a study that only a few of the population were willing to take agriculture as a career and the majority preferred to work in non-farming agricultural endeavors e.g. offices (Agamugu et al.,2018). According to Owigho et al. (2023) youth/students had negative perceptions about agriculture, leading to only 24.22% of the youth/students participating in agriculture. The findings of Olagunju and Dawodu (2023) clearly established that parents'/guardians' socio-economic status had an influence on how their children see agriculture and eventually participating or choosing it as a subject to study. Abdulhamid et al. (2022) also reported that a substantial relationship exists between the work of a parent/guardian and what the child would want to be. That is, children whose parents are engineers would want to be engineers as well, and children whose parents are big time farmers would want to be farmers too. It has been found out that guardians' impact, peers, classmates, age mates, family background had a great influence on both genders in their willingness to choose agriculture in both higher Schools and as a Career (Uloh et al.,2022). Egbule (2020) found out that majority of secondary school students choose careers in medicine, while few choose agriculture.

When guardians have awareness about their children learning agriculture in school, it may serve as a positive indicator towards making children develop interest in agriculture. On the other hand, a lack of awareness of agriculture among guardians' may discourage their children from having interest in agriculture. It is of top priority that this issue be investigated into. Thus, this study aims to assess the influence of guardians' perceptions regarding their children's choice of agriculture career in secondary schools in Ethiope East local government Area of Delta State.

Theoretical framework

This study is anchored on the theory of Planned Behavior (TPB) propounded by Ajzen in 1991. The theory shows how individuals' involvement in a behavior is influenced by three factors: How good or bad a person sees a behavior, the pressure to act the behavior and the person's belief on the ease or how hard it is to carry out the behaviour. (Ajzen,1991).

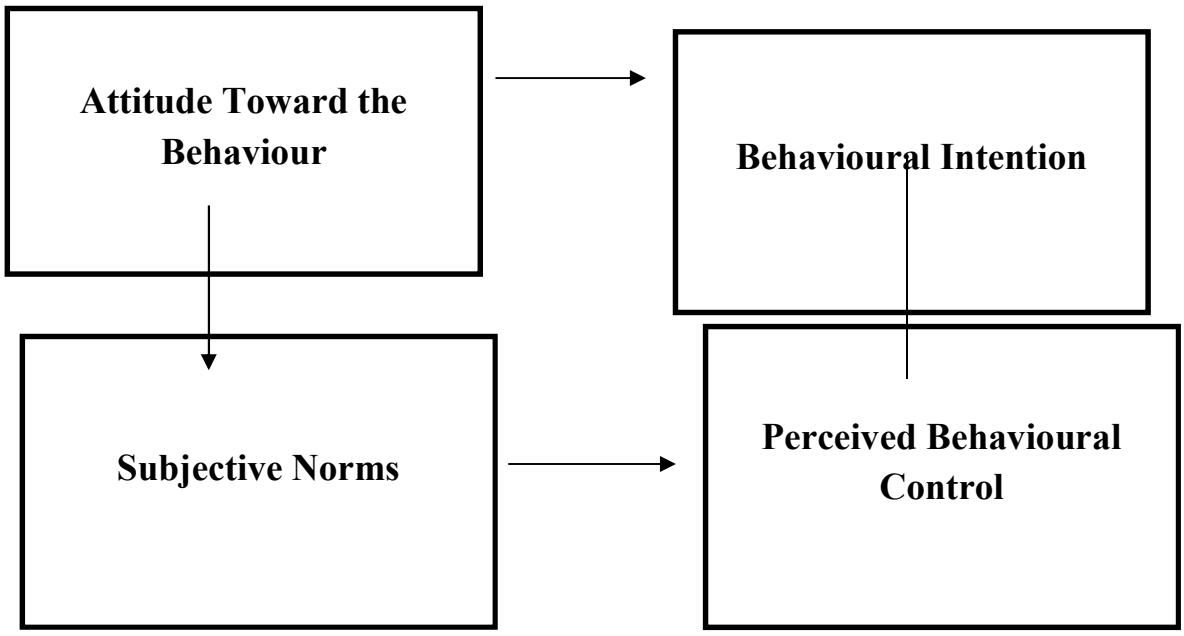

Figure 1: Model of Planned Behaviour Adapted from Ajzen (1991)

The diagram explains that guardians advocate for agriculture is not by accident, it is molded by how they view agriculture (attitude), what the society thinks (Subjective norms) and what they believe is practically possible (Perceived Control). This perception influences how the guardians direct their children choosing agriculture in Ethiope East, Delta State.

Purpose of the study

The main purpose of this study was to examine guardians' perception of their children's choice of agriculture subject in senior secondary schools in Ethiope East local government area, Delta state.

Specifically, this study sought to:

1. Describe the demographic characteristics of guardians in Ethiope East L.G.A., Delta State?
2. Examine the perceptions of guardians in relation to their children's learning about agriculture in secondary schools across Ethiope East L.G.A., Delta State.
3. Assess how guardians' perceptions affect students' engagement.
4. Identify the factors that shape guardians' views on agriculture.

Research Questions

In line with the research objectives, the study will seek to provide answers to the following questions:

1. What are the the demographic characteristics of guardians in Ethiope East L.G.A., Delta State?
2. What are the perceptions of guardians regarding their children's learning of

agriculture in secondary schools in Ethiope East L.G.A., Delta State?
3. How do guardians' perceptions affect students' engagement and participation in agriculture?
4. What are the factors that shape guardians' views on agriculture.

Methodology

The study adopted survey research design. According to Creswell (2014), the survey method involves collecting samples to represent the entire population. This study is designed to elicit data from samples on the guardians' view of their children learning about agriculture in senior secondary schools.

The total population of Ethiope East LGA is 275,400. The study comprises of all the guardians in Ethiope east Local Government protectively numbering about 56,769 for people between the age of 30 to 69 years (City population, n.d.).

A sample size of 120 guardians identified around secondary schools in Ethiope East local Government were purposively selected to respond to the instrument for the study.

Abraka I, Agbon VI and Abraka III, these 3 wards were subdivided into 9 towns, it is from these 9 towns that the 120 respondents were selected.

The study made use of the questionnaire. The questionnaire was used as a major source of data collection. A questionnaire is a form for getting information from a respondent, it is a self-reporting form (Brace & Bolton, 2022). The instrument was critically vetted by 3 experts in research methods and agricultural education to meet validity and reliability standards. To determine the reliability of the research instrument the test-re-test reliability test was used. It entails the researcher conducting a pilot study. The research instrument was administered to a sample of 20 respondents at Adesuwa Grammar School, Benin City, Edo State and re-administered later to see if they have same results. The results from the first and second administration were analysed using Pearson product moment correlation (PPMC) to see if the results correlated with one another. After the analysis, the derived correlation coefficient was 0.817. Hence, the research instrument is regarded as reliable.

The questionnaire was divided into four sections. The first section contained the demographic characteristics of the respondents. The second section is structured to elicit the view of guardians about agriculture. The third section was structured to obtain information on guardians' influence on student participation in agriculture and the last part was structured to obtain information on factors that shape guardians' views on agriculture and how the perceptions influence students' career choices in agriculture. The first part provided options for respondents to select, while the second and third parts were constructed with a rating scale.

The procedure used in the study was the direct method of distribution of questionnaires. The questionnaire was administered to guardians who have children in senior secondary schools in Ethiope east L.G.A. The procedure entails a brief explanation on the questionnaire before respondent fills in the form in case of unclear items.120 questionnaire copies were administered and 90(75%) copies well filled and used for the study.

The research questions were analyzed using frequency distribution tables, simple percentage, mean and standard deviation

statistical tools. The cut-off point used for this study is 2.50.

The following are the results as presented in Tables 1-4.

Results

Table 1
Demographic / Professional Characteristics of Guardians in Ethiope East L.G.A. (n=90)

Characteristics		Frequency	Percentage	Average
Gender	Male	30	33.33	
	Female	60	66.67	
Age	36-46	23	25.56	
	46-56	37	41.11	22.13
	56 and	30	33.33	
Educational level	No formal education	6	6.67	
	Primary education	1	1.11	
	Secondary education	27	30	
	Tertiary education	56	62..22	
Occupation	Farmer	27	30	
	Civil servant	10	11.11	
	Trader	17	18.89	
	Private writer	31	34.44	
	Unemployed	5	5.56	
	Others			

Table 1 shows that the highest respondents were the females 60 (66.67%), while 30 (33.33%) represented the males. By age, the majority of the guardians fall into the age range of 46–56 (41.11%), followed by 36–46 (25.56%) and above 56 were (33.33%); the average range of the respondents was 22.13years. By educational level, the majority of the guardians had tertiary education with 62.22%, 30% of the guardians had secondary education, about 6% had no formal education while only 1% had primary education. By occupation, 34.44% of the guardians were private sector workers,30% of them were farmers, about 11.11% were civil servants,18.87% were traders while only 5.56% were unemployed.

Table 2
Guardian's View About Agriculture in Ethiope East L.G.A (n=90)

S/N	Items	Mean	SD	Remarks
1	I am certain that agriculture is a beneficial career choice for my child.	2.48	0.02	Disagreed
2	The Nigerian economy cannot fully function without agriculture.	3.61	1.11	Strongly agreed
3	I would support and encourage my child if they decide to undertake agriculture in school.	3.17	0.67	Agreed
4	I would support and encourage my child if they decide to undertake agriculture in school.	2.41	0.09	Disagreed
5	Agriculture can serve as a stable source of income.	3.44	0.94	Strongly agreed
6	People who study agriculture are most likely to succeed in life.	3.0	0.5	Agreed
7	Agriculture should be taught more in secondary schools.	3.14	0.64	Agreed
8	I consider farming to be a respectable profession.	3.41	0.91	Strongly agreed
9	I am well informed about current trends in agriculture.	2.78	0.28	Agreed
10	I have participated in an agricultural training or extension program before.	2.41	0.09	Disagreed
11	I believe agriculture is no longer appealing to youths compared to modern professions.	2.94	0.44	Agreed
12	Agriculture involves a lot of stress and hardship.	3.28	1.33	Strongly agreed
13	Farming is only for people in the villages and the poor.	2.83	0.33	Agreed
14	Guardians play a big role in shaping their children's career choices.	3.46	0.96	Strongly agreed
15	I read agricultural journals and newspapers.	2.29	0.21	disagreed

16	Modern agriculture can be technologically advanced and innovative.	3.23	0.73	Agreed
17	I believe agriculture is only suitable for people without better career options.	2.9	0.4	Agreed
18	I would prefer my child to study medicine, law, or engineering instead of agriculture.	3.09	0.59	Agreed
19	I see agriculture as a career with low social status.	2.29	0.42	Agreed
20	I would feel bad if my child turns out to be a farmer.	2.29	0.42	Agreed

Table 2 shows that out of the 20 items, 16 items had the mean values of between 2.78 and 3.61 which were above the cutoff point of 2.50 and the standard deviation ranged from 0.28 to 1.33, suggesting that respondents agreed on the items. However, 4 items had mean values of 2.29 to 2.48 and the standard deviation ranged from 0.02 to 0.21, which were below the cut-off points. From the 20 items, respondents agreed on items 3, 11-13 and 17-20 and disagreed on items 2,5-8 and item 14 indicating that guardians view agriculture as a layman's job, while the respondents agreed on item 9 and disagreed on items 10 and 15 indicating that guardians have personal experience with farming practices.

Table 3
Guardians Influence on Student Participation in Agriculture in Ethiope West L.G.A. (n=90)

S/N	Items	Mean	SD	Remarks
1	My thoughts about agriculture influence my child's interest in the subject.	3.31	0.81	Strongly agreed
2	I tell my child about how important agriculture is.	2.79	0.29	Agreed
3	My child has shown interest in Agriculture because of my participation in farming.	2.46	0.14	Agreed
4	I believe exposure to practical farming activities encourages students to develop interest in agriculture.	3.18	0.68	Agreed
5	I always tell my child to take part in school farming or agricultural activities.	2.54	0.04	Agreed
6	I have taken my child to a farm or agricultural event.	2.43	0.08	Disagreed
7	I discourage my child from studying agriculture due to how dirty farming and farmers are.	2.16	0.34	Disagreed
8	I am certain that learning agriculture in school can lead to self-employment.	3.16	0.66	Agreed
9	I assist my child with agricultural projects or assignments from school.	2.49	0.01	Disagreed
10	I see agriculture as a subject that should not be taken seriously in school.	2.01	0.49	Disagreed
11	My child sees agriculture as a boring and unimportant subject.	2.69	0.19	Agreed
12	I provide learning materials or tools needed for my child's agricultural studies.	2.46	0.04	Disagreed
13	I believe parents should be involved in encouraging agriculture among students.	3.32	0.82	Agreed

14	I feel satisfied when my child does well in agricultural studies.	2.97	0.47	Agreed
15	My child's interest in agriculture has increased due to family support.	2.74	0.24	Agreed
16	I think agricultural knowledge is vital for all children, regardless of career choice.	3.18	0.68	Agreed
17	Guardians' support can increase students' motivation in agriculture.	3.29	0.79	Strongly agreed
18	My child wants to study agriculture in a tertiary institution.	3.29	0.22	Disagreed
19	I see the potential for my child to become a farmer.	2.13	0.37	Disagreed
20	I would invest in my child's agricultural education by all means	2.39	0.11	Disagreed

Table 3 shows that out of the 20 items,12 items recorded mean value of between 2.54 and 3.32 which were above the cutoff point of 2.50 and the standard deviation ranged from 0.04 to 0.82 of all which respondents agreed on. From the table also,8 items recorded mean values of between 2.01 and 2.49 with the standard deviation that ranged from 0.01 to 0.49, all which respondents disagreed on. From the 20 items, respondents agreed on items 1-3, item 5, and items 13-17. This reveals that guardians' influence on agriculture arouses their children's interest towards participating in agriculture. Respondents also agreed on item 4 and 8 and disagreed on items 7-10 and items 12, 18 & 20. This indicates that guardians support agricultural education in theory, but do not advocate agriculture as a career path for their children. This is evident as items 18 and 20 indicated that their children do not want to study agriculture in a tertiary institution.

Table 4
Factors Shaping Guardians View on Agriculture (=90)

S/N	Items	Mean	SD	Remarks
1	Government policies and programs contribute to how often I talk about agriculture.	3.38	0.55	Strongly Agreed
2	The Opinions of community members determine how I rate agriculture.	2.7	0.2	Agreed
3	The risks and uncertainties in farming makes forming a dangerous idea	3.19	0.69	Agreed
4	Market demands of farm produce are difficult to establish.	2.69	0.19	Agreed
5	Climate in my community (Ethiope East LGA) does not favour agriculture.	1.68	0.82	disagreed
6	Regular flooding is a problem in the community.	3.27	0.77	Strongly Agreed
7	Available irrigation facilities shape my view about agriculture.	3.0	0.5	Strongly Agreed
8	Agriculture contributes to environmental conservation in my LGA.	3.5	1	Strongly Agreed
9	Agricultural insurance (if available) makes farming a great adventure.	3.53	1.03	Strongly Agreed
10	The level of security is worth considering in farming.	3.44	0.94	Strongly Agreed
11	Availability of storage facilities shapes how I view agriculture.	3.27	0.23	Strongly Agreed
12	Money from farming is mostly seasonal.	2.54	0.04	Agreed
13	Land conflicts are a common event in my locality.	3.42	0.92	Strongly Agreed
14	Farm labour is not easy to come across in my locality.	3.14	0.64	Agreed
15	Agriculture contributes to food security	3.52	1.02	Strongly Agreed

16	Food security is a major concern to me.	3.39	0.89	Strongly Agreed
17	Agriculture is only carried out by males in my locality.	1.84	0.66	Disagreed
18	My family background supports agriculture of any kind.	2.29	0.22	Disagreed
19	There is enough land available for farm practices.	2.06	0.56	Agreed
20	Market demands of farm produce are easy to establish.	3.78	1.28	Agreed

Table 4 reveals that 17 items recorded the mean values of between 2.54 and 3.78 with the standard deviation ranging from 0.04 to 1.28. This indicates that respondents agreed that factors listed influence their perceptions of agriculture. Respondents agreed on items like government policies, irrigation facilities, peer group, guardians' opinion, community opinions, risks and uncertainties, market demands, floods, climate, conservation, Agricultural insurance, security, storage facilities, seasonal income in agriculture, land conflicts, farm labour, family background, land availability and market demand are factors that shape how guardians view agriculture. The table also reveals that 3 items out of the 20 items recorded the mean value of between 1.68 and 2.28 with the standard deviation ranging from 0.22 to 0.82. This shows that respondents disagreed on item 8, 17 and 8 with the mean value of between 1.65 and 2.28 because they do not qualify as factors that shape how guardians perceive or view agriculture.

Discussion

Demographics: Demographics of the guardians in Ethiope East L.G.A reveals that majority of the guardians are females with (66.6%), followed by males with (33.3%) although, males slightly outnumber the females in Ethiope east L.G.A. (National population Census Commission [NPC], 2007).These findings did not come as a shock affirming the fact that during the early and mid-hours of the day the males are usually out to tend to their workshop and their transportation businesses.

Demographics also revealed that a high number of respondents (62.22%) had higher education. This is not surprising because the local government has a number of higher institutions, notable of which is the Delta State University, Abraka. Also, federal government education policies and support have led to the reduction in the level of illiteracy in the local government area (FME, 2018).

Demographics further revealed that guardians in Ethiope East L.G.A are mostly private workers (34.44%) followed by Farming (30%) which are predominantly women who are into cassava farming, this is in line with Soluan (n.d). This finding is not new as men around Ethiope East are mainly into transport and majority of the people are into the private sector as government jobs are difficult to come by these days.

Guardian's view about Agriculture in Ethiope East L.G.A: Guardians agreed to a high level that agriculture is important to the nation's economic growth and development. This aligns with the Food and Agricultural organizations (n.d.) that 70 million of Nigerians are employed in the agricultural

sector. Guardians know how important agriculture is but do not want agriculture as a career choice for their children. This has led to many parents supporting their children choosing careers in medicine rather than agriculture (Egbule, 2020). The findings revealed that Guardians view farming as a low status occupation. This is in line with the findings of Egbule (2004) that some guardians considered farmers as poor people especially if these guardians are not agricultural innovators. The findings also revealed that guardians view agriculture as a stressful adventure and would not want their children to be stressed. This is in line with the findings of Diaz et al (2024) who reported that farming is associated with fatigue and other stress parameters.

Guardians Influence on student participation in Agriculture: This study found that guardians have a considerable amount of influence on their children's interest regarding them learning and choosing agriculture as a career as they agreed to a high extent that their thoughts about agriculture influence their children's interest in the subject. The findings of Obiunu (2018) supports this finding when he stated that parents have some measure of influence on their children's academic work in senior secondary school. Also, the findings of Olagunju and Dawodu (2023) support this finding when it was stated that parents / guardians' socio-economic status influences how their children see agriculture and eventually participating or choosing it as a subject to study. To further solidify this finding, the findings of Abdulhamid et al. (2022) reveal that a substantial relationship exist between the work of a parent/guardian and what the child would desire to be.

This study further revealed that guardians support agricultural education in theory but do not advocate agriculture as a career choice for their children. This has now led to the diminutive proportion of post-primary school students consenting to study agriculture in higher institutions. According to Okebukola (2023) the toll is heavy on agricultural higher schools as enrolments continue to decline.

Factors Shaping Guardian's View on Agriculture: This study revealed that 17 out of 20 items are factors that shape how guardians view or rate agriculture.in Ethiope East LGA, land Conflicts especially between neighboring Communities is a big factor on how guardians view agriculture. Security issues such as fulani herdsmen rob-off the local farmers who are predominantly women leaving them in fear to venture into their farmlands for agricultural production. The flooding menace in Nigeria did not spare the local government as floods during heavy downpour of rain or during the recent Cameroon dam issues ravage the farm lands. This is in line with Reuters (2024) where it was found that millions of Nigerians cry each time flood destroys their agricultural properties.

Conclusion

Agriculture remains the cardinal anchor on which Nigeria's economy is built and a vital tool that propels national development and food security. This is evident as agriculture employs a very large number of Nigeria's population as well as provides food for consumption. Despite its profound and tremendous contributions, agriculture still suffers from an ongoing negative connotation of being perceived as a low status occupation in the shadow of the oil related fields and other white-collar professions. This study found out that guardians in Ethiope East L.G.A support agriculture in theory but do not want it as a career path for their children. It is then possible to change this stereotype perception but it requires all hands-on deck from the stakeholders of agriculture and policy makers in education. Agriculture must be given a high priority in the Nigerian educational system. Guardians must be

provided with accurate and modern knowledge of agriculture through targeted & tailored exposure campaigns and extension services. This study stated that the perceptions of guardians in Ethiope East L.G.A plays a crucial role in shaping their children's learning and choosing agriculture as a career. Conclusively, for Nigeria to really diversify its economy and ensure lifetime success, investment efforts must be made to secure positive attitudes of today's guardians and also secure the aspirations of tomorrow's youth. The future of agriculture depends on the views we create about agriculture today.

Recommendations

Based on the findings of this study, the following recommendations were made.

i. The government should implement agricultural awareness and sensitization campaigns through the use of extension workers/agents.
ii. Special agricultural senior secondary schools should be established by the government. These schools should focus on agriculture solely. Here, all equipment as needed in the real work environment are provided and teachers who are practically inclined are employed and not by politics. This will help students prioritize agriculture when they see the level of seriousness accrued to it by the government.
iii. Government should establish farms all over Ethiope East L.G.A to absorb graduates from agricultural schools so established.
iv. Secondary Schools in Ethiope East L.G.A should include guardians in career counselling programs: This will close the gap between students' career interests and parental anticipations.

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Perceived Effect of Farmer Training Programs in Combating Economic Hardship and Strengthening Food Systems for Sustainable Food Security in Northeast Nigeria

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Abstract
This study investigated the perceived effect of farmer training programs in combating economic hardship and strengthening food systems for sustainable food security in Northeast Nigeria. Specifically, the study examined how farmer training programs improve agricultural productivity, impact household income and poverty reduction, strengthen market access into agricultural value chains, and reduce post-harvest losses among smallholder farmers. A descriptive survey research design was adopted, with a population of 8,391 comprising 6,780 smallholder farmers and 1,611 agricultural extension workers across the six states of Northeast Nigeria. Using Taro Yamane's formula at a 5% margin of error, a sample size of 382 respondents (309 farmers and 73 extension workers) was selected through simple random sampling. Data were collected using a structured questionnaire measured on two scales: one ranging from "very high extent" to "very low extent" and the other from "strongly agree" to "strongly disagree." Mean and standard deviation were used to answer research questions, while hypotheses were tested using chi-square statistics at a 0.05 level of significance. Findings revealed that farmer training programs significantly improve agricultural productivity, enhance household income, strengthen farmers' market access, and reduce post-harvest losses, thereby contributing meaningfully to sustainable food security in the region. Based on these findings, the study recommends scaling up farmer training programs, improving access to credit and inputs, promoting market integration, and investing in post-harvest infrastructure. These measures are essential for building resilient food systems and alleviating economic hardship in Northeast Nigeria.
Keywords: *Farmer training programs, agricultural productivity, poverty reduction, market access, post-harvest losses, food security, Northeast Nigeria.*

Introduction

Agriculture plays a central role in Nigeria's economy, accounting for approximately 24% of the national GDP and providing livelihoods for over 70% of the population, particularly in rural areas of Northeast Nigeria (National Bureau of Statistics [NBS], 2020). The Northeastern Nigeria is predominantly agrarian, with smallholder farmers engaged in crop production, livestock rearing, and fisheries forming the backbone of local economies. Despite this significance, the agricultural sector in Northeast Nigeria faces persistent and multi-layered challenges, including widespread poverty, chronic food insecurity, recurrent climate-related shocks (such as droughts and floods), soil degradation, and environmental depletion (FAO, 2021; Ibrahim & Mohammed, 2019). These issues are compounded by the long-running Boko Haram insurgency, which has displaced millions of people, destroyed farmlands, disrupted local markets, and eroded community resilience (Adamu & Ngala, 2021).

Poverty levels in Northeast Nigeria are among the highest in the country, with many households depending on subsistence farming that barely meets their food needs, let alone generates surplus for sale or reinvestment (World Bank, 2020). Additionally, climate change has altered rainfall patterns and increased the frequency of extreme weather events, further

undermining agricultural productivity and food availability (Ishaku et al., 2019). As soils become less fertile due to overuse, erosion, and nutrient depletion, farmers are forced to cultivate marginal lands, intensifying environmental degradation and triggering a vicious cycle of poverty and food scarcity (Ojo & Bello, 2020).

In this challenging context, farmer training programs have emerged as critical and strategic interventions designed to equip smallholder farmers with the knowledge, skills, and practical resources they need to enhance agricultural productivity, adapt to changing climate conditions, and strengthen household and community food security. These programs cover a wide range of topics, from introducing improved crop varieties and livestock breeds to promoting soil conservation, water management, integrated pest control, and post-harvest handling (Adebayo & Okuneye, 2019). By improving farmers' technical capacities and decision-making abilities, training programs enable them to shift from low-yield, traditional methods to more efficient, climate-smart, and market-oriented agricultural practices.

Moreover, farmer training programs do not merely focus on technical farming techniques; they also include essential components such as financial literacy, market linkages, cooperative formation, gender inclusion, and access to modern technologies (Agbaje & Saka, 2018; Aliyu & Yusuf, 2020). This holistic approach is crucial because it empowers farmers not only to increase their yields but also to navigate value chains more effectively, reduce post-harvest losses, improve incomes, and build resilience against future shocks. In the long term, such training interventions contribute to strengthening local food systems by ensuring that food production is sustainable, inclusive, and capable of meeting the nutritional needs of the growing population.

Farmer training programs involve structured interventions that teach improved agricultural practices, resource management, market access strategies, and technological innovations (Adebayo & Okuneye, 2019). In Northeast Nigeria, where many farmers still use traditional, low-yield methods, such training programs introduce climate-smart agriculture, soil conservation techniques, post-harvest handling, and value addition skills (Ojo & Bello, 2020). These interventions not only enhance crop and livestock productivity but also reduce post-harvest losses and improve incomes, thereby addressing both food availability and economic hardship.

Importantly, farmer training programs serve as platforms for knowledge exchange and community empowerment. According to Adamu et al. (2022), when farmers receive training in group settings, they benefit from peer learning, cooperative marketing, and shared access to farm inputs, which enhance their resilience to external shocks like market price fluctuations or drought. Such collective capacity building strengthens local food systems by ensuring a more stable and reliable supply of food products.

Moreover, training initiatives aligned with modern technologies — such as mobile advisory services, precision farming tools, and early warning systems — enable farmers to make data-driven decisions, reduce risk, and increase efficiency (Agbaje & Saka, 2018). In Northeast Nigeria, where infrastructure gaps and insecurity often hinder market participation, training programs that incorporate market linkages, financial literacy, and entrepreneurship can help farmers transition from subsistence to commercial production, thereby stimulating rural economies and alleviating poverty (Usman & Haruna, 2021).

Beyond economic benefits, farmer training also has social and environmental dimensions. Women and youth, who are often marginalized in agricultural value chains, gain empowerment through targeted training interventions, improving household nutrition and livelihoods (Aliyu & Yusuf, 2020). Environmentally, promoting sustainable land and water management practices through training helps protect ecosystems, ensuring that agricultural intensification does not come at the expense of long-term resource degradation (Ishaku et al., 2019).

However, the success of these programs depends on several factors: government support, extension service quality, adequate funding, and local stakeholder involvement (Okeke & Eze, 2017). Without addressing policy and institutional barriers, even the best-designed training programs may fail to reach scale or

achieve lasting impact. Therefore, integrating farmer training into national agricultural policies, development plans, and donor-supported projects is crucial for creating an enabling environment that sustains food system resilience in Northeast Nigeria.

Farmer training programs are indispensable for combating economic hardship and reinforcing food systems in Northeast Nigeria. They offer a multi-dimensional approach that not only enhances agricultural productivity but also empowers communities, improves rural livelihoods, and builds resilience against climate and market shocks. For sustainable food security to be achieved in the region, scaling up and investing in inclusive, context-specific, and well-supported training interventions must remain a top priority. It is against this backdrop that this study investigated the effect of farmer training programs in combating economic hardship and strengthening food systems for sustainable food security in Northeast Nigeria

Statement of the Problem

Agriculture remains the backbone of livelihoods in Northeast Nigeria, where over 70% of the population relies on farming for income and food (National Bureau of Statistics [NBS], 2020). Despite its importance, the region is plagued by persistent challenges such as low agricultural productivity, poverty, food insecurity, climate variability, land degradation, poor market access, and, notably, the impacts of prolonged insurgency (FAO, 2021; Adamu & Ngala, 2021). These interconnected problems have weakened local food systems, reduced household incomes, increased unemployment, and left millions vulnerable to hunger and malnutrition. Smallholder farmers, who form the bulk of agricultural producers, often lack access to modern knowledge, improved technologies, and the necessary skills to adapt to changing environmental and economic conditions (Adebayo & Okuneye, 2019). Without adequate training, these farmers are trapped in cycles of low productivity, post-harvest losses, and poverty, further exacerbating regional food insecurity (Ojo & Bello, 2020).

Although farmer training programs have been introduced as part of national and regional agricultural development strategies, their reach, effectiveness, and sustainability remain uneven across Northeast Nigeria (Aliyu & Yusuf, 2020). Many training interventions face challenges such as limited funding, poor extension services, inadequate follow-up, lack of gender inclusivity, and weak integration into broader agricultural value chains. As a result, the potential of these programs to combat economic hardship, improve resilience, and strengthen food systems has not been fully realized. There is a pressing need to assess whether farmer training programs are effectively equipping smallholder farmers with the tools, techniques, and market access required to enhance productivity, raise incomes, and achieve sustainable food security in this conflict-affected and climate-vulnerable region. This study seeks to address this gap by investigating the effect of farmer training programs on combating economic hardship and strengthening food systems for sustainable food security in Northeast Nigeria.

Purpose of the Study

The purpose of the study was to determine the perceived effect of farmer training programs in combating economic hardship and strengthening food systems for sustainable food security in Northeast Nigeria. The study aims to:

1. Examine the extent to which farmer training programs improve agricultural productivity among smallholder farmers in Northeast Nigeria.
2. Assess the impact of farmer training programs on household income levels/poverty reduction in in Northeast Nigeria.
3. Determine the extent to which farmer training programs strengthen market access into agricultural value chains.
4. Determine the contribution of farmer training programs in reducing post-harvest losses among smallholder farmers in Northeast Nigeria.

Research Questions

The following research question guided the study:

1. To what extent do farmer training programs improve agricultural productivity among smallholder farmers in Northeast Nigeria?
2. To what extent do farmer training programs impact household income

levels/poverty reduction in in Northeast Nigeria.
3. To what extent do farmer training programs strengthen market access into agricultural value chains?
4. What is the contribution of farmer training programs in reducing post-harvest losses among smallholder farmers in Northeast Nigeria.

Hypotheses

The following hull hypotheses were tested at 0.05 level of significance:

1. Farmer training programs have no significant effect on agricultural productivity among smallholder farmers in Northeast Nigeria.
2. Farmer training programs have no significant impact on household income levels and poverty reduction in Northeast Nigeria.
3. Farmer training programs do not significantly strengthen market access and integration into agricultural value chains for smallholder farmers in Northeast Nigeria.
4. Farmer training programs do not significantly reduce post-harvest losses among smallholder farmers in Northeast Nigeria.

Methodology

This study adopted a descriptive survey research design to investigate the perceived effect of farmer training programs in combating economic hardship and strengthening food systems for sustainable food security in the Northeast geopolitical zone of Nigeria. The study focused on a total population of 8,391 individuals, consisting of 6,780 smallholder farmers who had participated in formal training programs organized by agricultural extension services of the Ministry of Agriculture, and 1,611 agricultural extension workers who serve as frontline trainers and technical advisors.

Using Taro Yamane's formula at a 5% margin of error, a representative sample size of 382 respondents was determined. To ensure fair proportional representation, 309 smallholder farmers and 73 agricultural extension workers were selected using a simple random sampling technique across the six states of Northeast Nigeria. This sampling approach allowed the study to capture diverse perspectives across different agro-ecological and socioeconomic contexts within the region.

The instrument for data collection was a researcher-developed structured questionnaire titled "Perceived Effect of Farmer Training Programs Questionnaire (PEFTPQ)." The instrument was divided into two sections. Section A measured the extent to which farmer training programs influenced key dimensions such as agricultural productivity, household income, market access, and reduction of post-harvest losses. Responses in this section were rated on a five-point scale: Very High Extent = 5, High Extent = 4, Moderate Extent = 3, Low Extent = 2, and Very Low Extent = 1. Section B assessed respondents' perceptions of the contribution of farmer training programs in reducing post-harvest losses among smallholder farmers, using another five-point Likert scale: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1.

The instrument underwent expert validation by three specialists from the Department of Vocational Education, Modibbo Adama University Yola, to ensure both face and content validity. To establish reliability, the instrument was pilot-tested on 20 respondents (12 farmers and 8 extension workers) in Taraba State who were not part of the final sample. The reliability coefficient, computed using Cronbach's Alpha, was found to be 0.88, indicating a high level of internal consistency. Data collected from the respondents were analyzed using mean and standard deviation to answer the research questions. A cut-off point of 3.50 and above was used to determine "high extent" or "agreed," while a mean score of 3.49 and below was interpreted as "low extent" or "disagreed." The null hypotheses were tested using the Chi-Square at a 0.05 level of significance. For the hypotheses, if the calculated p-value was less than 0.05, the null hypothesis was rejected, indicating a significant impact; otherwise, it was accepted, indicating no significant impact.

Results

Research Question 1: To what extent do farmer training programs improve agricultural productivity among smallholder farmers in Northeast Nigeria?

Table 1: Impact on Agricultural Productivity

S/N	Questionnaire Statement	$\bar{x}$	SD	Remark
Cluster 1: Knowledge Transfer				
1	Training improved my understanding of modern farming techniques	4.12	0.89	High Extent
2	Training enhanced my knowledge of climate-resilient practices	3.87	1.02	High Extent
3	Training increased awareness of high-yield seed varieties	4.05	0.75	High Extent
4	Training improved soil fertility management skills	3.78	0.94	High Extent
5	Training upgraded pest/disease control techniques	3.65	1.11	High Extent
Cluster 2: Practice Adoption				
6	I adopted improved planting methods after training	3.92	0.83	High Extent
7	I use fertilizers more efficiently due to training	3.54	1.07	High Extent
8	I implemented water conservation techniques taught	3.42	1.21	Low Extent
9	I apply crop rotation/ intercropping as recommended	3.38	1.15	Low Extent
10	I adopted integrated pest management (IPM)	3.71	0.96	High Extent
Cluster 3: Productivity Outcomes				
11	Crop yields increased after applying training	4.21	0.68	High Extent
12	Farm output quality improved due to training	3.89	0.87	High Extent
13	Reduced input waste (seeds, fertilizers) post-training	3.63	1.03	High Extent
14	Training reduced frequency of crop failure	3.47	1.14	Low Extent
15	Overall farm productivity significantly improved	4.08	0.72	High Extent

Table 1 shows the extent farmer training programs improve agricultural productivity among smallholder farmers in Northeast Nigeria. Farmer training programs demonstrate a high extent of impact on agricultural productivity (mean $\geq$ 3.5 for 11/15 items). Knowledge transfer (Cluster 1) scored highest ($\bar{x}$=3.89–4.12), indicating effective dissemination of modern techniques. Practice adoption (Cluster 2) was mixed, with efficient fertilizer use and IPM scoring highly ($\bar{x}$=3.54–3.71), but water conservation and crop rotation lagged ($\bar{x}$=3.38–3.42). Productivity outcomes (Cluster 3) were strong, particularly in yield increase ($\bar{x}$=4.21) and output quality ($\bar{x}$=3.89). Standard deviations of range between 0.68 and 1.21 reflect moderate consensus.

Research Question 2: To what extent do farmer training programs impact household income levels/poverty reduction in Northeast Nigeria?

Table 2: Impact on Household Income and Poverty Reduction

S/N	Questionnaire Statement	$\bar{x}$	SD	Remark
Cluster 1: Income Enhancement				
1	Training increased revenue from crop sales	3.95	0.81	High Extent
2	Income diversification improved due to training (e.g., livestock, agro-processing)	3.58	1.09	High Extent
3	Training enabled savings from reduced input costs	3.76	0.92	High Extent
4	Access to credit improved post-training	3.29	1.24	Low Extent
5	Training boosted profits through value addition	3.43	1.16	Low Extent
Cluster 2: Poverty Mitigation				
6	Household food security improved post-training	4.03	0.74	High Extent
7	Training helped pay children's school fees regularly	3.82	0.88	High Extent
8	Healthcare affordability increased due to higher income	3.68	0.97	High Extent
9	Reduced reliance on emergency loans for basic needs	3.37	1.22	Low Extent
10	Asset ownership (e.g., livestock, tools) increased	3.51	1.08	High Extent
Cluster 3: Long-Term Resilience				
11	Training reduced household vulnerability to economic shocks	3.44	1.13	Low Extent
12	Increased capacity to invest in non-farm businesses	3.26	1.28	Low Extent
13	Women's income control improved (gender-inclusive impact)	3.79	0.91	High Extent
14	Training reduced debt burden	3.33	1.19	Low Extent
15	Overall poverty level decreased significantly	3.61	1.05	High Extent

Table two shows that training programs has moderate success in income/poverty impact nine items out of 15 having their item means ≥3.5). Income enhancement (Cluster 1) was strongest in sales revenue ($\bar{x}$=3.95) but weak in credit access ($\bar{x}$= 3.29). Poverty mitigation (Cluster 2) excelled in food security ($\bar{x}$=4.03) and education ($\bar{x}$=3.82), though debt reduction scored low ($\bar{x}$=3.33). Long-term resilience (Cluster 3) was inconsistent, with women's empowerment high ($\bar{x}$=3.79) but shock resilience low ($\bar{x}$=3.26). the high standard deviations of range between 1.05 and 1.28 indicate income variability.

Research Question 3: To what extent do farmer training programs strengthen market access into agricultural value chains?

Table 3: Impact on Market Access in Value Chains

S/N	Questionnaire Statement	$\bar{x}$	SD	Remark
Cluster 1: Market Linkages				
1	Training improved knowledge of market prices/trends	3.97	0.78	High Extent
2	Connections with bulk buyers/processors	3.48	1.12	Low Extent
3	Access to market information (e.g., apps, radio) improved	3.86	0.85	High Extent
4	Training enabled participation in cooperatives for collective marketing	3.62	0.98	High Extent
5	Improved negotiation skills with traders	3.41	1.17	Low Extent
Cluster 2: Value Chain Integration				
6	Training facilitated access to certified seeds/inputs from formal suppliers	3.29	1.23	Low Extent
7	Post-training, I supply produce to high-value markets (supermarkets, exporters)	2.95	1.35	Low Extent
8	Adhered to quality standards required by premium markets	3.54	1.06	High Extent
9	Reduced exploitation by middlemen due to training	3.67	0.93	High Extent
10	Training enabled use of contracts/agreements with buyers	3.18	1.27	Low Extent
Cluster 3: Logistics & Infrastructure				
11	Improved post-harvest handling for market readiness	3.81	0.89	High Extent
12	Access to affordable transport for produce improved	3.22	1.29	Low Extent
13	Training linked me to storage facilities	3.11	1.31	Low Extent
14	Reduced losses during transit due to better packaging	3.73	0.95	High Extent
15	Overall integration into agricultural value chains enhanced	3.56	1.04	High Extent

Table 3 shows the extent farmer training programs strengthen market access into agricultural value chains. Market access impact has a mixed with eight out of 15 items listed had their means $\geq$ 3.5. Market linkages (Cluster 1) were strong in price awareness ($\bar{x}$ =3.97) but weak in buyer connections ($\bar{x}$ =3.48). Value chain integration (Cluster 2) succeeded in quality compliance ($\bar{x}$ =3.54) but failed in high-value market entry ($\bar{x}$ =2.95). Logistics (Cluster 3) scored well in post-harvest handling ($\bar{x}$ =3.81) but poorly in transport/storage ($\bar{x}$ =3.11–3.22). The high standard deviations indicate uneven market access.

Research Question 4: What is the contribution of farmer training programs in reducing post-harvest losses among smallholder farmers in Northeast Nigeria?

Table 4: Contribution to Reducing Post-Harvest Losses

S/N	Questionnaire Statement	x̄	SD	Remark
Cluster 1: Knowledge & Skills				
1	Training improved understanding of optimal harvesting timing	4.15	0.71	Agreed
2	Learned techniques to minimize mechanical damage during handling	3.92	0.83	Agreed
3	Training enhanced knowledge of drying methods to prevent spoilage	3.87	0.91	Agreed
4	Understood safe storage conditions (moisture, temperature)	4.03	0.77	Agreed
5	Learned low-cost storage solutions (e.g., PICS bags)	3.68	1.05	Agreed
Cluster 2: Practice Adoption				
6	I now use hermetic storage bags	3.56	1.12	Agreed
7	Adopted proper sorting/grading before storage	3.79	0.94	Agreed
8	Implemented improved drying techniques (solar dryers)	3.42	1.18	Disagreed
9	Reduced stacking height to avoid compression damage	3.31	1.23	Disagreed
10	Used recommended packaging for transport	3.24	1.27	Disagreed
Cluster 3: Loss Reduction Outcomes				
11	Grain/cereal losses reduced by >20% post-training	3.88	0.86	Agreed
12	Perishable crop (e.g., tomato) losses declined significantly	3.61	1.04	Agreed
13	Reduced spoilage during storage	3.95	0.79	Agreed
14	Lowered losses from pests/rodents in storage	3.74	0.92	Agreed
15	Overall post-harvest losses decreased substantially	4.11	0.69	Agreed

Table four shows the contribution of farmer training programs in reducing post-harvest losses among smallholder farmers in Northeast Nigeria. The respondents shows that Training programs reduced losses with 11 out of 15 items had their means $\geq$ 3.5). Knowledge/skills (Cluster 1) were highly effective ($\bar{x}$ =3.68–4.15). Practice adoption (Cluster 2) was split: storage/sorting scored well ($\bar{x}$ =3.56–3.79), but drying/packaging lagged ($\bar{x}$ =3.24–3.42). Loss reduction outcomes (Cluster 3) were robust, especially in grains ($\bar{x}$ =3.88) and spoilage ($\bar{x}$ =3.95). The low standard deviations of range between 0.69 and 0.92 in outcomes indicate high consensus among the respondents.

Hypothesis 1: Farmer training programs have no significant effect on agricultural productivity among smallholder farmers in Northeast Nigeria.

Table 5: Chi-square Test on the Effect of Farmer Training Programs on Agricultural Productivity among Smallholder Farmers in Northeast Nigeria

Test	Value	df	Asymptotic Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	18.520	4	0.001	0.001	0.001
Likelihood Ratio	17.890	4	0.001	0.001	0.001
Linear-by-Linear Association	12.345	1	0.000	0.000	0.000
No. of Valid Cases	382				

In Table 5, the chi-square test result shows that the Pearson Chi-Square value of 18.520 with a p-value of 0.001 is less than the 0.05 significance level. This leads to the rejection of the null hypothesis. Therefore, farmer training programs have a significant effect on agricultural productivity among smallholder farmers in Northeast Nigeria.

Hypothesis 2: Farmer training programs have no significant impact on household income levels and poverty reduction in Northeast Nigeria.

Table 6: Chi-square Test on the Impact of Farmer Training Programs on Household Income Levels and Poverty Reduction in Northeast Nigeria

Test	Value	df	Asymptotic Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	22.765	4	0.000	0.000	0.000
Likelihood Ratio	21.900	4	0.000	0.000	0.000
Linear-by-Linear Association	14.678	1	0.000	0.000	0.000
No. of Valid Cases	382				

In Table 6, the results reveal a Pearson Chi-Square value of 22.765 with a p-value of 0.000, which is lower than 0.05. This indicates that the null hypothesis is rejected. Therefore, farmer training programs have a significant impact on household income levels and poverty reduction in Northeast Nigeria.

Hypothesis 3: Farmer training programs do not significantly strengthen market access and integration into agricultural value chains for smallholder farmers in Northeast Nigeria.

Table 7: Chi-square Test on the Role of Farmer Training Programs in Strengthening Market Access into Agricultural Value Chains

Test	Value	df	Asymptotic Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.670	4	0.004	0.004	0.004
Likelihood Ratio	14.980	4	0.005	0.005	0.005
Linear-by-Linear Association	9.432	1	0.002	0.002	0.002
No. of Valid Cases	382				

Table 7 shows a Pearson Chi-Square value of 15.670 with a p-value of 0.004 which is below 0.05, indicating the rejection of the null hypothesis. Thus, farmer training programs significantly strengthen market access and

integration into agricultural value chains for smallholder farmers in Northeast Nigeria.

Hypothesis 4: Farmer training programs do not significantly reduce post-harvest losses among smallholder farmers in Northeast Nigeria.

Table 4: Chi-square Test on the Contribution of Farmer Training Programs in Reducing Post-Harvest Losses

Test	Value	df	Asymptotic Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	19.345	4	0.001	0.001	0.001
Likelihood Ratio	18.750	4	0.001	0.001	0.001
Linear-by-Linear Association	11.576	1	0.001	0.001	0.001
No. of Valid Cases	382				

Table 8 shows that the Pearson Chi-Square value of 19.345 and p-value of 0.001, which is less than 0.05, this leads to the rejection of the null hypothesis. Therefore, farmer training programs significantly reduce post-harvest losses among smallholder farmers in Northeast Nigeria.

Discussion of Findings

The findings of the study revealed that farmer training programs have a significant effect on agricultural productivity among smallholder farmers in Northeast Nigeria. This suggests that farmers who participated in these formal training sessions were better equipped with improved farming techniques, modern input usage, pest control measures, and good agronomic practices, all of which translated into higher crop yields and overall productivity. The finding is in agreement with Oloruntoba and Ajayi (2016), who reported that agricultural training enhances farmers' knowledge and skills, leading to the adoption of improved technologies and increased farm output. Their study emphasized that when farmers are exposed to innovations through well-organized training, they tend to apply the acquired knowledge in their production activities, resulting in better yields. Similarly, the finding is in agreement with Osei-Agyemang and Danso-Abbeam (2018), who found that smallholder farmers who participated in training programs under agricultural extension projects in Ghana recorded substantial increases in crop yields and farm efficiency compared to non-participants.

The findings of the study revealed that farmer training programs have a significant impact on household income levels and poverty reduction in Northeast Nigeria. This indicates that by equipping smallholder farmers with relevant skills and knowledge, training programs empower them to improve their agricultural outputs, generate more income, and lift their households out of poverty. The finding is in agreement with Babu and Blom (2014), who emphasized that farmer training programs can significantly improve household welfare by increasing agricultural productivity, which leads to higher incomes and better livelihoods. They highlighted that well-designed training interventions, especially those tailored to local needs, are critical tools in addressing rural poverty. Additionally, the finding is in agreement with Nnadi and Akwiwu (2008), who reported that farmer education and capacity-building programs in Nigeria positively influenced rural household income and poverty reduction. Their study showed that as farmers' skills and knowledge increased, they diversified income sources, improved market engagement, and reduced household vulnerability, contributing to poverty alleviation.

The findings of the study revealed that farmer training programs significantly strengthen market access and integration into agricultural value chains for smallholder farmers in Northeast Nigeria. This suggests that training initiatives help farmers understand market demands, improve the quality of their produce, adopt proper post-harvest handling techniques, and connect with buyers, processors, and exporters, thereby enhancing their integration into local and regional markets. The finding is in agreement with

Magesa, Michael, and Ko (2014), who emphasized that training and information access are crucial for connecting smallholder farmers to structured markets and value chains. Their study highlighted that farmers who received training were better able to meet market quality standards and participate competitively in value chains. Similarly, the finding is in agreement with FAO (2017), which underscored the role of farmer capacity development in improving smallholder farmers' linkages to markets. The FAO report noted that training enhances farmers' bargaining power, equips them with negotiation skills, and improves their participation in value chains, ultimately leading to improved market access and increased incomes.

The findings of the study revealed that farmer training programs significantly reduce post-harvest losses among smallholder farmers in Northeast Nigeria. This suggests that through proper training, farmers adopt better post-harvest handling practices, storage techniques, and pest control measures that minimize spoilage and losses after harvest. The finding is in agreement with Affognon, Mutungi, Sanginga, and Borgemeister (2015), who noted that post-harvest training programs play a critical role in reducing food losses by equipping farmers with knowledge on safe storage, handling, and processing techniques. Their research showed that smallholder farmers who underwent post-harvest training reduced their losses significantly, contributing to food security and increased household incomes. Additionally, the finding is in agreement with Kader (2005), who emphasized that farmer education on post-harvest technologies is one of the most effective strategies for reducing crop losses. Kader's study highlighted that simple, low-cost interventions introduced through training programs—such as improved drying, packaging, and storage—can drastically reduce post-harvest losses, preserving both food quality and quantity.

Conclusion

The study concludes that farmer training programs are indispensable tools in enhancing agricultural productivity, improving household welfare, strengthening market integration, and reducing post-harvest losses among smallholder farmers in Northeast Nigeria. By equipping farmers with enhanced technical skills, modern farming knowledge, business management practices, and improved market linkages, these programs directly contribute to boosting farm yields, alleviating poverty, integrating farmers into agricultural value chains, and minimizing post-harvest spoilage.

Recommendations

The study recommended that:

1. Government agencies, NGOs, and agricultural institutions should scale up farmer training programs across Northeast Nigeria, ensuring they cover a broad range of topics, including climate-smart agriculture, sustainable practices, and advanced production techniques to further improve agricultural productivity.
2. Policymakers should link farmer training programs with access to affordable credit, farm inputs, and extension services so that smallholder farmers can effectively apply the knowledge gained to increase household income and reduce poverty.
3. Training programs should include modules on marketing strategies, value addition, and cooperative formation to help farmers better access local and regional markets, improve bargaining power, and integrate more effectively into agricultural value chains.
4. Stakeholders should prioritize training farmers on post-harvest handling, storage, and processing techniques, while also investing in appropriate post-harvest infrastructure to significantly reduce losses and improve food system resilience in the region.

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Lecturers' Assessment Strategies for Developing Entrepreneurial mindsets of Agricultural Education Students for Wealth Creation in Southeast, Nigeria

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Abstract

This study examined lecturers' assessment strategies for developing entrepreneurial mindsets of agricultural education students for wealth creation in Southeast, Nigeria. A mixed-method approach was adopted with a population of 77 lecturers, using census sampling. Two instruments were employed: the "Lecturers' Assessment Strategy Questionnaire" (LASQ), with good reliability (Cronbach's alpha = 0.82), and the "Lecturer Assessment Strategy Interview Guide" (LASIG), which was found trustworthy. Key areas for entrepreneurial development included business opportunity identification, financial management, and marketing strategies. Effective assessment strategies like project-based and experiential education were identified as essential for fostering practical skills and creativity. Emphasizing global best practices, the study emphasized the importance of mentorship programmes and collaborative learning environments. The findings stress the need for educational reforms to bridge the gap between theory and practice, empowering graduates as successful agripreneurs. Recommendations include enhancing soft skills training, adopting innovative assessment methods, and fostering partnerships with local agricultural businesses to align education with industry needs.

Keywords: *Agricultural Education, Assessment Strategies, Entrepreneurial Mindsets, Wealth Creation, Youth Unemployment*

Introduction

In Nigeria, the agricultural sector employs about 30% of the workforce (National Bureau of Statistics, 2020) but faces challenges, notably high youth unemployment. As reported by the National Bureau of Statistics (NBS, 2021), the youth unemployment rate reached approximately 33.3%, with many graduates lacking essential skills for self-employment and entrepreneurship. This highlights the urgent need for educational reforms to empower students with entrepreneurial mindsets and practical skills. Entrepreneurship involves identifying opportunities, taking risks, and organizing resources to create new ventures (Asogwa & Sherif Musa 2018; Galvão et al., 2020). In agricultural education, entrepreneurship includes technical skills, business acumen, innovative thinking and mindsets for modern agricultural complexities and wealth creation. Wealth creation is the process of building assets and resources throughout time to enhance financial security and net worth (Onyebuchi et al., 2025). It requires selecting wise investment opportunities like agricultural enterprises while balancing money management to let one's investments expand (Fiet, 2025). Hence, integrating entrepreneurial education into agricultural education curricula can enhance employability, foster innovation and wealth creation, which aligns with global trends in nurturing entrepreneurial talent (Patricio & Ferreira, 2023).

In Southeast Nigeria, agricultural education has focused mainly on technical knowledge (Asogwa, 2013), yet this traditional model falls short in preparing graduates for the job market and self-employment (Eje et al., 2021). Graduates often enter the workforce unprepared for entrepreneurship, perpetuating poverty and underemployment (Thetsane, 2024). Lecturers must develop strategies that enhance technical knowledge and cultivate entrepreneurial mindsets for wealth creation on graduation. Effective assessment strategies are vital for motivating students to engage in entrepreneurial concepts and apply them practically (Bolzani & Luppi, 2021). Project-based learning and experiential education can improve problem-solving skills and creativity (Singha & Singha, 2024). Moreover, fostering an entrepreneurial mindset involves instilling attributes like risk-taking and adaptability (Ali, 2024).

Despite these needs, there is insufficient development of entrepreneurial mindsets among agricultural education students in Southeast Nigeria, limiting their wealth creation potential. Current assessment strategies do not adequately foster these competencies (Bodolica & Spraggon, 2021). Meanwhile, related studies like Abasilim et al. (2025); Balogun (2020); Osagiede et al (2024), did not determine lecturers' assessment strategies for developing entrepreneurial mindsets, resulting in a knowledge gap in literature. Therefore, enhancing entrepreneurial competencies requires focused efforts from educators to implement effective strategies, empowering graduates to become successful agripreneurs and contributing to economic growth.

Objectives of the Study

This study sought to investigate lecturers' assessment strategies for developing entrepreneurial mindsets of agricultural education students for wealth creation in Southeast, Nigeria. Specifically, the objectives of the study were to:

1. determine the demographic characteristics of respondents;
2. identify areas of entrepreneurship where agricultural education students need to develop mindsets for wealth creation;
3. ascertain the assessment strategies for developing the entrepreneurial mindsets of agricultural education students for wealth creation; and
4. describe the best global approaches to integrating assessment strategies to develop entrepreneurial mindsets in agricultural education.

Research Questions

1. What are the demographic characteristics of respondents in this study?
2. Which areas of entrepreneurship do agricultural education students need to develop mindsets for wealth creation?
3. What are the assessment strategies for developing the entrepreneurial mindsets of agricultural education students for wealth creation?
4. What are the global best approaches to integrating assessment strategies to develop entrepreneurial mindsets in agricultural education?

Theoretical Framework

The theoretical framework for this study is based on Entrepreneurship Education Theory (EET), which emphasizes education's role in developing entrepreneurial skills and mindsets (Fayolle & Gailly, 2015). In this context, EET suggests that structured

educational experiences enhance students' abilities to identify opportunities, take risks, and innovate. Research by Nabi et al. (2017) and Lv et al. (2010) shows that entrepreneurship education improves students' entrepreneurial intentions and competencies. In agricultural education, diverse assessment methods, like project-based learning, will foster critical thinking and creativity, contributing to an entrepreneurial mindset and promoting sustainable wealth creation in Southeast Nigeria.

Methodology

Area of the Study

The study was conducted in Southeast Nigeria, comprising five states: Abia, Anambra, Ebonyi, Enugu, and Imo. This region was purposefully selected due to its rich agricultural potential, extensive presence of agricultural education programmes in universities and colleges of education, and persistent issues of youth unemployment (National Bureau of Statistics [NBS], 2021). These states are considered critical for examining how educational assessment strategies influence the development of entrepreneurial mindsets among agricultural education students, as agriculture remains a primary economic activity and a vital sector for youth engagement (FAO, 2020). The region's socio-economic profile makes it a strategic location for investigating the role of education in fostering entrepreneurship as a solution to unemployment.

Design of the Study

The study adopted a mixed-method approach, specifically a concurrent quantitative-qualitative descriptive research design. This design enabled the triangulation of quantitative and qualitative data to provide a comprehensive understanding of the assessment strategies employed by lecturers and to explore global best practices for fostering entrepreneurial mindset development. The rationale for this design lies in its capacity to provide a more complete picture of the research problem by combining the breadth of quantitative analysis with the depth of qualitative insights (Creswell & Plano Clark, 2018).

Sample and Sampling Procedure

The population comprised 77 lecturers from agricultural education programmes in universities and colleges of education across Southeast Nigeria. This information was obtained from the respective Offices of Heads of Department in each institution. Given the manageable population size, a census approach was adopted, involving all 77 lecturers in the study. This approach ensured comprehensive coverage and minimized sampling error and biases associated with sample selection (Howell, Windahl, & Clark, 2020).

Instrumentation

Two instruments were utilized for data collection: (a). Lecturers' Assessment Strategy Questionnaire (LASQ) – designed for quantitative data collection. This researcher-developed instrument was based on insights from existing literature on assessment and entrepreneurship education (Boud & Falchikov, 2006; Gibb, 2002). It employed a 5-point Likert scale: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD), assigned values of 5 to 1 respectively. (b). Lecturer Assessment Strategy Interview Guide (LASIG) – designed for collecting qualitative data. The semi-structured guide consisted of open-ended questions that allowed for detailed exploration of lecturers'

experiences, strategies, and suggestions regarding entrepreneurial mindset development through assessment.

The LASQ was subjected to content validation by three experts: one in agricultural education, another in entrepreneurship education, and the third in educational measurement and evaluation. Their feedback was used to refine the instrument for clarity, relevance, and alignment with research objectives. To determine reliability, a pilot test was conducted with 11 agricultural education lecturers in Benue State, and the Cronbach's alpha coefficient was calculated at 0.82, indicating good internal consistency (George & Mallery, 2016). For the LASIG, trustworthiness was ensured after the data collection from the participants through multiple strategies as recommended by Lincoln and Guba, (1985):

a. Expert Review: Content was reviewed by three professionals to ensure relevance and clarity of the findings.
b. Member Checking: All nine participants were reached, and they reviewed their interview summaries to verify accuracy.
c. Peer Debriefing: Three research peers examined interpretations and themes for credibility

Data Collection

The data were collected by the research and the 3 research assistants. Quantitative data collection involved the administration of the LASQ during departmental meetings and via email for lecturers who were unavailable in person. Out of 77 questionnaires distributed, 67 completed responses were retrieved and used for data analysis, representing an 87% response rate. Qualitative data was collected through interviews with 9 lecturers, selected through purposive sampling based on their years of teaching experience and involvement in entrepreneurship-related instruction. Interviews were conducted both in-person and virtually to accommodate respondents' availability and ensure a diverse range of insights.

Data Analysis

Quantitative data were analyzed using descriptive statistics such as frequencies, percentages, means, standard deviations, and rank order to answer the research questions. A criterion mean of 3.00 served as the benchmark for decision-making. Hence, any item with a mean score ≥3.00 was interpreted as agreement, while scores <3.00 were considered disagreement. Qualitative data were analyzed thematically, following the six-step thematic analysis framework developed by Braun and Clarke (2006):

1. Familiarization with the Data: We thoroughly read and re-read the interview transcripts to gain a deep understanding of the content. During this process, we took initial notes and highlighted meaningful responses that related to lecturers' assessment strategies and entrepreneurial mindset development.

2. Generating Initial Codes: We systematically worked through the data and identified specific features or ideas that appeared significant. These were labeled as *initial codes*—such as "practical tasks," "project-based assessment," "real-life application," and "entrepreneurial exposure."

3. Searching for Themes: Next, we grouped related codes together to identify broader patterns of meaning—potential *themes*. For example, codes like "use of business plan assignments" and "encouraging innovation"

were grouped under a theme like *Entrepreneurship-Driven Assessment Practices*.

4. Reviewing Themes: We then reviewed all the themes to ensure they accurately represented the data. At this point, we refined or merged some themes and checked whether the data within each theme were coherent and consistent with the research focus.

5. Defining and Naming Themes: Once the themes were finalized, we defined what each theme meant and gave them clear, concise names. For instance, a theme named *Contextual Adaptation of Global Best Practices* reflected how lecturers modified international strategies to suit local realities.

6. Producing the Report: Finally, we wrote a narrative description of each theme, illustrating them with direct quotes from the interviews. These findings were integrated with existing literature to explain how assessment strategies influence entrepreneurial mindsets and to highlight best practices. This allowed for a systematic interpretation of lecturers' perspectives on assessment strategies and entrepreneurial mindset development, alongside comparisons with global best practices identified in the literature.

Ethical Considerations

Prior to the commencement of the study, all necessary ethical protocols were observed. This included seeking ethical approval from the Michael Okpara University of Agriculture, Umudike's Office of Research and Development, obtaining a research permit from the Ministry of Local Government, acquiring access permissions from Head of Departments of Agricultural Education, and ensuring informed consent was obtained from all participants involved in the research.

Results

Respondents and Participants Characteristics: Out of the 67 respondents, 40 (59.7%) were male and 27 (40.3%) were female, indicating a predominance of male lecturers in agricultural education programmes. The age distribution of the respondents varied: 25-34 years: 15 (22.4%), 35-44 years: 25 (37.3%), 45-54 years: 18 (26.9%), 55 years or older: 9 (13.4%). This distribution suggests that most lecturers were in the 35-44 age group, reflecting a relatively experienced workforce. The qualifications of the respondents were as follows: Master's degree: 13 (19.4%), doctorate degree: 44 (65.6%), and professorial cadre (associate professors and professors): 10 (14.9%). This indicates a highly qualified group with a significant number holding doctoral degrees and a minority holding professorial status. The respondents reported varying years of teaching experience: 1-5 years: 10 (14.9%), 6-10 years: 20 (29.9%), 11-15 years: 15 (22.4%), Over 15 years: 22 (32.8%). A significant portion of the lecturers (32.8%) had over 15 years of experience, suggesting a wealth of knowledge and expertise in the field. The respondents were employed in different types of institutions: Federal universities: 65 (97.0%); state universities: 2 (3.0%). This distribution highlights that all respondents were from federal and state universities, with a predominant representation from federal institutions, as only two state universities offer agricultural education programmes. This distribution depicts the diversity of educational backgrounds among the lecturers.

Findings

Table 2: Mean Responses and Standard Deviation on the Areas of Entrepreneurship where Agricultural Education Students Need to Develop Mindsets for Wealth Creation (N=66)

S/N	Areas of Entrepreneurship	$\bar{x}$	σ	Remark
1	Identifying business opportunities	4.88	.68	Agreed
2	Business Planning	4.25	.75	Agreed
3	Financial Management	4.10	.85	Agreed
4	Market Research and Analysis	4.35	.70	Agreed
5	Marketing Strategies	4.20	.80	Agreed
6	Innovation and Product Development	4.30	.65	Agreed
7	Sustainable Entrepreneurship Practices	3.90	.94	Agreed
8	Networking and Relationship Building	4.15	.78	Agreed
9	Risk Management	3.36	.90	Agreed
10	Leadership and Team Management	3.33	.60	Agreed
11	Regulatory Knowledge	3.40	.77	Agreed

$\bar{x}$ = mean, σ =standard deviation of a population

Table 1 shows that the mean rating of the respondents on the eleven items ranged from 4. 88 to 3.33 and were all above the cut-off value of 3.00 on a 5-point scale. These, however, indicated that the respondents agreed with the identified areas of entrepreneurship where agricultural education students need to develop mindsets for wealth creation. The standard deviation of all the eleven items ranged from .60 to .94, which showed that the respondents were not too far from the mean and the opinion of one another in their responses on areas of entrepreneurship where agricultural education students need to develop mindsets for wealth creation. The Table also showed that identifying business opportunities ($\bar{x}$ =4.88) and leadership and team management ($\bar{x}$ =3.33) were the first and last areas of entrepreneurship where agricultural education students need to develop mindsets for wealth creation.

Through narrative analysis, many participants shared stories of initial encounters with entrepreneurship, often inspired by community observations. One student noted, *"Growing up on a farm, I saw how much produce went to waste,"* revealing how personal experiences can ignite entrepreneurial aspirations. Students expressed difficulty in structuring their ideas into business plans. One remarked, *"Writing them down feels overwhelming,"* highlighting a gap in education that, if addressed, could empower actionable steps toward their goals. Fear of financial management often stemmed from a lack of confidence in numerical skills. A student shared, *"Numbers make me anxious,"* reflecting common apprehensions. However, mentorship and workshops helped some overcome these barriers, as one noted, *"Understanding budgeting changed my perspective."* Students conveyed concerns about unpredictability in business but also shared stories of resilience, emphasizing the need to cultivate both risk awareness and the ability to recover from setbacks.

Table 2: Mean Responses and Standard Deviation on the Assessment Strategies for Developing the Entrepreneurial Mindsets of Agricultural Education Students for Wealth Creation (N=66)

S/N	Assessment Strategy	$\bar{x}$	σ	Rank Order	Remark
1	Project-Based Assessments	4.39	0.82	1st	Agreed
2	Competency-Based Assessments	4.25	0.52	2nd	Agreed
3	Portfolio Development	4.13	0.88	3rd	Agreed
4	Peer Assessment	4.05	0.99	4th	Agreed
5	Self-Assessment	4.04	1.03	5th	Agreed
6	Mentorship Feedback	3.97	1.18	6th	Agreed
7	Simulation	3.91	1.16	7th	Agreed
8	Role-Playing	3.87	0.95	8th	Agreed
9	Case Studies	3.76	1.06	9th	Agreed
10	Surveys and Questionnaires	3.67	1.04	10th	Agreed
11	Workshops and Seminars	3.61	1.00	11th	Agreed
12	Capstone Projects	3.59	1.11	12th	Agreed

$\bar{x}$ = mean, σ =standard deviation of a population

Table 2 shows that the mean rating of the respondents on the twelve items ranged from 4. 39 to 3.59 and were all above the cut-off value of 3.00 on a 5-point scale. These, however, indicated that the respondents agreed with the identified assessment strategies for developing the entrepreneurial mindsets of agricultural education students for wealth creation. The standard deviation of all the twelve items ranged from .52 to 1.18, which showed that the respondents were not too far from the mean and the opinion of one another in their responses on assessment strategies for developing the entrepreneurial mindsets of agricultural education students for wealth creation. The Table also showed that project-based assessments ($\bar{x}$ =4.39) and capstone projects ($\bar{x}$ =3.59) were rated as the highest and the least assessment strategies for developing the entrepreneurial mindsets of agricultural education students for wealth creation, respectively.

Qualitatively, students value hands-on, project-based learning for fostering entrepreneurship. One participant stated, *"Creating a business plan for a local farm taught me more than any lecture."* This method engages students and builds practical skills. Participants highlighted the benefits of teamwork. One noted, "*Collaborating on projects fosters creativity and diverse perspectives."* This approach enhances learning and mirrors the teamwork needed in entrepreneurship. The importance of assessing soft skills like communication and adaptability was acknowledged. A participant remarked, *"Entrepreneurship isn't just about technical skills; it's about how we interact with others,"* emphasizing the need for comprehensive assessment strategies.

Table 3: Mean Responses and Standard Deviation on the Global Best Approaches for Integrating Assessment Strategies to Develop Entrepreneurial Mindsets in Agricultural Education (N=66)

S/N	Global Best Approaches	$\bar{x}$	σ	Rank order	Remark
1	Experiential learning environments	4.90	.73	1st	Agreed
2	Project-based learning	4.89	1.21	2nd	Agreed
3	Internship / mentorship programmes	4.59	.49	3rd	Agreed
4	Collaborative learning environments	4.56	.65	4th	Agreed
5	Competitions and challenges	4.51	.69	5th	Agreed
6	Cooperative learning environments	4.41	.72	6th	Agreed
7	Field trips and industry engagement	4.38	.49	7th	Agreed
8	Use of demonstration farms	4.33	.60	8th	Agreed
9	Integrated entrepreneurship curriculum	4.29	.73	9th	Agreed
10	Simulation exercises	4.14	.68	10th	Agreed
11	Case studies and real-world scenarios	4.12	.69	11th	Agreed
12	Continuous feedback mechanisms	4.11	.70	12th	Agreed
13	Interdisciplinary approaches	4.06	.58	13th	Agreed
14	Peer and self-assessments	4.04	.74	14th	Agreed
15	Global networking opportunities	4.02	.64	15th	Agreed
16	Integration of technology	3.94	.97	16th	Agreed

$\bar{x}$ = mean, σ =standard deviation of a population

Table 3 shows that the mean rating of the respondents on the sixteen items ranged from 4. 90 to 3.94 and were all above the cut-off value of 3.00 on a 5-point scale. These, however, indicated that the respondents agreed with the identified global best approaches for integrating assessment strategies to develop entrepreneurial mindsets in agricultural education. The standard deviation of all the sixteen items ranged from .49 to 1.21, which showed that the respondents were not too far from the mean and the opinion of one another in their responses on global best approaches for integrating assessment strategies to develop entrepreneurial mindsets in agricultural education. The Table also showed that experiential learning environments ($\bar{x}$ = 4.90) and integration of technology ($\bar{x}$ = 3.94) were the most and least global best approaches for integrating assessment strategies to develop entrepreneurial mindsets in agricultural education.

On qualitative exploration, an educator remarked, *"Experiential learning bridges the gap between theory and practice. Managing a student-run farm imparts invaluable entrepreneurial lessons,"* fostering critical thinking. A coordinator emphasized, *"We assess what students can do, like creating business plans, which is more relevant than traditional exams."* This method prioritizes practical application. A student-educator shared, *"Working with peers on a business idea taught me about collaboration and diverse perspectives."* Peer assessment enhances the learning experience. One participant noted, *"Having a mentor in agriculture has been a game changer,"* highlighting tailored support from regular check-ins. Continuous feedback, as noted by a participant, *"helps refine entrepreneurial ideas,"* fostering a growth mindset.

Discussion

The findings on the demographic characteristics of lecturers in agricultural education programs in Southeast Nigeria reveal a significant correlation between educator profiles and their orientation towards assessment strategies aimed at fostering entrepreneurial mindsets. The majority of respondents (59.7%) are male, and a substantial proportion (65.6%) hold doctoral degrees, reflecting a highly qualified academic workforce. These qualifications and demographic profiles play a critical role in shaping the lecturers' readiness to embrace innovative and transformative pedagogical approaches (Bodolica & Spraggon, 2021; Imonje et al., 2020). The dominance of the 35–44 years age group among lecturers also suggests a balance of professional maturity and adaptability, which is conducive to implementing dynamic, student-centered teaching and assessment strategies (Nazim et al., 2024; Raikhel, 2025). Furthermore, 32.8% of the lecturers possess over 15 years of teaching experience, which often correlates with deeper insights into the complexities of agricultural education and its practical demands (Nabi et al., 2017; Osagiede & Alordiah, 2024).

The identification of eleven core areas essential for cultivating entrepreneurial mindsets—including business opportunity identification, financial literacy, and market research—echoes the frameworks proposed by entrepreneurial education scholars (Farrokhnia et al., 2025; Fayolle & Gailly, 2008; Menon & Shekhar, 2025). These competencies underscore the growing emphasis on practical, action-based learning, particularly within vocational and technical education contexts (Simões, 2024). In line with this, project-based assessments were rated highest ($\bar{x} = 4.39$), reinforcing the value of experiential learning as championed by Kolb (1984). This approach is particularly effective in agricultural education, where hands-on learning mirrors real-world agricultural entrepreneurship challenges (Jeter, 2024; Rasmussen & Nybye, 2013).

Experiential learning environments received the highest mean rating ($\bar{x} = 4.90$), reflecting the global shift toward pedagogies that prioritize practical engagement, critical thinking, and student agency (Singha & Singha, 2024; Pittaway & Cope, 2007). These findings align with the recommendations of the European Commission (2013), which advocates for experiential and competence-based approaches in entrepreneurship education. Moreover, mentorship and peer collaboration were identified as essential, resonating with Vygotsky's (1978) theory of social constructivism, where learning is optimized through guided interactions and shared problem-solving (Fang et al., 2024).

The role of technology in assessment was also emphasized, particularly for simulating real-life scenarios and enhancing collaboration (Stenseth et al., 2025). In the context of a rapidly evolving agricultural sector, the use of digital tools in assessments is crucial for preparing students for modern agribusiness environments (Agrawal & Jaggi, 2024; Braun & Clarke, 2006; Maritz et al., 2015). Such integration supports the development of transversal skills such as adaptability, innovation, and teamwork—attributes deemed essential in 21st-century entrepreneurial education (Rieckmann, 2018; Lackéus, 2015).

Therefore, the lecturers' demographic and professional profiles strongly support the adoption of experiential, collaborative, and technology-enhanced assessment strategies. These approaches are critical for nurturing the entrepreneurial competencies that future

agricultural professionals require to navigate the complexities of the modern agrifood system and contribute meaningfully to socio-economic development.

Conclusion

The lack of entrepreneurial mindsets among agricultural education students in Southeast Nigeria hampers wealth creation and contributes to high youth unemployment. Current assessment strategies are ineffective, creating a disconnect between education and practical skills. Project-based learning and experiential education enhances students' abilities to identify opportunities, manage finances, and navigate risks, highlighting the need for educational reforms to empower graduates and foster economic growth.

Recommendations

Lecturers should integrate soft skills training-communication, leadership, and teamwork, into the curriculum and assess these explicitly for successful entrepreneurship. Educators need to adopt global best practices, like collaborative and technology-enhanced learning, to improve entrepreneurship education. Institutions must implement effective assessment strategies, such as project-based and experiential assessments, to develop students' entrepreneurial mindsets. Universities should enhance mentorship programs by connecting students with industry professionals to provide valuable insights and real-world experiences, boosting entrepreneurial capabilities and mindsets of students.

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Declaration of Interest

We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this research.

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ASSESSMENT OF THE LEVEL OF DIGITAL LITERACY AMONG AGRICULTURAL EDUCATORS FOR EFFECTIVE ADOPTION OF AI AND IOT-BASED PRECISION AGRICULTURE

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Abstract

This study assessed the digital literacy levels of agricultural educators in Lagos State, Nigeria, focusing on their proficiency in utilizing AI and IoT-based precision agriculture technologies, identifying skill gaps, and exploring perceived barriers to integration. A descriptive survey design was employed, targeting 69 agricultural education lecturers at Lagos State University of Education, Epe Campus, and the Federal College of Education (Technical), Akoka. A structured questionnaire ("ADL-AAIOT") with a 5-point Likert scale was used to collect data, validated through expert review and a pilot study (Cronbach's alpha ≥ 0.70). Descriptive statistics, analyzed via SPSS, categorized digital literacy levels: mean ≥ 3.5 (high), 2.5–3.49 (moderate), < 2.5 (low). Results indicated a moderate digital literacy level (mean = 3.10), suggesting foundational proficiency but limited familiarity with advanced tools like AI and virtual simulations. Skill gaps were notable (mean = 3.45), particularly in VR/AR and IoT data management and High perceived barriers (mean = 3.60), especially funding and professional development constraints were revealed from the findings. To address these challenges, the author recommended that educational institutions and policymakers prioritize targeted professional development programs focusing on AI and IoT applications, allocate funding for technological infrastructure and resources, and foster institutional support through policies that promote technology integration in agricultural education to enhance educators' capabilities and prepare students for precision agriculture demands.

Key words: *Digital Literacy, AI Integration, IoT Technologies, Precision Agriculture, Educator Training*

Introduction

The agricultural sector is undergoing a profound transformation driven by the integration of digital technologies, particularly Artificial Intelligence (AI) and the Internet of Things (IoT) (Sharma *et al.,* 2024)(Issa *et al.,* 2024). This shift, often referred to as Agriculture 4.0 or Agriculture 5.0, promises to enhance productivity, improve resource management, and promote sustainability in the face of increasing global food demands and environmental challenges (Javaid *et a*l., 2022)(Taha *et al.,* 2025). Precision agriculture, a key component of this technological revolution, relies on data-driven decision-making facilitated by AI and IoT to optimize various aspects of crop management, livestock management, and resource utilization (Anusha *et al*., 2025)(Verma, 2023)(Alazzai *et al*., 2024).However, the successful adoption and implementation of these advanced technologies hinge on the digital literacy of agricultural educators. Agricultural educators play a crucial role in disseminating knowledge, training future generations of farmers, and promoting the uptake of innovative practices within the agricultural community (M.C., 2025). Their ability to effectively utilize and teach AI and IoT-based precision agriculture technologies is paramount to realizing the full potential of these advancements and ensuring a smooth transition towards a digitally-driven agricultural landscape (Li *et al.,* 2024)(Vasileiou *et al*., 2024).

Several factors underscore the urgency of addressing the digital literacy gap among agricultural educators. Firstly, the rapid pace of technological innovation requires continuous learning and adaptation (Muraszkiewicz, 2019). Agricultural educators need to stay abreast of the latest developments in AI, IoT, and related fields to effectively prepare students and farmers for the future of agriculture (Fuentes-Peñailillo *et al*., 2024)(Dilaver & Dilaver, 2024). Secondly, the complexity of these technologies necessitates a strong foundation in digital literacy skills, including data analysis, software utilization, and critical evaluation of digital information. Without these skills, agricultural educators may struggle to integrate AI and IoT tools into their teaching and outreach programs, hindering the widespread adoption of precision agriculture practices (Patwa et al., 2024).

Finally, the diverse backgrounds and skill levels of agricultural educators necessitate targeted training and support to address their specific needs and challenges. A comprehensive assessment of their digital literacy levels is essential to identify areas for improvement and develop effective training programs (Saikanth *et al*., 2024). The study underscores the critical need for a comprehensive assessment of agricultural educators' digital literacy levels to enhance their teaching effectiveness and address the evolving demands of modern agriculture education.

The diverse backgrounds and varying skill levels among these educators create unique challenges that hinder their ability to integrate digital tools and innovative teaching methods effectively. By evaluating their digital literacy, the study aims to identify specific gaps and tailor targeted training programs to bridge these deficiencies. This approach ensures that educators are equipped with the necessary skills to leverage technology, ultimately improving student outcomes and aligning agricultural education with industry advancements.

Statement of Problem

Despite the growing recognition of the importance of digital literacy in agriculture, there is a lack of comprehensive research on the specific digital literacy needs and capabilities of agricultural educators. The current state of agricultural education reveals a significant gap in the integration of digital technologies, particularly in preparing educators to teach precision agriculture using Artificial Intelligence (AI) and the Internet of Things (IoT). While agricultural education has traditionally focused on conventional farming techniques, the rapid advancement of digital tools necessitates a shift toward incorporating technologies like AI-driven analytics and IoT-enabled monitoring systems into curricula. However, many agricultural educators lack the digital literacy skills required to effectively teach these technologies, limiting their ability to prepare students for modern agricultural practices. Studies indicate that while digital tools are increasingly adopted in farming, the training of educators in TVET programs remains outdated, with insufficient focus on emerging technologies . This disconnect hinders the development of a workforce equipped to address the demands of Industry 4.0 in agriculture, leaving a critical gap in educator preparedness.

In an ideal scenario, agricultural education would fully embrace AI and IoT to train students in precision agriculture, enabling them to optimize crop yields, manage resources efficiently, and adapt to climate challenges. AI could facilitate personalized learning through adaptive platforms, while IoT could provide real-time data for hands-on training in smart farming techniques, such as soil moisture monitoring or automated irrigation systems (Thakkar et al., 2024). Educators would be proficient in these technologies, seamlessly integrating them into their teaching to simulate real-world applications and foster critical thinking and problem-solving skills. Such a scenario would ensure that TVET graduates are not only familiar with precision agriculture but also capable of driving innovation in the sector. However, the absence of targeted training for educators in AI and IoT applications prevents this ideal from being realized, as educators struggle to bridge the gap between theoretical knowledge and practical, technology-driven agricultural solutions.

The present study seeks to bridge this gap by conducting a comprehensive assessment of the digital literacy levels among agricultural educators in TVET programs and identifying the barriers to integrating AI and IoT into their teaching practices. By employing a mixed-methods approach, including surveys and interviews, this research will evaluate educators' current capabilities and pinpoint specific training needs to enhance their proficiency in precision agriculture technologies. Unlike prior studies that broadly explore AI and IoT applications in agriculture, this study focuses specifically on educators' roles, offering actionable insights to develop targeted professional development programs. By addressing these gaps, the research aims to empower educators to effectively incorporate AI and IoT into agricultural education, ultimately preparing students for the demands of modern, technology-driven agriculture.

Objectives of the research

The main objective of this thesis is to assess the level of digital literacy among agricultural educators and to identify strategies for enhancing their capacity to effectively adopt AI and IoT-based precision agriculture technologies.

The specific objectives of this study are to:

i. assess their current level of digital literacy and their familiarity with AI and IoT-based precision agriculture technologies.

ii. identify the specific digital skills and knowledge gaps that hinder the effective adoption of these technologies by agricultural educators.

iii. Investigate the perceived barriers and challenges faced by agricultural educators in integrating AI and IoT technologies into their teaching and outreach programs.

Research Questions

This research addressed the following key questions:

i. How proficient are agricultural educators in [specific region/country] in utilizing digital tools and platforms relevant to precision agriculture?
ii. Identify the specific digital skills and knowledge gaps that hinder the effective adoption of these technologies by agricultural educators.
iii. What are the primary obstacles preventing agricultural educators from effectively integrating AI and IoT technologies into their curriculum and extension activities?

Methodology

This study employed a descriptive survey design to assess the digital literacy levels of agricultural educators in relation to AI and IoT-based precision technologies. The study was carried out at Lagos State university of Education, Epe Campus and thew Federal College of Education (Technical), Akoka, Lagos State. The target population consisted of 69 agricultural education lecturers, all of the lecturers were selected as respondents because of the relatively small number, enabling a total enumeration approach to ensure comprehensive data collection. A structured questionnaire tagged "ADL-AAIOT" was developed specifically for this purpose, with sections that capture demographic information such as age, years of teaching experience, and academic qualification. The core part of the questionnaire focused on assessing the respondents' digital literacy concerning AI and IoT, with items designed to measure familiarity, skills, and confidence in using these technologies. Responses were rated on a Likert scale, ranging from strongly disagree to strongly agree. To ensure the validity and reliability of the instrument, the questionnaire was reviewed by experts in the field for content validity. A pilot study involving 10 respondents was conducted to evaluate the internal consistency of the items, with a target Cronbach's alpha of at least 0.70. Data collection was carried out through self-administered questionnaires, which was distributed physically. For data analysis, responses were summarized using descriptive statistics, particularly means and standard deviations, to gauge the overall digital literacy levels among the respondents. The mean scores was interpreted to categorize literacy levels: a mean of 3.5 or higher indicated high digital literacy; scores between 2.5 and 3.49 reflected moderate literacy; and those below 2.5 denoted low literacy. The analysis was conducted using SPSS. This approach provided an objective measure of the respondents' competencies, guiding recommendations for targeted training or interventions to enhance their adoption of AI and IoT-based precision agriculture technologies.

Results and Presentation

Research Question: How proficient are agricultural educators in Lagos State in

utilizing digital tools and platforms relevant to precision agriculture?

Table 1: ***Mean responses of respondent on the Current Level of Digital Literacy and Familiarity with AI and IoT-Based Precision Agriculture Technologies (Research Question 1)***

Item No.	Statement	Mean	SD	Interpretation
1	I am confident in using basic digital tools (e.g., computers, tablets, or smartphones) for teaching agricultural concepts.	3.80	0.75	High
2	I have experience using AI-based tools (e.g., predictive analytics or decision-support systems) in agricultural education.	2.70	0.90	Moderate
3	I am familiar with IoT devices (e.g., soil sensors, weather stations) used in precision agriculture.	2.90	0.85	Moderate
4	I can effectively integrate digital platforms (e.g., learning management systems) into my teaching to support student learning.	3.20	0.80	Moderate
5	I understand how AI algorithms can analyze agricultural data to improve crop management practices.	2.80	0.88	Moderate
6	I have used virtual simulations or software to teach precision agriculture techniques in my classes.	2.60	0.92	Moderate
7	I am comfortable troubleshooting basic technical issues with digital tools used in agricultural education.	3.50	0.78	High
8	I have knowledge of IoT applications for real-time monitoring of farm conditions (e.g., irrigation or soil moisture).	3.00	0.84	Moderate
9	I regularly incorporate digital resources (e.g., online databases or apps) to enhance my teaching of agricultural topics.	3.40	0.79	Moderate
10	I feel proficient in explaining AI and IoT concepts to students in the context of precision agriculture.	2.90	0.87	Moderate
Overall		3.10	0.82	Moderate

Table 1 shows the overall mean score of 3.10 indicates a moderate level of digital literacy among agricultural educators in Lagos State, suggesting a foundational proficiency in utilizing digital tools for precision agriculture. The standard deviation of 0.82 reflects moderate variability, indicating differences in familiarity across respondents. High mean scores for basic digital tool confidence (3.80) and troubleshooting (3.50) suggest strong general digital skills, while lower scores for AI-based tools (2.70) and virtual simulations (2.60) highlight limited experience with advanced technologies.

Research Question: What are the specific digital skills and knowledge gaps that hinder the effective adoption of AI and IoT technologies by agricultural educators?

Table 2: ***Mean responses of respondent on the Specific Digital Skills and Knowledge Gaps***

Item No.	Statement	Mean	SD	Interpretation
1	I lack sufficient training in using AI tools for agricultural data analysis.	3.60	0.76	High
2	I find it challenging to understand how IoT devices collect and process data for precision agriculture.	3.30	0.80	Moderate
3	I need more knowledge about integrating AI-driven analytics into my teaching curriculum.	3.40	0.79	Moderate
4	I am unsure how to use virtual or augmented reality tools to teach precision agriculture concepts.	3.20	0.85	Moderate
5	I lack skills in managing and interpreting data from IoT sensors used in farming.	3.50	0.77	High
6	I feel unprepared to teach students how to use AI-based decision-support systems for crop management.	3.30	0.81	Moderate
7	I need training on incorporating digital platforms (e.g., learning management systems) into agricultural education.	3.70	0.75	High
8	I find it difficult to stay updated with the latest AI and IoT advancements in agriculture.	3.40	0.80	Moderate
9	I lack confidence in designing lessons that incorporate AI and IoT for hands-on learning.	3.50	0.78	High
10	I need more resources or training to effectively teach precision agriculture technologies to students.	3.80	0.74	High
Overall		3.45	0.78	Moderate

Table 2 shows the overall mean score of 3.45, close to the high literacy threshold (≥ 3.5), suggests that agricultural educators perceive notable but not critical skills and knowledge gaps in adopting AI and IoT technologies. The standard deviation of 0.78 indicates moderate variability in responses. High mean scores for needing resources (3.80), training in digital platforms (3.70), and AI/IoT lesson design (3.50) reflect a strong demand for professional development, while moderate scores for VR/AR tools (3.20) and IoT data understanding (3.30) indicate specific areas of difficulty.

Research Question: What are the primary obstacles preventing agricultural educators from effectively integrating AI and IoT technologies into their curriculum and extension activities?

Table 3: Mean *responses of respondents on the Perceived Barriers and Challenges*

Item No.	Statement	Mean	SD	Decision
1	Limited access to AI and IoT technologies (e.g., sensors, software) hinders my ability to teach precision agriculture.	3.80	0.80	High
2	Insufficient funding for digital tools and training is a major barrier to integrating AI and IoT in my teaching.	3.90	0.76	High
3	Lack of institutional support (e.g., policies or infrastructure) prevents effective use of AI and IoT in education.	3.70	0.82	High
4	I face challenges due to inadequate internet connectivity or technological infrastructure at my institution.	3.60	0.84	High
5	Time constraints make it difficult to learn and implement AI and IoT technologies in my teaching.	3.50	0.79	High
6	Students' lack of prior exposure to digital tools complicates teaching AI and IoT-based agriculture concepts.	3.40	0.86	Moderate
7	I perceive a lack of relevant professional development opportunities for AI and IoT in agricultural education.	3.80	0.77	High
8	Ethical concerns about AI (e.g., data privacy or bias) make me hesitant to adopt these technologies in teaching.	3.20	0.90	Moderate
9	The complexity of AI and IoT systems makes it challenging to integrate them into my curriculum.	3.70	0.81	High
10	Resistance from colleagues or administration to adopt new technologies hinders AI and IoT integration in education.	3.30	0.88	Moderate
Overall		3.60	0.85	High

Table 3 shows the overall mean score of 3.60 indicates a high level of perceived barriers, suggesting significant obstacles to integrating AI and IoT technologies into agricultural education. The standard deviation of 0.85 shows moderate variability, reflecting differences in perceived barrier severity. High mean scores for funding (3.90), access to technologies (3.80), and professional development (3.80) highlight critical resource and training constraints.

Discussion of Findings

Table 1 indicates a moderate level of digital literacy among agricultural educators

in Lagos State, suggesting a foundational proficiency in utilizing digital tools for precision agriculture. This is in line with the study of Rodrigues, 2023 which highlighted limited utilization of AgTech in educational programs, emphasizing the need for improved teacher training in advanced digital tools. The study by Rathore (2022) noted that while basic digital skills are often strong among agricultural professionals, there is typically less familiarity with advanced

technologies like AI and virtual simulations. This aligns with the findings of this study, suggesting that while foundational digital literacy exists, there remains a gap in the adoption of more sophisticated digital tools in agricultural education. The findings align with the study of Ayodele (2024) indicating that while agricultural educators possess foundational digital skills, there is a notable gap in advanced technology usage. Similarly, Ojo and Adebayo (2022) found that educators often struggle with integrating advanced digital technologies into their practices, underscoring the need for targeted professional development in these areas.

Table 2 indicated that agricultural educators recognize significant, yet not critical, gaps in their skills and knowledge regarding AI and IoT technologies. The overall mean score of 3.45 suggests a need for improvement, particularly in professional development areas. This is supported by the study of Jayashree et al (2024) which reported a moderate score for VR/AR tools (3.20) and IoT data understanding (3.30) highlight particular challenges educators face in adopting these technologies. The finding is in agreement with the study of McKay *et al* (2022) which highlighted agricultural educators' perceived gaps in skills and knowledge for adopting digital media, aligning with literature emphasizing the need for professional development in technology integration. The study by Patel *et al* (2024) highlights a significant awareness of AI-based technologies among agricultural extension professionals, with a mean score indicating notable skills gaps hence aligns with findings of this present study.

Table 3 revealed that the majority of the respondents agreed on significant challenges faced by students and educators regarding perceived barriers to integrating AI and IoT technologies into agricultural education. The overall mean score of 3.60 indicates a high level of perceived barriers, with specific areas such as funding, access to technologies, and professional development showing critical resource constraints. The findings aligns with study of Jayashree *et al* (2024) which reported a mean score of 3.90 suggests that financial limitations are a primary obstacle, as many educational institutions struggle to secure necessary funding for technology integration. The findings also is in corroboration with the study of Abi et al (2024) which identified challenges in IoT adoption in agriculture, including technology integration and costs, aligning with the high perceived barriers in education. It emphasizes the need for further research on resource constraints, such as funding and professional development, to address these issues

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Adult Literacy and Farmers' Adoption of Agricultural Innovation in South-East, Nigeria

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Abstract

One of the aims of adult literacy is to equip farmers with the skills of reading, writing, and counting in order to be open to innovations, including agricultural operations. However, an empirical link between adult literacy and farmers' adoption of agricultural innovation in south-east Nigeria is currently lacking in the literature. This study established the relationship between adult literacy and farmers' adoption of agricultural innovation in south-east Nigeria. A quantitative method and correlational survey research design were adopted for the study. Three hundred and seventy-nine respondents were used for the study. Multistage sampling procedures were used for the study. The instrument for data collection was a 44-item structured questionnaire titled Adult Literacy and Agricultural Innovation Farmers' Adoption Questionnaire (ALAIFAQ). The instrument was face-validated by three experts. The Cronbach Alpha reliability method was used to estimate a reliability coefficient of.76. The data collected for the study was analysed using Pearson Product Moment Correlation to answer research questions and test the null hypotheses at the 0.05 level of significance. It was found that adult literacy to a significant positive high extent correlates with farmers' awareness, a significant positive moderate extent correlates with farmers' interest, a non-significant positive low extent correlates with farmers' evaluation, a significant positive high extent correlates with farmers' trials, and a significant positive high extent correlates with farmers' adoption of agricultural innovation for sustainable development in South-East Nigeria. It was recommended, among others, that farmers advance their literacy to increase their rate of adoption of agricultural innovations.

Keywords: farmers' adoption, adult literacy, agricultural innovation, farmers, south-east Nigeria,

Introduction

Agriculture is an essential sector in Nigeria, and it contributes significantly to the country's Gross Domestic Product (GDP). According to the National Bureau of Statistics (2021), agriculture contributed 21.97% of Nigeria's GDP in the fourth quarter of 2020. To further increase this contribution in Southeastern Nigeria, there is a need for farmers to adopt agricultural innovations, which requires advancing their literacy levels. In the submission of Faure (2019), agricultural innovation is a product of social negotiation, as an intrinsic characteristic of farmers is that they innovate to sustain and improve their production systems. Asogwa (2018) described agricultural innovation as the process of creating and putting into use combinations of agricultural knowledge, principles, and practices (KPP) from many different sources, like researchers, farmers, and consumers. The knowledge, principles, or practices may not be brand new but are usually a combination of existing ones. Glover et al. (2019) noted that agricultural innovation has to be novel to the farmer, group of farmers, or place of adoption during diffusion but may not be necessarily new globally. The adoption of agricultural innovations is essential for increasing productivity among farmers and the sustainable development of the sector (Carmela Annosi et al., 2020).

Adoption, in the submission of Rogers (1983), is the use or nonuse of a new technology by a farmer over a given period of time. It could be individual (farm-level) or aggregate adoption. In distinguishing them, Feder et al. (1985) defined individual (farm level) adoption as the degree of use of a new technology (innovation) in a long-run equilibrium when the farmer has full information about the new technology and its potential, while aggregate adoption (diffusion) was the process of spreading a technology within a region. Thirtle and Ruttan (1987) defined aggregate adoption as the spread of a new technique within a population. The implication is that aggregate adoption is measured by the aggregate level of use of a given technology within a given geographical area. Hassan (1996) clarified that the adoption decision process includes the simultaneous choice of whether to adopt a technology or not and the intensity of its use. The author emphasised that before adoption choices are made, a farmer makes a set of several interdependent decisions.

Furthermore, Rogers (1983) identified five stages in the adoption of agricultural innovation among farmers, irrespective of whether they were individual farmers, farmers' groups, or whole communities. The stages are: (1) *Awareness:* This is a stage where a farmer learns of the existence of the idea but knows little about it. (2) *Interest:* Here, the farmer develops a feeling of curiosity or concern about the idea and seeks more information about it from either a friend or the extension agent. (3) *Evaluation:* This is the stage at which the farmer judges if the new idea will be of benefit or disadvantage to his farming operations and how difficult it might be to put into practise. The farmer may seek further information or go to a demonstration or meeting and then decide whether or not to try out the new idea. (4) *Trial:* At this stage, the farmer decides to try the idea on a small scale. For example, they may decide to put manure or fertiliser on a small part of one field and compare the result with the rest of the field. To do this, they seek advice on how and when to apply fertiliser or manure. (5) *Adoption:* If the farmer is convinced by the trial, he or she accepts the idea fully for adoption, and it becomes part of his or her customary farming practices.

However, the capacity of farmers to adopt agricultural innovations is significantly influenced by their level of literacy (Llewellyn & Brown, (2020). Nmadu (2015) and Onyeneke (2017) found that the rate of adoption of agricultural innovations among individual or group farmers is impacted by several factors, such as level of education, attitude of farmers, financial status of the farmer, farm size, presence of extension agents, and results of demonstration plots. Asogwa et al. (2014) and Yoon et al. (2020) revealed that farmers' level of education is one of the most important factors affecting their rate of adoption of agricultural innovations. Similarly, Odoemenem and Obinne (2010) and Duru et al. (2018) reported that the present level of education among farmers in south-east Nigeria is low, with only 23.6% having completed secondary school. According to Duru et al. (2018), the majority of farmers in Nigeria's southeast region have only primary education, 14.3% have a secondary education, and 1.9% have a higher degree. This shows that to enhance farmers' accessibility to knowledge and adoption rates of agricultural innovations in South-East Nigeria, there is a need to improve adult literacy in South-East Nigeria.

Adult literacy is the practice of teaching reading, writing, and numeracy knowledge, skills, or values to adults who lack these abilities (Gal et al., 2020). As an aspect of adult education, it is classified into four

areas: functional literacy, written literacy, mathematical literacy, English as a Second or Other Language (ESOL), and cultural literacy (Cun, 2022). The National Centre for Education Statistics (NCES) explained that adult literacy programmes aim to improve individuals', like farmers, employment opportunities, community involvement, health outcomes, and overall quality of life (Kutner et al., 2007; Omoregie & Oyelami, 2021). Zossou et al. (2020) buttressed that adult literacy in agriculture extension is designed to help farmers understand and communicate their challenges effectively and also access and adopt agricultural innovations from research institutes.

In South-East Nigeria, farmers' adoption of agricultural innovation is low, and this affects their productivity, whereas adult literacy plays an important role in their adoption of agricultural innovation. For farmers to use new technologies and practice them effectively, they must have the ability to read and comprehend information. This is especially true in the face of rapid technological advancement, as new methods and tools are constantly being introduced into the agricultural sector. Farmers can keep up with the most recent technologies and use them to improve their yields and livelihoods with more access to educational resources, such as adult literacy programmes. Despite the endorsement of a policy on adult education by the Central Board of Education in 1951 (Nnazor, 2005), a focused group interaction by the researchers with 9 extension officers, 3 from each state in south-eastern Nigeria, confirmed that farmers' rate of adoption of agricultural innovation is still very slow compared to neighbouring states. The agents expressed that their biggest challenges are the farmers' level of education and financial status. Therefore, further research was required to ascertain if adult literacy correlates with farmers' adoption of agricultural innovation, and if it does, to what extent it correlates with farmers' adoption of agricultural innovation in south-east Nigeria. Consequently, this study aims to investigate the relationship between adult literacy and farmers' adoption of agricultural innovation in the south-east of Nigeria. The result can be used to develop strategies for increasing farmer adoption rates and, as a result, agricultural productivity in the region. It could also provide valuable insights for policymakers and development practitioners working to improve agricultural productivity in the region.

Purpose of the Study

The purpose of the study was to investigate the extent to which adult literacy facilitated and farmers' adoption of agricultural innovation in South-East Nigeria. Specifically, the study determined the extent to which adult literacy correlates with:

1. farmers' awareness of agricultural innovation in south-east Nigeria;
2. farmers' interest in agricultural innovation in south-east Nigeria;
3. farmers' evaluation of agricultural innovation in south-east Nigeria;
4. farmers' trial of agricultural innovation in south-east Nigeria; and
5. farmers' adoption of agricultural innovation in south-east Nigeria

Research questions

1. To what extent does adult literacy correlate with farmers' awareness of agricultural innovation in the south-east of Nigeria?
2. What is the extent to which adult literacy correlates with farmers'

interest in agricultural innovation in the south-east of Nigeria?
3. To what extent does adult literacy correlate with farmers' evaluations of agricultural innovation in the south-east of Nigeria?
4. What is the extent to which adult literacy correlates with farmers' trials of agricultural innovation in the south-east of Nigeria?
5. To what extent does adult literacy correlate with farmers' adoption of agricultural innovation in the south-east of Nigeria?

Hypotheses

1. Adult literacy significantly correlates with farmers' awareness of agricultural innovation in the south-east of Nigeria.
2. Adult literacy does not significantly correlate with farmers' interest in agricultural innovation in the south-east of Nigeria.
3. Adult literacy significantly correlates with farmers' evaluations of agricultural innovation in the south-east of Nigeria.
4. Adult literacy does not significantly correlate with farmers' trials of agricultural innovation in the south-east of Nigeria.
5. Adult literacy significantly correlates with farmers' adoption of agricultural innovation in the south-east of Nigeria.

Theoretical Framework

The theory underpinning this correlation study is diffusion theory, which believes that adult literacy improves farmers' ability to learn and apply new agricultural practices, resulting in increased productivity and sustainable development. Everett Rogers (1987) proposed diffusion theory, which is particularly relevant to this study since it describes how new ideas and inventions spread throughout a society, including in the setting of agriculture. This theory aided in identifying the characteristics that influence farmers' adoption of sustainable agricultural practices in South-East Nigeria, such as relative advantage, compatibility, complexity, trialability, and observability. Understanding these factors allows policymakers, extension agents, and adult educators to create literacy interventions that promote the adoption of sustainable farming practices in the region.

Methodology

This study adopted a quantitative method with a correlational survey research design. Quantitative research is the act of collecting and analysing numerical data in order to create predictions, evaluate causal linkages, and generalise results to larger populations (Bhandari, 2022). This design is suitable because the study established a relationship between two variables: independent, which is "adult literacy" and independent, which is "farmers' adoption of agricultural innovation". Secondly, a group of people were studied by collecting information from a representative of a population using a structured questionnaire, and the findings were generalised to the entire population. The study was carried out in South-East Nigeria, which is made up of five states: Abia, Anambra, Ebonyi, Enugu, and Imo, as shown in figure 1.

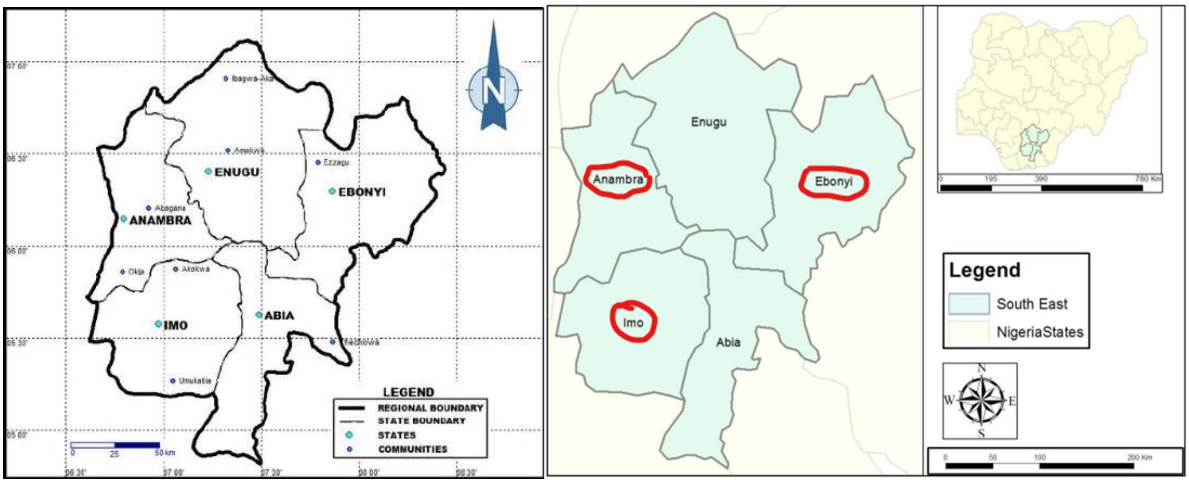

Figure 1: Map of South-East Nigeria (Anejionu et al., 2013).

Using the Roasoft calculator (2023), a sample size of 385 was estimated at 5% marginal error, 95% confidence level, 50% population proportion, and unlimited population size. The application of Roasoft to estimate a specified value helped to maximise the sampling error and statistically represent the entire population so that generalisations of the findings can be reliably made for a wider context.

Firstly, a stratified proportionate simple random sampling technique was used to select three from the five states, which resulted in Anambra, Ebonyi, and Imo being chosen. This technique was employed to give each state equal chances of being selected. Secondly, a simple random sampling technique was also used to sample one agriculture zone from each of the three states selected, summing up to three zones. Thirdly, the stratified proportionate sampling (SPS) technique was used to establish the number of respondents from the selected agriculture zone in each of the three states, thus: 164 from the Awka zone in Anambra, 56 from Ebonyi South in Ebonyi, and 108 from Okigwe in Imo State. The SPS technique gave sampled states and zones relative chances of selection according to their populations. Fourthly, a simple random sampling technique was used to pick each individual farmer who responded to the questionnaire.

However, due to the difficulty of data collection in developing countries and the usability of the returned questionnaires, a reserve of 33% was added. Therefore, 600 questionnaires were first distributed (300 in each state and/or 30 in each community). Although 290 questionnaires from Ebonyi and 190 from Anambra states were returned, complete information necessary for this study was available in only 259 and 141 questionnaires from Ebonyi and Anambra states, respectively. Therefore, the final sample size used in the study was 400 farm households. The field survey was very intensive and was carried out during the months of October and November 2011. The questionnaire was pre-tested and modified as required prior to final administration.

The instrument used for data collection was a 37-item structured questionnaire developed by the researchers from a literature review and titled the Adult Literacy and Agricultural Innovation Farmers' Adoption Questionnaire (ALAIFAQ). The instrument was divided into three parts. Part A dwelt on demographic variables of the respondent; part B focused on

the participation of farmers in literacy programmes; and part C centred on farmers' adoption of agricultural innovation. This last part was further subdivided into farmers' awareness, farmers' interest, farmers' evaluation, farmers' trials, and farmers' adoption of agricultural innovation for sustainable development in South-East Nigeria to cover the 5 research objectives.

The items on Parts B and C were structured on a four-point scale of strongly agree, agree, disagree, and strongly disagree, with corresponding values of 4, 3, 2, and 1, respectively. The instrument was face-validated by three experts: one from the Department of Adult Education, one from the Department of Agricultural Education, and the other from the Department of Agricultural Extension at the Michael Okpara University of Agriculture, Umudike. Their corrections and suggestions were used to improve the initial copy for the production of the final copies of the questionnaire. There was item mobility from 52 items on the initial draught to 44 on the final version of the questionnaire. Thirty-five copies of the ALAIFAQ were administered to 35 farmers in Benue State who were not part of the study but have similar characteristics by virtue of their farming operations. The Cronbach's alpha reliability method was used to estimate the internal consistency of the questionnaire items. A reliability coefficient of.76 was obtained, which implied that the questionnaire items were reliable for the study. Five research assistants who were familiar with the area of study and fluent in the language were hired and given orientation on how to administer and retrieve the questionnaire from respondents. Four hundred copies of the questionnaire were administered, but 379 copies were retrieved, giving a retrieval rate of 94.75%.

The data collected for the study was analysed using Pearson Product Moment Correlation to answer research questions and test the null hypotheses at the 0.05 level of significance since the study was designed to establish a relationship and the strength of the relationship between variables: adult literacy and farmers' adoption of agricultural innovation. The extent or strength of the relationship between the variables was interpreted using Creswell's (2008) correlation coefficient scale, which says that.70–1.00 = strong or high,.30–.69 = moderate or medium, and.00–.29 = none (.00) to weak or low. Creswell asserted that correlation coefficients can range from -1.00 to +1.00, with positive numbers being used to identify a positive relationship and negative numbers being used to identify a negative relationship, while no linear association is indicated with a correlation coefficient of 0.00. Asterisks are often used to indicate correlations that are statistically significant in Pearson Product Moment Correlation Analysis (Briggs, 2019; Slavin, 2007). Statistical significance for correlational research indicates that the probability of any obtained correlation coefficient between two variables is due to chance less than.05 or.01 (depending on which cutoff a researcher has selected). Therefore, the hypothesis of no significant difference was rejected where the p-value was less than the alpha-value of.05 but not rejected where the p-value was greater than or equal to the alpha-value of.05. All statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) software version 20.0.

Ethical Consideration

The Ministry of Agriculture in Umuahia, Abia State, was approached for ethical approval. The cover page of the instruments was a consent letter to present the study and ask approval from the respondents prior to

participation because it was optional. The goal of the study and the method of data collection were explained to participants. The materials used to acquire the data were solely available to the research team. The respondents were permanently protected because no portion of the instrument contained information that might be used to track down a specific individual after data collection. The respondents' identities were kept anonymous, and only their gender was recorded for data analysis. Respondents were informed that they might opt out of the study at any moment. All of the materials recovered were kept in a locked cabinet, and the computer data was password protected. The acquired data was treated confidentially, thoroughly evaluated, and discussed for this academic objective. This article has been verified for plagiarism and has remarkable uniqueness.

Results

The results of the data analysis for answering research questions and testing hypotheses are presented in Tables 1 to 5.

Table 1: Correlation Matrix of Adult Literacy and Farmers' Awareness of Agricultural Innovation

		Adult literacy	Farmers' awareness
Adult literacy	Pearson Correlation	1	.755*
	Sig. (2-tailed)		.008
	N	379	379
Farmers' awareness	Pearson Correlation	.755*	1
	Sig. (2-tailed)	.008	
	N	379	379

*. Correlation is significant at the 0.05 level (2-tailed).

Table 1 indicates a correlation coefficient of.76, which is positive and within the range of.70 to 1.00. This indicates that adult literacy, to a high positive extent, correlates with farmers' awareness of agricultural innovation. The table also shows a p-value of.01, which is less than the alpha value of.05. This means that adult literacy significantly correlates with farmers' awareness of agricultural innovation in south-east Nigeria. Therefore, the hypothesis that adult literacy significantly correlates with farmers' awareness of agricultural innovation in south-east Nigeria was upheld.

Table 2: Correlation Matrix of Adult literacy and farmers' interest in agricultural innovation

		Adult literacy	Farmers' interest
Adult literacy	Pearson Correlation	1	.617*
	Sig. (2-tailed)		.036
	N	379	379
Farmers' interest	Pearson Correlation	.617*	1
	Sig. (2-tailed)	.036	
	N	379	379

*. Correlation is significant at the 0.05 level (2-tailed).

Table 2 indicates a correlation index of.62, which is positive and within the range of.30 to.69. This shows that adult literacy, to a moderate positive extent, correlates with

farmers' interest in agricultural innovation. The table also shows a p-value of.04, which is less than the alpha value of.05. This indicates that adult literacy significantly correlates with farmers' interest in agricultural innovation in South-East Nigeria. Therefore, the hypothesis that adult literacy does not significantly correlate with farmers' interest in agricultural innovation in South-East Nigeria was rejected.

Table 3: Correlation Matrix of Adult literacy and farmers' evaluation of agricultural innovation

		Adult literacy	Farmers' evaluation
Adult literacy	Pearson Correlation	1	.230
	Sig. (2-tailed)		.201
	N	379	379
Farmers' evaluation	Pearson Correlation	.230	1
	Sig. (2-tailed)	.201	
	N	379	379

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 reveals a correlation coefficient of.23, which is positive and within the range of.00 to.29. This indicates that adult literacy, to a low positive extent, correlates with farmers' evaluations of agricultural innovation. The table also shows a p-value of.20, which is greater than the alpha value of.05. This means that adult literacy does not significantly correlate with farmers' evaluations of agricultural innovation in south-east Nigeria. Therefore, the hypothesis that adult literacy significantly correlates with farmers' evaluations of agricultural innovation in south-east Nigeria was not upheld.

Table 4: Correlation Matrix of Adult literacy and farmers' trial of agricultural innovation

		Adult literacy	Farmers' trial
Adult literacy	Pearson Correlation	1	.703
	Sig. (2-tailed)		.001
	N	379	379
Farmers' trial	Pearson Correlation	.703	1
	Sig. (2-tailed)	.001	
	N	379	379

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4 indicates a correlation index of.70, which is positive and within the range of the correlation coefficient of.70 to 1.00. This shows that adult literacy, to a highly positive extent, correlates with farmers' trials of agricultural innovation. The table also shows a p-value of.00, which is less than the alpha value of.05. This indicates that adult literacy significantly correlates with farmers' trials of agricultural innovation in south-east Nigeria. Therefore, the hypothesis that adult literacy does not significantly correlate with farmers' trials of agricultural innovation in southeast Nigeria was rejected.

Table 5: Correlation Matrix of Adult literacy and farmers' adoption of agricultural innovation

		Adult literacy	Farmers' adoption
Adult literacy	Pearson Correlation	1	.811
	Sig. (2-tailed)		.000
	N	379	379
Farmers' adoption	Pearson Correlation	.811	1
	Sig. (2-tailed)	.000	
	N	379	379

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5 shows a correlation coefficient of.81, which is positive and within the range of.70 to 1.00. This indicates that adult literacy, to a high positive extent, correlates with farmers' adoption of agricultural innovation. The table also reveals a p-value of.00, which is less than the alpha value of.05. This means that adult literacy significantly correlates with farmers' adoption of agricultural innovation in southeast Nigeria. Therefore, the hypothesis that adult literacy significantly correlates with farmers' adoption of agricultural innovation in southeast Nigeria was upheld.

Discussion of Results

The findings of the study in Table 1 indicate that adult literacy correlates to a significant, high-positive extent with farmers' awareness of agricultural innovation. This implies that as farmers' literacy increases, their awareness of agricultural innovation also increases. Amusan et al. (2021) affirmed that livestock systems but negatively correlated with the adoption of agroforestry systems, although these correlations were weak (Segnon et al., 2015).

Table 2 indicates that adult literacy significantly moderately positively correlates with farmers' interest in agricultural innovation in the south-east of Nigeria. The implication is that as farmers advance in literacy, their interest in agricultural boosting adult literacy in south-east Nigeria could lead to improved awareness of agricultural innovation among farmers, which could contribute to the region's long-term growth. As a result, investing in adult literacy programmes could be a major strategy for encouraging economic growth and reducing poverty in the area. In the same vein, the World Bank reported that Nigerian farmers find it difficult to adopt modern agricultural technologies and practices because of their poor literacy and education levels, which ultimately limits their country's potential for economic growth and poverty eradication (Maddison, 2007). Agba et al. (2014) noted that the growth of the South-East Nigerian region's economy may be significantly impacted by adult literacy programmes and financial literacy initiatives. Also, farmers' knowledge of crop diversity management in cropping systems was positively correlated with involvement in crop-tree-

innovation also increases. This shows that raising literacy among farmers could be a viable technique for increasing their interest in adopting sustainable agricultural practices, such as agroforestry systems, which can benefit both the environment and their livelihoods (Mbow et al., 2014). This result is in line with the results of Segnon et al. (2015), who found that farmers' intention to adopt agroforestry systems was significantly affected by the ecological region where farmers operated, sociolinguistic

membership, and land tenure. Besides, Seyoum and Amdemeske (2016) found that the relationship between overall adult learning achievement and assessment of

learning was positive and significant. The authors also found that the methods used by facilitators correlated positively and significantly.

Table 3 reveals that adult literacy, to a non-significantly low positive extent, correlates with farmers' evaluations of agricultural innovation in south-east Nigeria. This means that an increase in farmers' literacy to a lesser degree results in their evaluation of agricultural innovation in south-east Nigeria. According to the findings, while adult literacy is vital for farmers to evaluate agricultural innovation, other factors may also play a key role in their decision-making process. This result is in conformity with the result of Sadati et al. (2010), which showed that there was a positive correlation between literacy, participation in extension courses, off-farm income, farmer's knowledge about sustainable agriculture, level of use of sustainable agriculture methods, extension contacts, and job satisfaction, and a negative correlation between age, experience in agricultural activities, family size, and agrarian land with attitude towards sustainable agriculture. In addition, Zheng and Lin (2018) found that there is a strong positive correlation between agricultural economic growth and the degree of agricultural industrial agglomeration in China. As the agricultural economy grows, the degree of agricultural industrial agglomeration gets better, and the improvement in the degree of agricultural industrial agglomeration promotes agricultural product specialisation, thus imposing a reaction on the agricultural economy itself. Mustapha et al. (2022) found that education and income correlated highly positively with the knowledge, attitude, and practice level of the farmers and extension workers.

Table 4 indicates that adult literacy correlates to a significantly high positive extent with farmers' trials of agricultural innovation in south-east Nigeria. This indicates that farmers' literacy is remarkably directly proportional to farmers' trials of agricultural innovation in the south-east of Nigeria. As a result, it is critical to engage in adult literacy programmes for farmers and extension workers in order to promote sustainable agricultural practices and boost their capacity to adopt novel techniques. Furthermore, these programmes can increase contact between farmers and extension workers, resulting in a more efficient transmission of information on sustainable agriculture. Kebede and Zizzo (2015) found that experimentally measured money burning on the village level is negatively correlated to real-life agricultural innovations. Segnon et al. (2015) found that farmers' knowledge was positively influenced by the ecological contexts in which they were living, sociolinguistic membership, and socio-demographic factors such as education.

Table 5 shows that adult literacy significantly high positively correlates with farmers' adoption of agricultural innovatiosouth-east-East Nigeria. The result displays that any effort made by the government towards enhancing farmers' literacy results equally in farmers' adoption of agricultural innovation in south-east Nigeria. According to the study, increasing adult literacy rates in south-east Nigeria could lead to increased adoption of sustainable agriculture practises. This could have a good impact on the environment and the livelihoods of farmers in the region. Similarly, Segnon et al. (2015) found that adoption of agroforestry systems was significantly affected by ecological region, sociolinguistic membership, and land tenure but did not vary significantly with their age.

Adesope et al. (2012) posited that increasing farmer education levels in Nigeria may result in the adoption of new agricultural practices, which will ultimately be advantageous to the agricultural economy as a whole. Leitgeb et al. (2011) asserted that promoting environmental consciousness while offering farmers educational opportunities may result in more agricultural inventions and knowledge.

Conclusion

For the past two decades, there have been substantial imbalances between adult literacy and farmers' adoption of agricultural innovation. Low adult literacy rates in South-East Nigeria affect farmers' access to information on new agricultural practices and technologies, as well as their interest in, evaluation, trials, and adoption of new agricultural practices and technologies. To improve farmers' adoption of agricultural innovation in the south-east of Nigeria, it is essential to increase adult literacy rates. Literacy programmes, seminars, and workshops organised by agricultural extension officers and adult facilitators can help increase adult literacy rates and improve farmers' adoption of agricultural innovation. Any government's strategy to promote farmers' literacy levels will certainly enhance farmers' adoption of agricultural innovation in the south-east of Nigeria.

Recommendations

Based on the findings of the study and conclusion, it was recommended that:

1. Farmers should advance their literacy to increase their rate of adoption of agricultural innovations.
2. Adult literacy facilitators and agricultural extension agents should organise literacy programmes, seminars, and workshops for farmers to educate them and help them learn how to read and write to be able to adopt new agricultural practices and technologies;
3. Adult literacy facilitators should work together with agricultural extension agents to increase the relationship between farmers' literacy and their adoption of agricultural innovations.
4. Extension workers should create and administer literacy programmes for farmers in order to increase their uptake of agricultural innovation, and policymakers should prioritise the supply of functional adult literacy education in rural areas.
5. Adult literacy programmes should be prioritised by the government and other stakeholders as a means of increasing farmers' adoption of agricultural innovation, and their curriculum should be adapted to the specific requirements and challenges experienced by farmers in the study region.
6. The Ministry of Education should add more adult literacy programmes to their annual budget to increase farmers' literacy and adoption of agricultural innovations; and
7. Adult educators and agricultural researchers could conduct additional research to look into other factors that might affect farmers' adoption of agricultural practices.

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Interests

In this work, the researchers have no conflict of interest.

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Alt conclusions are original and

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reliable, all writers whose works were consulted but not referenced are hereby recognised.

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CAPACITY BUILDING REQUIRED BY YOUTHS IN SUSTAINABLE RICE PRODUCTION FOR ALLEVIATING FOOD SECURITY CHALLENGES AND ECONOMIC HARDSHIP IN GOMBE STATE

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Abstract

The study was carried out on capacity Building required by youths in sustainable Rice Production for Alleviation of food Security challenges and Economic hardship in Gombe State. The population of the study was 100 made up of 60 Teachers of Agricultural Science in Secondary School and 40 Agricultural Extension workers in the state ministry of Agriculture and Agricultural Development Project (ADP). There was no sampling in the study due to the sizeable number of the population. A 53 items questionnaire developed from literature reviewed was utilized to collect data for the study. Data collected was analyzed using mean and standard deviation. It was found out from the study that the youths in Gombe metropolis and Akko Local Government Area required capacity building in 14 items in planning for rice production, 10 items in pre-planting operation of rice production, 10 items in post-planting operation of rice production, 13 items in processing and marketing of rice produce and 6 items in strategies for engaging the youths in rice production in Gombe state.

Keywords: *Capacity-Building, Rice Production, Food security, challenges and Economic Hardship.*

Introduction

Capacity building according to Olaitan et al (2010) involves the retraining of teachers of agriculture in the operation of computer and access to the internet and their appropriate application to learning in schools in order to reduce to the barest minimum obvious problems associated with lack of adequate exposure and training of teachers to the use of computer in schools. Also, Asogwa et al (2014) stated that capacity building is the effort geared towards improving the level of knowledge, skills and attitude possessed by an individual in a given task or job: Moreover, Abubakar (2020) stated that capacity building entails improving upon the production ability of the vocational agricultural science lectures to be able to meet the current technology and ICT world. In addition to this, Lawal et al (2023) stated that capacity building is the process of equipping teachers of agricultural science with the knowledge, skills, attitude and access to current information and training that will enable the teachers to be proficient and perform well in the task of guiding student in making the right and un-regrettable career choice. In this study capacity building involves packaging the step-by step process of rice cultivation into modules to train the unemployed youths to acquire skills in rice production at a sustainable level.

Sustainable according to Cambridge Dictionary (2025) is the ability to continue something over a period of time. Thesarus.com (2025) stated that sustainable is being able to maintain or keep going, as action process over a period of time. Investopedia (2025) viewed sustainable as being strong enough to continue existing, occurring and happening over a long time without any damage. In this study, sustainable is the ability of the youths in Gombe state to engage in rice production for long period of time so as to achieve food security and alleviation of economic hardship in the state.

Economic hardship in Nigeria is associated with the economic recession of 2016 when Annual Gross Domestic Product Growth continues to decline up to 2.7% and from 2.7% to 1.5% due to prolong shortage of oil production and decline in price of oil in the world market. (Biluet et al 2018). The authors continue that Nigeria economy has drastically slow down due to reduction in the Annual Gross Domestic Product Growth. The implications of this, is that Nigeria Government had to increase the fuel price in order to meet up in the international market. This has led to general hyper-increase in prices of other commodities including food items which has made it difficult for an average Nigerian to afford three square meal a day. In the effort of the Nigerian Government to alleviate the economic hardship came up with Economic Recovery and Growth Plan in which agriculture was outline as a means of the economic recovery through abundance of animals and food Crops such as maize, rice, yam cattle and poultry. Rice production in the northern part of Nigeria particularly Gombe state could be a ready source of economic recovery and alleviation of hardship if produced at a sustainable level.

Rice production according to International Rice Research Institute (IRRI, 2025) is the cultivation and harvesting of rice, the author continue that rice cultivation process begin with field preparation which involves plowing, leveling and creating irrigation channels to manage water flow, it requires careful management and attention to details to ensure a successful harvest. Fiveable (2025) described rice production as the cultivation and harvesting of rice as a staple food crop that is integral to the diet of millions of people worldwide. Moreover Babban Gona (2025) stated that rice production is a complex process from planting to harvesting and post harvesting

activities like drying storage and milling. The author continue that rice production involve the following: site selection and land preparation, seed selection and planting, water management; fertilizer application; pest and disease control; weed management;

Harvesting; drying and storage. In this study rice production involves the ability of unemployed youths in Gombe state to utilize the skills acquired in rice production to cultivate and produce rice to a sustainable level.

The Youths are young energetic boys and girls of age bracket of 16 years to 22 years.

Purpose of the study

The purpose of the this study was determine the capacity building required by youths in sustainable rice production for alleviating food security challenges and economic hardship in Gombe state. Specifically the study sought to:

1. Determine the skills in planning for sustainable rice production where youths in Gombe state required capacity building.

2. Identify the skills in pre-planting operation of rice production where youths in Gombe state required capacity.

3. Determining the skills in pest-planting operation of rice production where youths in Gombe state required capacity building.

4. Ascertain the skills in processing and marketing of rice produce where youths in Gombe state required capacity building.

Some of them attended secondary schools but they did not gain admission to tertiary institutions and they are not tangibly employed in any works. Majority of this youth never attended any school and they are not employed in any trade but roam around the street begging for food for survival (popularly called Almajeri). If these youths that have constituted themselves as nuisance to communities in Gombe state could be trained to acquire skill in rice production and empowered to produce rice to a sustainable level, this will help in the economic recovery thereby alleviating the economic hardship in Nigeria particularly in Gombe state.

5. Identify strategies for engaging the youths in sustainable rice production in Gombe state.

Research Questions

The following research questions guided the study.

1. What are the skills in planning for rice production where the youths in Gombe state required capacity?

2. What are skills in pre-planting operation offer rice production where youths in Gombe state required capacity building?

3. What are the skills in post-planting operations of rice production where youths in Gombe state required capacity building?

4. What are the skills in processing and marketing of rice produce where youths in Gombe state required capacity building?

5. What are the strategies for engaging the youths is sustainable rice production in Gombe state?

Methodology

The study adopted survey research design. Survey design according to Nworgu in

Mustapha et al (2024) involves collecting data on and describing in systematic manners, the characteristic features or facts about a given population. This design is appropriate for this study as the study sought to collect data and the data collected was used to describe the characteristic, features and fact about a population. The population of the study was 100 made up of 60 teachers of agricultural science in Secondary Schools in Gombe metropolis and Akko Local Government area in Gombe state, and 40 Agricultural extension workers in the State Ministry of Agriculture and Agricultural Development Project (ADP).the study was restricted to Akko Local Government Area and Gombe metropolis Local Government Area due to large concentration of agricultural science teachers, ministry of education and agricultural development project extension workers in the two Local Government Areas. There was no sampling due to the sizeable number of the population. A 53 items questionnaire develop from literature reviewed was used to collect data for the study. The questionnaire has the following response options of

Highly Required (HR) moderately (MR) Slightly Required (SR) and Not Required (NR) with corresponding values of 4,3,2 and 1 respectively. The instrument was validated by four (4) experts , two (2) from Agricultural Education unit in the Department of Science Education Federal University of Kashere while the other two (2) experts are from the Department of Agronomy, Faculty of Agriculture, Federal University of Kashere, Gombe State. The suggestion of the validates was incorporated into the final instrument that was used to collect data for the study. The reliability of the instrument was determined through the use of Cronbach Alppha (α) method and a coefficient of 0.78 were obtained. The researchers with the help of four (4) researches assistant administered 100 copies the questionnaire on the respondents and 90 copies were retrieved. The entire questionnaire retrieved were analyzed using mean and standard deviation to answer the research questions. Through the calculation of the arithmetic mean, 2.50 was used as cut-off point. Therefore, any item with a man value of 2.50 or above was regarded as item in which the youths required capacity building while any item with a mean below 2.50 was regarded as an item the youth did not required capacity building on. Any item with low standard deviation indicated that the respondents were not far from the mean and from one another in their responses while any item with high standard deviation indicated that the respondents were far from one another in their responses.

Results

The results are presented in table 1-5

Research Question One: What are the skills in planning for rice production where the youths in Gombe state required capacity?

Answer to research question one are presented in table 1.

Table 1: Mean ratings of the responses of teachers of Agricultural Science and Agricultural extension workers on skills in planning for sustainable rice production where youths in Gombe state required capacity building.

No=90 (T=51, EW=39

S/N	Skills in Planning For Rice Production	$\bar{x}$	SD	Remark
1.	Formulate specific objectives for rice production.	3.35	0.69	CBR
2.	Review the objectives periodically to meet rice production demand.	2.77	0.57	CBR
3.	Draw up programme plan for rice production.	2.58	0.43	CBR
4.	Identify major activities required to achieve the objectives.	4.09	0.44	CBR
5.	Decide and locate the site for rice production.	3.17	0.64	CBR
6.	Acquire the suitable site for rice production.	4.02	0.57	CBR
7.	Select appropriate techniques for rice production.	4.02	0.57	CBR
8.	Identify relevant personnel to assist in rice production.	2.56	0.43	CBR
9.	Make budget for rice production.	3.16	0.89	CBR
10.	Set goals for rice production.	2.56	0.55	CBR
11	Identify relevant inputs for rice production.	3.21	0.35	CBR
12.	Identify suitable management improvement for rice production	3.10	0.34	CBR
13.	Identify market outlet for rice produce.	2.78	0.68	CBR
14.	Identify various records to be kept for rice production.	3.15	0.37	CBR

Key: $\bar{x}$ =Mean, SD= Standard deviation, N=Population, CBR= Capacity building required, CBNR= Capacity buildings not required, T=Teachers, EW= Extension workers

Table 1 revealed that the mean values of the fourteen (14) skill items ranged from 2.56 to 4.09 and were above the cut-off point of 2.50, this indicated that the youths in Gombe state required capacity building in all the (14) skills items in planning for rice production.

Research Question Two: What are skills in pre-planting operation offer rice production where youths in Gombe state required capacity building?

Answer to research question two are presented in table 2.

Table 1 also revealed that the standard deviation of all the 14 skill items ranged from 0.34 to 0.95 and were low, this indicated that the respondents were not far from the mean and from one another in their response and this added credence to the value of the mean

Table 2: Mean rating of the response of teachers of Agricultural Science and Agricultural extension workers on skills in pre-planting operations of rice production where youths in Gombe stated required capacity building

No=90 (T=51, EW=39

S/N	Skills in Pre-planting Operation Rice Production	$\bar{x}$	SD	Remark
1.	Survey the selected site for rice production.	2.90	0.74	CBR
2.	Clear the land of the existing weed and vegetation.	3.65	0.60	CBR
3.	Carry soil testing to determine the soil pH.	2.81	0.76	CBR
4.	Park the refuse and burn.	2.77	0.31	CBR
5.	Stump the site to remove roots from the soil.	3.49	0.77	CBR
6.	Till the soil by plough and Harrow.	3.50	0.41	CBR
7.	Make ridges for planting of rice.	3.71	0.67	CBR
8.	Select the variety of rice seeds to be planted.	3.61	0.60	CBR
9.	Sort healthy seed for planting.	2.51	0.11	CBR
10.	Establish the nutrient status of the soil before planting.	2.55	0.27	CBR

Key: $\bar{x}$ =Mean, SD= Standard deviation, N=Population, CBR= Capacity building required, CBNR= Capacity buildings not required, T=Teachers, EW= Extension workers

Table 2 revealed that the mean values of the ten (10) items ranged from 2.51 to 3.71 and were above the cut-off point of 2.50, this indicated that the youths in Gombe state required capacity building in all the ten (10) skills items in pre-planting operation of rice production. It was also revealed in table 2 that the standard deviation of all the ten (10) items ranges from 0.11 to 0.77 and were low, this indicated that the respondents were not far from the mean and from another in their responses.

Research Question Three: What are the skills in post-planting operations of rice production where youths in Gombe state required capacity building?

Answers to research question Three are presented in table 3.

Table 3: Mean rating of the responses of Agricultural Science teachers and Agricultural extension workers on skills in post-planting operation of rice production where youths in Gombe state required capacity building.

No=90 (T=51, EW=39

S/N	Skills in Post-planting Operation Rice Production	$\bar{x}$	SD	Remark
1.	Plant treated seed at the appropriate planting distance.	2.53	0.51	CBR
2.	Thin seedling to 3 4o 4 seedlings per stand.	3.51	0.53	CBR
3.	Weed rice farm two (2) times before the crop matured (through cultural method & application of herbicides).	3.40	0.61	CBR
4.	Apply fertilizer 2 4o 3 weeks after planting.	3.52	0.23	CBR
5.	Apply insecticide and fungicide to control pest and diseases.	3.12	0.34	CBR
6.	Check and examine the plants for flowering 50-80 days after planting depending on the variety of planted.	3.39	0.57	CBR
7.	Check for maturity 3 to 6 months depending on the variety planted.	3.50	0.59	CBR
8.	Harvest the matured plant and keep in a safe place	3.45	0.29	CBR
9.	Sun-dry harvested rice.	3.11	0.28	CBR
10.	Bag the paddy rice for storage or for sale.	3.15	0.31	CBR

Key: $\bar{x}$ =Mean, SD= Standard deviation, N=Population, CBR= Capacity building required, CBNR= Capacity buildings not required, T=Teachers, EW= Extension workers

Table 3 revealed that the mean value of all the ten (10) items ranged from 3.10 to 3.53 and were above the cut-off point of 2.50, this indicated that all the 10 items were skills in post planting operation of rice where youths in Gombe state required capacity building. Table 3 also shows that the standard deviation of all the ten items ranged from 0.28 to 0.61 and were low this indicate that the respondents were not far from the mean and from one another in their responses and this added credibility to the value of the mean.

Research Question Four: What are the skills in processing and marketing of rice produce where youths in Gombe state required capacity building?

Answers to research question Four are presented in table 4.

Table 4: Mean rating of the responses of Agricultural Science teacher and Agricultural extension workers on skills in processing and marketing of rice produce where youths in Gombe state required capacity building.

No=90 (T=51, EW=39

S/N	Skills in Processing and Marketing of rice produce	$\bar{x}$	SD	Remark
1.	Per boil the paddy rice.	3.14	0.25	CBR
2.	Sun-dry the per-boiled rice to reduce its water content.	3.35	0.42	CBR
3.	Thresh the rice at the mill or locally.	3.15	0.21	CBR
4.	Winnow the threshed rice to remove shaft.	3.02	0.78	CBR
5.	Bag the rice and keep in cool dry place.	2.77	0.13	CBR
6.	Grade rice to meet market demand.	2.55	0.27	CBR
7.	Carry out market survey for the sale of rice.	2.52	0.68	CBR
8.	Locate market for the sale of rice.	3.05	0.20	CBR
9.	Select means of transporting rice to customers.	2.63	0.49	CBR
10.	Fix price for rice to earn the maximum profit.	3.16	0.42	CBR
11	Advertise the sales of rice through market agents.	2.52	0.13	CBR
12.	Distribute rice for customers at their base.	3.54	0.47	CBR
13.	Keep all the appropriate records on rice production and sales.	3.14	0.41	CBR

Key: $\bar{x}$ =Mean, SD= Standard deviation, N=Population, CBR= Capacity building required, CBNR= Capacity buildings not required, T=Teachers, EW= Extension workers

Table 4 revealed that the mean values of all the thirteen (13) items range from 2.52 to 3.54 and were above the cut-off point of 2.50, this indicated that all the 13 items were skills in processing and marketing of rice where youths in Gombe state required capacity building.

Table 4 also showed that the standard deviation of all the 13 items ranged from 0.13 to 0.78 and were low this indicated that the respondents were not far from the mean and from one another in their responses and this ensures the validity of the mean.

Answers to research question five are presented in table 5.

Research Question Five: What are the strategies for engaging the youths is sustainable rice production in Gombe state?

Table 5: Mean ratings of the responses of Agricultural Science teachers and Agricultural extension workers on the strategies for involving and engaging youths in Gombe state in sustainable rice production.

No=90 (T=51, EW=39

S/N	Strategies for engaging Youths in rice Production	$\bar{x}$	SD	Remark
1.	Free land should be made available for interested youth in rice production.	2.81	0.76	SR
2.	Youths should be motivated with the supply necessary farm inputs.	2.77	0.13	SR
3.	Workshop, seminars and conferences should be organized for youths on rice production.	3.67	0.60	SR
4.	The youths that perform very well in rice production should be given an award of recognition.	3.71	0.67	SR
5.	Government should provide an avenue in which the youth can have access to loan.	3.50	0.14	SR
6.	Government should create room for completion among the youth that are involved in rice production by setting a standard for them to meet	2.50	0.27	SR

Key: $\bar{x}$ =Mean, SD= Standard deviation, N=Population, CBR= Capacity building required, CBNR= Capacity buildings not required, T=Teachers, EW= Extension workers

Table 5 revealed that the mean values of all the six (6) items ranges from 2.50 to 3.71 and were above the cut-off point of 2.50, this indicated that all the (6) items were strategies required for engaging youth in sustainable rice production in Gombe state. It was revealed in table 5 that the standard deviation values for all the items ranged from 0.13 to 0.76 and were low, this indicated that he respondents were not far from the mean and from one another I their responses and this make the value of the mean to be reliable.

Discussion of Findings

The study found out that the youths in Gombe state (Gombe metropolis and Akko Local Government Area) required Capacity building in 14 items in planning for rice production, 10 items in pre-planting operations of rice production, 10 items in post-planting operations of rice production, 13 items in processing and marketing of rice produce and 6 items as strategies for involving and engaging the youths in sustainable production of rice. The findings of the study was in agreement with the findings of Ndem et al (2017) in study carried out on competencies required in heliculture by retired university lecturers in post oil boom economy where it was found out that retired university lecturers required 11 competencies in construction of snailry , 14 competencies in feeding snails, 13 management practices in rearing snail and 10 competencies in diseases predators and parasite control. Also the findings of this study is supported by the findings of Abubakar et al (2020) in study carried out on capacity building needs of Agricultural Education lecturers in crop improvement instructional delivery in colleges of Education in Northern Nigeria where it was found out that lecturers in colleges of Education needed capacity building in 17 Mendelian Genetics for crop improvement instructional delivery and 14 Genetic variability among crops improvement instructional delivery.

Moreover, the findings of this study was corroborated by the findings of Suwari and Mathew (2021) in a study carried out on entrepreneurial competencies required by youths for effective engagement in meat storage and preservation occupation in the

COVID-19 pandemic in Bayelsa state, Nigeria. Where it was found out that youths in Bayelsa state required 8 skills in meat storage and 11 skills in meat preservation required by youth in sustainable rice production was in consonance with the finding of Onipede E.(2024) in a study carried out on required capacity building by secondary school graduate in profitable Sesame production for sustainable National Development in a depressed economy where it was found out that secondary school graduate in Gombe state required capacity building in 19 planting skills for sesame production, 8 plantings skills in sesame production, 12 post – planting skills in sesame production and 11 processing and marketing skills of sesame produce and product.

The findings of the study on capacity building required by youth in rice production was in consonance with the finding of lawal *etals(*2014) in a study carried out on competency capacity building needs of agricultural science teacher in utilization of school farm for skills acquisition among secondary school students where it was find out that teachers of agricultural science needed capacity building in 13 items in planning and organizing school far practical to enhance skills acquisition among secondary school student, 8 items in implementing school farm practical, 6 items in coordinating school farm practical and 6 items in evaluation of school farm practical. Moreover, the findings of this study on capacity building required by youth in rice production was corroborated by the findings of Onipede *etal* (2025) in a study carried out on entry level skills required by secondary school graduates for profitable Guinea Fowl domestication and production in Taraba State, where it was find out that secondary school graduates in Taraba State required 7 skill items for domestication of Guinea Fowl, 27 skill items for management of Guinea Fowl, 10 skill items for processing Guinea Fowl and 8 skill item for marketing of Guinea Fowl and its products.

occupation. The findings of this study on capacity building

Conclusion

The study concluded that youth in Gombe state particularly the youth in Gombe metropolis and Akko Local Government Area required capacity building in sustainable rice production for Alleviating food security challenges and economic hardship. Specifically, the youth required capacity building in 14 items in planning for rice production, 10 items in pre-planning operation for rice production, 13 items in processing and marketing rice production and 6 items on strategies for involving the youth in sustainable rice production.

Recommendation

1. It was recommended based on the findings of this study that Gombe state Government should package all the 40 identified skills in rice production (Skill in planning, in pre-planting operation, post-planting operation, processing and marketing of rice) into modules for training the youths at the various vocational centres in the state.

2. it was recommended that the 6 items strategy of involving the youth in sustainable rice production should be implemented by the State Government to enhance the involvement of yoh in sustainable rice production.

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CONTRIBUTION OF CASSAVA FARMERS TO HOUSEHOLD FOOD SECURITY IN THE SOUTHERN AGRO-ECOLOGICAL ZONE OF CROSS RIVER STATE, NIGERIA

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Abstract
This study explores how cassava farming contributes to food security for households in the Southern Agro-Ecological Zone of Cross River State, Nigeria. Cassava, known for its resilience to drought and high nutritional value, serves as both a staple food and a cash crop for many rural families in the region. Despite its importance, there has been little research on how cassava farming specifically impacts food security in this area. To address this gap, the study surveyed 400 cassava farmers, using structured questionnaires to gather data on farming practices, income, and food security. The data were then analyzed using descriptive statistics such as frequencies and percentages and regression analysis. The findings show that cassava farming plays a crucial role in ensuring food availability and supporting household income. About 72% of farmers reported being food secure for most of the year, thanks to the reliable availability of cassava. Moreover, over 60% of farmers stated that cassava farming provides more than half of their household's annual income. However, the study also uncovered several challenges that limit the crop's potential. These include limited access to modern farming practices, low adoption of new technologies, and poor infrastructure. The absence of extension services and the continued reliance on traditional farming methods have further complicated efforts to increase productivity. The study highlights the urgent need for improvements in agricultural practices, better infrastructure, and increased access to extension services. These changes are essential to maximizing the role of cassava in improving food security and boosting economic resilience in the region. The results provide valuable insights for policymakers and development organizations working to strengthen food security and support sustainable agricultural practices in Southern Cross River State.

Keywords: Cassava, Food Security, Household, Southern Agro-Ecological Zone

Introduction

Food security is a critical global issue that affects millions of people, especially in developing countries. In these nations, food security is intricately linked to the availability, accessibility, and stability of food sources, which directly influences the well-being of individuals and communities. For countries like Nigeria, where agriculture forms the backbone of the economy, ensuring that agricultural practices contribute to household food security is a priority. One such agricultural practice that holds promise for enhancing food security is cassava farming, particularly in the Southern Agro-Ecological Zone (SAEZ) of Cross River State.

In Nigeria, agriculture remains a fundamental sector, providing employment for over 60% of the population (Food and Agriculture Organization FAO, 2020). Despite the country's vast potential in food production, food security remains a pressing concern, with millions of Nigerians facing hunger and malnutrition (World Bank, 2022). The Southern Agro-Ecological Zone, known for its favorable climatic conditions and fertile soil, is one of the most agriculturally productive areas in Nigeria. However, the region faces significant challenges, including unpredictable rainfall patterns, soil degradation, and socio-economic factors that hinder optimal agricultural productivity.

Cassava (*Manihot esculenta*) is a resilient crop capable of growing under diverse climatic conditions, including periods of drought, making it a key staple across many countries in sub-Saharan Africa, particularly Nigeria. Cassava's resilience to environmental stresses, along with its relatively low production cost and

high caloric value, has made it an essential crop for food security in the region. It serves as both a primary food source and for many rural households, especially in Cross River State, where it is a major agricultural commodity. Cassava provides a reliable and continuous food supply due to its ability to be harvested at different times of the year, making it an important crop for improving food security at the household level.

Despite the widespread cultivation of cassava in Cross River State, the relationship between cassava farming and household food security has not been thoroughly examined, particularly in the Southern Agro-Ecological Zone. Most studies on cassava farming have focused on its economic potential, yield improvement, or processing techniques, while less attention has been paid to its specific role in enhancing household food security. Understanding how cassava farming influences food security in this region is crucial for policymakers, agricultural practitioners, and development organizations working to improve the livelihoods of smallholder farmers.

Household food security, as defined by the Food and Agriculture Organization of the United Nations (FAO, 2021), refers to the consistent availability of and access to sufficient, safe, and nutritious food that meets the dietary needs and preferences of individuals for an active and healthy life. It is influenced by multiple factors, including agricultural production, income levels, market access, and social safety nets. In rural areas like those in Cross River State, where access to formal markets and income-generating activities may be limited, agriculture, particularly cassava farming, can play a vital role in ensuring food security. By providing both food for consumption and income from sales, cassava has the potential to enhance household food security.

However, while cassava farming is widely practiced in Cross River State, the benefits to household food security are not always fully realized. This may be due to factors such as limited access to high-quality seeds, poor farming practices, low levels of agricultural knowledge, and inadequate infrastructure for processing and marketing cassava. Furthermore, climate change, with its associated impacts on weather patterns, poses an additional threat to cassava production in the region. Therefore, understanding how these factors influence the relationship between cassava farming and food security in the Southern Agro-Ecological Zone is essential to developing strategies that can improve food security outcomes for farmers in the region.

Previous studies have highlighted the importance of cassava as a food security crop in various parts of Nigeria. For instance, Odebode and Olayemi (2019) found that cassava farming significantly contributes to food availability in southwestern Nigeria, where the crop is grown both for subsistence and commercial purposes. Similarly, studies by Okuneye (2021) and Oyewole (2020) indicate that cassava farming provides a critical source of income for smallholder farmers, which in turn supports food security at the household level. However, these studies have largely focused on other regions of Nigeria, with limited research conducted in Cross River State and the Southern Agro-Ecological Zone.

Additionally, while the drought-resistant nature of cassava has been extensively documented, the specific ways in which it contributes to food security in regions prone to irregular rainfall and other climatic challenges have not been thoroughly explored (Adebayo *et al.,* 2022). This gap in knowledge is particularly important in understanding how cassava farming in the Southern Agro-Ecological Zone can act as a buffer against climate-induced food insecurity. By exploring the relationship between cassava farming and household food security in this region, this study aims to fill a critical gap

in the literature and provide insights that can inform local agricultural policies and interventions.

In the Southern Agro-Ecological Zone, cassava cultivation is not just a means of food production; it is a social and economic activity that sustains rural livelihoods. Farmers in this region have traditionally relied on cassava as a primary crop, yet their ability to harness its full potential for food security remains limited by several challenges. These challenges include low adoption of improved farming techniques, lack of access to modern processing technologies, and inadequate support from extension services. Furthermore, while cassava is an important food source, it is often grown alongside other crops, such as yam, and maize, which complicates the assessment of cassava's specific contribution to food security.

In light of these complexities, this study seeks to investigate the direct and indirect ways in which cassava farming influences food security in Cross River State. This study concentrates on the Southern Agro-Ecological Zone to examine the socio-economic contributions of cassava farming, identify the factors that promote or constrain its role in enhancing food security, and assess the extent to which government and development agencies support farmers. The study also seeks to generate evidence on practical ways of strengthening cassava production systems so as to improve household food security, alleviate poverty, and build the capacity of rural communities to cope with climate variability and economic pressures.

Statement of the Problem

Despite cassava's importance as a staple crop and its contribution to food security in Cross River State, Nigeria, there is a significant lack of comprehensive research on its specific role in household food security, especially in the Southern Agro-Ecological Zone. While cassava provides food and income for many rural households, its impact on food availability, accessibility, and stability at the household level remains underexplored. Existing studies have primarily focused on the crop's economic potential or broader agricultural trends, without examining how cassava farming directly affects food security in this particular region.

The socio-economic dynamics surrounding cassava farming further complicate the understanding of its contribution to food security. Factors such as limited access to high-quality planting materials, inadequate agricultural extension services, and the impacts of climate change on crop yields hinder the full potential of cassava to ensure consistent food security. Additionally, the complex nature of rural livelihoods, where farmers engage in multiple agricultural practices beyond cassava cultivation, makes it challenging to isolate the crop's specific role in food security. There is also a lack of region-specific data, especially for Southern Cross River State, where cassava is a major crop but has not been studied in depth.

This study addresses this gap by examining how cassava farming influences household food security in Southern Cross River State. It specifically analyses the contribution of cassava production to food availability, income generation, and food stability among rural households, while also identifying the socio-economic and institutional factors that shape these outcomes. The study further evaluates the role of existing support systems in enhancing or constraining cassava production. The findings are expected to inform strategies for strengthening cassava-based livelihoods and improving household food security in the region.

Purpose of the study

The major purpose of this study is to examine the contribution of cassava farming to household food security in the

Southern Agro-Ecological Zone of Cross River State, Nigeria.
The study specifically seeks to:

To assess the contribution of cassava farmers to the availability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

1. To evaluate the contribution of cassava farmers to the accessibility of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.
2. To examine the contribution of cassava farmers to the stability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

Research Questions

1. What is the contribution of cassava farmers to the availability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria?
2. How do cassava farmers contribute to the accessibility of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria?
3. In what ways do cassava farmers contribute to the stability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria?

Hypotheses

1. There is no significant contribution of cassava farmers to the availability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.
2. Cassava farmers do not significantly contribute to the accessibility of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.
3. There is no significant contribution of cassava farmers to the stability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

Literature review

Contribution of cassava farmers to the availability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

Cassava (*Manihot esculenta*) is a cornerstone of Nigeria's agricultural sector, particularly in the Southern Agro-Ecological Zone, encompassing Cross River State. Recognized for its adaptability, climate resilience, and high yield potential, cassava plays a central role in improving household food security, particularly in terms of food availability. Serving as a primary staple food, cassava provides a reliable source of calories and household income. Itam, Ajah, and Agbachom (2018), in a study conducted in Akpabuyo Local Government Area of Cross River State, demonstrated the profitability of cassava cultivation with a per-hectare gross margin of ₦9,520.66. Their research further revealed that variables such as farm size, land value, gender, age, educational attainment, and farming experience significantly influence cassava output. These factors directly impact the level of food available to farming households. Notably, the study found that women constitute the majority of cassava farmers in the area, underscoring their essential role in local food systems and food provisioning.

Beyond individual household production, cassava farming holds a vital position in the economic structure of Cross River State. “According to Governor Bassey Otu, cassava is a major agricultural commodity in Cross River State, with a large proportion of the population engaged in its cultivation and processing as part of the state’s agribusiness value chain (Adebayo, 2023).” This widespread participation demonstrates cassava's potential to ensure the steady availability of

food not only for subsistence but also for local markets, thus reinforcing food security throughout the region.

Productivity in cassava farming is closely linked to technical efficiency, which directly influences food availability. Itam *et al.,* (2018), in their analysis using a stochastic production frontier model, found that small-scale cassava farmers in the region achieved a mean technical efficiency of 89%. This indicates that while the current practices are fairly effective, there remains significant room for improving resource utilization. Enhancing farmer education, expanding farm size, and building on existing farming experience were identified as potential levers for boosting efficiency and, consequently, increasing cassava output and food supply.

However, the ability of cassava farmers to sustain high levels of output and food availability is constrained by several factors. A more recent study by Alawa and Bishie-Unung (2024) in Obudu Local Government Area identified key barriers including inadequate storage facilities, poor transportation infrastructure, and limited market access. These challenges contribute to substantial post-harvest losses, curtailing the amount of cassava that reaches consumers and undermining the food availability component of household food security. The authors advocate for targeted interventions in rural logistics and market integration as necessary steps to reduce these losses and stabilize food supply chains.

Recognizing the strategic importance of cassava, the Cross River State government has introduced proactive policy measures to expand its production. In 2023, the government allocated 100,000 hectares of land specifically for cassava farming as part of a broader agricultural development strategy (Okoro, 2023). This initiative is expected to boost large-scale cultivation, reduce raw material deficits for local processing industries, and increase the availability of cassava-based foods at household and commercial levels. Such policy-driven support not only affirms the central role of cassava in food security planning but also aligns with sustainable rural development goals.

Accessibility of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

The Southern Agro-Ecological Zone of Cross River State, Nigeria, is a region with significant agricultural potential, yet food security remains a critical concern for many households. Access to food, an essential aspect of food security, is influenced by various factors, including economic conditions, infrastructure, social networks, gender dynamics, and policy interventions. Market access is a crucial determinant of food security in the Southern Agro-Ecological Zone, as it directly influences both the availability and affordability of food. Inadequate infrastructure and high transportation costs are major barriers to market access. According to Memon and El Bilali (2020), poor road infrastructure in rural areas contributes to inflated food prices and reduces farmers' ability to sell surplus produce. This lack of access to markets leads to increased post-harvest losses, thus exacerbating food insecurity. Furthermore, Egbetokun *et al.,* (2019) found that improving road networks and market infrastructure could significantly reduce transportation costs, thereby facilitating better market access and improving food availability, especially for staple crops such as cassava.

Social capital, which includes networks, relationships, and trust within communities, plays a significant role in enhancing food security. In rural Cross River State, participation in community groups has been shown to facilitate better access to resources such as farming tools, credit, labor, and market information. Ekong and Okunlola (2020) demonstrated

that such participation improves food security by enhancing farmers' access to critical resources, with women's social networks particularly aiding in managing food production and distribution costs. Additionally, Udo *et al.,* (2021) highlighted that strong social networks enable farmers to access vital information about food

prices and market opportunities, further boosting food security. These findings suggest that strengthening social networks and community groups is a key strategy to enhance food accessibility.

Inadequate infrastructure is a significant barrier to food accessibility in the Southern Agro-Ecological Zone. Poor road networks, insufficient storage facilities, and limited processing capabilities hinder the efficient transportation and preservation of agricultural products. Okwu *et al.,* (2019) emphasized that limited transportation infrastructure worsens food insecurity by restricting farmers' access to markets, thereby increasing food waste and inefficiency in food distribution. Moreover, inadequate storage facilities contribute to post-harvest losses. Ojieh *et al.,* (2022) found that the lack of proper storage options for perishable crops like cassava results in significant wastage, reducing the availability of food for both households and markets. Investments in infrastructure, including roads and storage facilities, are essential to reducing food waste and improving food accessibility.

Gender dynamics are crucial factors in food security, especially since women play a central role in food production and distribution in the Southern Agro-Ecological Zone. However, gender inequalities often limit women's access to resources necessary for agricultural productivity, such as land, credit, and technology. Okoro and Udeh (2019) found that women face significant challenges in accessing these resources, which limits their ability to improve food production and accessibility. Empowering women by addressing gender-based barriers could significantly enhance food security. Adegoke and Olayemi (2020) also noted that when women are empowered through access to land, capital, and education, food accessibility improves for both women and their households. Gender-sensitive policies that support women's access to resources are therefore crucial in improving food security in the region.

Government policies are pivotal in shaping food security outcomes, as they influence food production, distribution, and accessibility. Recent initiatives by the Cross River State government have focused on improving market access through investments in rural infrastructure and agricultural support programs (Cross River State Government, 2023). However, Alhassan *et al.,* (2020) argued that while these interventions have been effective in some areas, more targeted policies are needed to address the specific needs of rural farmers, such as enhancing market access, storage facilities, and transportation infrastructure. Policies that improve the economic accessibility of food, such as subsidies for agricultural inputs, have also been shown to enhance food security. Kanu and Chukwu (2020) found that farmers who received government support for fertilizers and seeds were more likely to produce surplus food, thus improving their ability to access food during lean periods. These findings underscore the importance of coordinated efforts between the government, farmers, and other stakeholders to address food accessibility challenges.

Contribution of cassava farmers to the stability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria

Cassava is a vital staple crop in the Southern Agro-Ecological Zone of Cross River State, Nigeria, playing a pivotal role in the agricultural economy and the stability of household food security. It explores the importance of cassava as a source of food, income, and livelihood, as well as the

challenges farmers face and the strategies they employ to ensure the stability of food security for their households. Cassava is regarded as a key crop for ensuring household food security due to its versatility, high yield potential, and resilience to drought. It is a primary source of carbohydrates for many households in the Southern Agro-Ecological Zone, providing food security even in the face of fluctuating agricultural productivity. According to Okoro *et al.,* (2021), cassava cultivation in Cross River State contributes significantly to household food security by providing a reliable and easily harvested crop that can be processed into a variety of foods, such as garri, fufu, and starch, which are staples in the local diet. The crop's ability to grow in diverse soil types and its tolerance to different environmental conditions make it a stable food source, especially in regions affected by climatic variability (Okwu *et al.,,* 2020).

Furthermore, a study by Egbetokun *et al.,* (2019) highlighted that cassava farming provides a buffer against seasonal food shortages in rural areas, as farmers can store harvested roots for long periods without significant spoilage. This characteristic is particularly important during lean periods, when the availability of other food crops is low. The crop also plays a central role in food processing, contributing to the regional economy by providing raw materials for local agro-industries (Udo *et al.,* 2022). Thus, cassava farmers contribute to food security not only by ensuring household availability but also by supporting local economic stability through processing and trade.

In addition to providing food, cassava farming is a primary source of income for many households in the Southern Agro-Ecological Zone. Income from cassava sales allows farmers to purchase other essential food items, thus improving their overall food security. According to Alhassan *et al.* (2020), cassava farming has a significant economic impact on rural households, as it enables farmers to generate income for purchasing food, paying for education, and covering health expenses. The crop's marketability ensures that farmers can access income even in areas where other crops may not be as lucrative due to market constraints or environmental challenges. A study by Adegoke and Olayemi (2020) found that the income derived from cassava farming has a direct influence on the ability of households to maintain consistent access to a balanced diet, especially during times of economic instability. Cassava's importance as a cash crop that supports both food and non-food security is emphasized by the fact that it contributes to improving the financial stability of households, which in turn supports their food security throughout the year.

Despite the numerous benefits of cassava farming, farmers in the Southern Agro-Ecological Zone face several challenges that hinder their ability to maximize the crop's potential for enhancing household food security. One major issue is inadequate access to agricultural inputs such as fertilizers, quality planting materials, and modern farming technologies. According to Ekong and Okunlola (2020), the lack of access to high-quality cassava varieties and the limited use of improved farming techniques often result in lower yields, which can compromise food security at the household level. Additionally, the impact of poor infrastructure, such as inadequate roads and transportation networks, limits farmers' ability to access markets where they can sell their cassava products. Okwu *et al.,* (2020) noted that poor transportation infrastructure increases post-harvest losses and reduces the profitability of cassava farming, further limiting the economic benefits that farmers derive from their crops. The high cost of transportation, coupled with poor road networks, makes it difficult for farmers to transport their produce to urban centers where demand for cassava is high, ultimately affecting their income and food security.

Climatic challenges, including irregular rainfall patterns and the increasing incidence of pests and diseases, also pose significant threats to cassava production. As climate change continues to affect agricultural productivity, cassava farmers are increasingly vulnerable to these environmental stressors. A study by Udo *et al.,* (2022) found that erratic rainfall and the prevalence of pests such as the cassava mealybug negatively impact yields, thereby reducing the crop's potential to contribute to food security. Farmers' adaptive strategies, such as the use of resistant varieties and crop diversification, are critical in mitigating these challenges, though they often require external support in terms of training and resources. Several strategies have been proposed to enhance the role of cassava farmers in promoting household food security in the Southern Agro-Ecological Zone. Improving access to high-quality inputs, such as improved cassava varieties, fertilizers, and pesticides, is one of the most effective ways to boost yields and stabilize food security. According to Egbetokun *et al.,* (2019), introducing farmers to advanced agricultural techniques, such as integrated pest management and proper soil fertility management, can help increase the productivity of cassava farms. Government programs and agricultural extension services aimed at providing training on best farming practices have been shown to improve the productivity of cassava farmers in rural Cross River State.

Another important strategy for improving household food security is enhancing market access through rural infrastructure development, particularly roads and storage facilities. Okwu *et al.,* (2020) observed that improved road networks facilitate the efficient transportation of cassava to urban markets, thereby reducing post-harvest losses and strengthening both food availability and household income. In addition, the provision of adequate storage facilities enables farmers to preserve harvested cassava for longer periods, which supports food accessibility and ensures more stable food supply across seasons.

With respect to food security stability, Udo *et al.,* (2022) noted that the promotion of climate-resilient cassava varieties can help reduce production risks associated with environmental variability. This, in turn, contributes to sustaining cassava production and maintaining consistent food availability for rural households in the Southern Agro-Ecological Zone.

Research methodology

This study was conducted in the Southern Agro-Ecological Zone of Cross River State, Nigeria. A descriptive survey research design was adopted. The design was considered appropriate because it enables the systematic collection of data from respondents in order to examine the contribution of cassava farming to household food security in terms of availability, accessibility, and stability. The population of the study comprised all cassava farmers in selected farming communities within the Southern Agro-Ecological Zone of Cross River State. These farmers were considered suitable for the study because they are directly involved in cassava production activities that influence household food security. A sample of 400 cassava farmers was drawn from the population using a multi-stage sampling procedure. In the first stage, the zone was stratified into major cassava-producing communities. In the second stage, communities were selected using simple random sampling technique. In the final stage, cassava farmers were selected proportionately from each chosen community using stratified random sampling to ensure adequate representation across the study area. Data were collected using a structured questionnaire titled "Cassava Farming and Household Food Security Questionnaire (CFHFQ)." The instrument was designed to obtain information on farmers' socio-economic characteristics, cassava production variables such as farm size and yield,

income and market access, and the dimensions of household food security, namely availability, accessibility, and stability. The instrument was validated through face and content validation by three experts in Agricultural Education and Measurement and Evaluation. Their observations and recommendations were used to modify and improve the questionnaire to ensure clarity, relevance, and alignment with the study objectives.

The instrument was validated through face and content validation by three experts in Agricultural Education and Measurement and Evaluation. Their observations and recommendations were used to modify and improve the questionnaire to ensure clarity, relevance, and alignment with the study objectives. The reliability of the instrument was established through a pilot test conducted outside the study area, using Cronbach's alpha method. A reliability coefficient of 0.82 was obtained, indicating that the instrument was reliable for the study, and a reliability of the instrument was established through a pilot test conducted outside the study area, using Cronbach's alpha method. A reliability coefficient of 0.82 was obtained, indicating that the instrument was reliable for the study.

The questionnaire was administered directly to respondents with the assistance of trained research assistants. Out of the 400 copies of the questionnaire distributed, all 400 were correctly completed and retrieved for analysis, giving a 100% response rate. Data collected were analyzed using the Statistical Package for the Social Sciences (SPSS) and results tested at .05 level of significance. Descriptive statistics such as frequencies, percentages, and mean scores were used to summarize respondents' socio- demographic characteristics and key farming variables. This approach provided a clear basis for assessing the contribution of cassava farming to household food security in terms of availability, accessibility, and stability in the study area.

Results and Analysis

Table 1: Descriptive Analysis of Cassava Farming and Household Food Security (N = 400)

Variable	Category	Frequency (n)	Percentage (%)
1. Availability			
Average Farm Size (hectares)	1.0–2.0	180	45.0
	2.1–3.0	140	35.0
	>3.0	80	20.0
Average Cassava Yield (tons/ha)	<10	120	30.0
	10–20	190	47.5
	>20	90	22.5
Cassava as Main Staple Food	Yes	360	90.0
	No	40	10.0
2. Accessibility			
Monthly Income from Cassava (₦)	<₦30,000	110	27.5
	₦30,000–₦60,000	200	50.0
	>₦60,000	90	22.5
Access to Local Markets	Yes	310	77.5
	No	90	22.5
Household Food Purchased Using Cassava Income	Yes	340	85.0
	No	60	15.0
3. Stability			
Regular Harvest Schedule	Yes	280	70.0
	No	120	30.0
Seasonal Food Shortages Experienced	Yes	150	37.5
	No	250	62.5
Use of Food Storage Techniques	Yes	190	47.5
	No	210	52.5

Socio- demographic characteristics of respondents

The study surveyed 400 cassava-farming households to assess the relationship between cassava cultivation and food security. Findings revealed that 45% of respondents operated small farms (1.0–2.0 hectares), while only 20% cultivated on land larger than 3.0 hectares. Cassava yield per hectare was modest, with nearly half (47.5%) producing between 10 and 20 tons/ha. A significant majority (90%) identified cassava as their main staple food.

In terms of accessibility, half of the respondents (50%) earned a monthly income between ₦30,000 and ₦60,000 from cassava farming, and 77.5% had access to local markets. Furthermore, 85% reported that income from cassava sales was used to purchase household food, underscoring its role in food accessibility.

Regarding food system stability, 70% of respondents had a regular harvest

schedule. However, 37.5% experienced seasonal food shortages, and slightly more than half (52.5%) did not use food storage techniques, suggesting potential vulnerabilities in food supply sustainability.

Hypothesis testing

Hypothesis 1: There is no significant contribution of cassava farmers to the availability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria**.**

To test the hypothesis, simple linear regression analysis was used and the result is presented on Table 2.

Table 2: Summary of regression analysis between food availability and cassava yields in the southern Agro- ecological zone, cross river state, Nigeria.

R	R^2	Adj.R^2	Std error	Unstand Beta
.223	.050	.047	1.937	.134
Model	Sum square	mean square	F-ratio	Sig
Regression	78.182	78.182	20.830*	0.000
Residual	1493.808	3.753		
Total	1571.990			

*Significant at .05, df = 399

There is a significant relationship between the contribution of cassava farming and the availability of household food security in the southern Agro-ecological zone of Cross River State, Nigeria. Simple linear regression analysis revealed a weak but positive relationship (R = .223), indicating that cassava farming positively affects food availability. With an adjusted R^2 of .047, the model explains about 4.7% of the variance in food availability, suggesting that other factors may also influence food security. The ANOVA results (F = 20.830, p = 0.000) showed that the null hypothesis is rejected, confirming that there is indeed a significant relationship between cassava farming and food availability in the region.

Hypothesis 2: Cassava farmers do not significantly contribute to the accessibility of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

To test the hypothesis, simple linear regression analysis was used and the result is presented on Table 3

.

Table 3: Summary of regression analysis between accessibility of household food security and monthly income from cassava in the southern Agro- ecological zone, cross river state, Nigeria.

R	R^2	Adj.R^2	Std error	Unstand Beta
.490	. 240	.238	1.795	. 490
Model	Sum square	mean square	F-ratio	Sig
Regression	404.069	404.069	125.447*	0.000
Residual	1281.971	3.221		
Total	1686.040			

*Significant at .05, df = 399

There is a significant relationship between the contribution of cassava farming and the accessibility of household food security in the southern Agro-ecological zone of Cross River State, Nigeria. Simple linear regression analysis revealed a moderate positive relationship (R = .490) between monthly income from cassava and food security accessibility. The adjusted R^2 of .238 indicates that approximately 23.8% of the variance in food security accessibility can be explained by the income from cassava farming, suggesting a meaningful contribution. The ANOVA results (F = 125.447, p = 0.000) confirm that the null hypothesis is rejected, indicating a significant relationship between cassava farming income and the accessibility of food security in the region.

Hypothesis3: There is no significant contribution of cassava farmers to the stability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria.

To test the hypothesis, simple linear regression analysis was used and the result is presented on Table 4

.

Table 4: Summary of regression analysis between stability of Household Food Security and cassava farming contribution in the Southern Agro-Ecological Zone, Cross River State, Nigeria

R	R^2	Adj.R^2	Std error	Unstand Beta
.034	. 001	-.001	1.882	12.984
Model	Sum square	mean square	F-ratio	Sig
Regression	1.662	1.662	.469	.494
Residual	1409.848	3.542		
Total	1411.510			

*Significant at .05, df = 399

The analysis found no significant relationship between the contribution of cassava farming and the stability of household food security in the southern Agro-ecological zone of Cross River State, Nigeria. Simple linear regression showed a very weak relationship (R = .034), indicating that cassava farming has minimal impact on food security. The adjusted R^2 of -0.001 suggests that the model does not adequately explain food security, and other factors may be influencing it. The ANOVA results (F = 0.469, p = 0.494) confirm that the null hypothesis is not rejected, meaning there is no significant relationship between cassava farming and household food security in the region.

Discussion of findings

Based on the results of the study, it appears that cassava farming does not significantly contribute to the availability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria. The implication of this finding is that cassava production in the study area may not be sufficient to ensure a steady and adequate food supply for households. It suggests that issues such as low production levels, weak post-harvest handling, inadequate processing capacity, and poor market systems may be limiting the extent to which cassava farming translates into improved food availability. This finding is consistent with the research by Itam, Ajah, and Agbachom(2018), who emphasized the role of cassava in enhancing food availability for farming households in the region. While cassava serves as a reliable source of calories for many households, the weak correlation found in this study suggests that other factors, such as market access, food distribution systems, and non-agricultural sources of income, play a critical role in influencing food security. Therefore, cassava's role, while important, is not sufficient on its own to guarantee food availability in the long term. Supporting this view, Alawa and Bishie-Unung (2024) highlighted that poor infrastructure and limited market access are key barriers that prevent cassava farming from fully realizing its potential to improve household food security. These constraints not only limit the volume of cassava that reaches households but also hinder its affordability and accessibility. As a result, cassava's potential contribution to food availability is diminished, reflecting the broader challenges faced by rural farmers in accessing the markets and resources necessary for food production and consumption.

In relation to the accessibility of household food security, the findings show a significant relationship between income from cassava farming and households' ability to access food in the study area. The implication of this finding is that cassava farming plays an important role in improving household food access through income generation. It suggests that increases in cassava-derived income enhance the purchasing power of rural households, thereby enabling them to obtain food and meet other essential needs. This aligns with the findings of Memon and El Bilali (2020), who argued that agricultural income plays a crucial role in the economic stability of farming households, particularly in rural areas where non-agricultural income opportunities are often scarce. For these households, income from cassava farming is a significant source of financial stability, enabling better access to food, healthcare, and other essential needs.

Finally, the findings indicate that cassava farming does not significantly contribute to the stability of household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria. The implication of this finding is that cassava farming may not provide a consistent and reliable food supply throughout the year for households in the study area. It suggests that

environmental challenges such as climate variability, pest infestations,
inadequate storage facilities, and post-harvest losses limit the capacity of cassava farming to ensure continuous food supply. This implies that households remain vulnerable to seasonal fluctuations in food availability despite engaging in cassava production. According to studies by Egbetokun *et al.,* (2019) and Udo *et al.,* (2022), climatic challenges such as irregular rainfall patterns and the prevalence of pests significantly affect the ability of cassava to stabilize food security over time. While cassava is considered a resilient crop, these environmental stressors can undermine its capacity to maintain consistent food production, especially during periods of climatic uncertainty. Furthermore, Okwu *et al.,* (2020) pointed out that post-harvest losses, primarily due to poor infrastructure and the lack of adequate storage, play a critical role in limiting cassava's potential as a stable food source. Without proper storage facilities and efficient transportation networks, cassava may spoil before it can reach households or markets, thus compromising its ability to contribute to food security stability.

Conclusion

Cassava farming is important for strengthening household food security in the Southern Agro-Ecological Zone of Cross River State, Nigeria. It helps ensure a steady food supply, provides a source of income, and supports the well-being of many households. However, challenges like limited access to modern farming practices and poor infrastructure prevent farmers from fully realizing the crop's potential. Addressing these issues could significantly enhance the impact of cassava farming on food security in the region.

Recommendations

Based on the findings and conclusion reached in this study, the following recommendations were made.

1. The government should focus on providing improved cassava varieties that are more resilient to pests and diseases, along with better access to extension services. This would help farmers adopt best practices and increase productivity. Additionally, investing in infrastructure, like roads and processing facilities, will make it easier for farmers to bring their cassava to market and improve overall efficiency in the supply chain.
2. It is crucial to equip farmers with the skills they need for modern cassava production. Offering training in areas like advanced farming techniques, pest management, and efficient harvesting methods will enable farmers to boost yields and maintain healthier crops. This will also help them adapt to changing climate conditions and improve their long-term sustainability.
3. Improving farmers' access to both local and international markets should be a top priority. By strengthening market linkages and ensuring fair, stable prices for cassava products, farmers can earn better incomes. This would not only improve food security but also provide farmers with a more reliable financial base to invest in their farms and livelihoods.

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FACTORS INFLUENCING THE IMPLEMENTATION OF CLIMATE SMART AGRICULTURE BY PILOT SECONDARY SCHOOLS IN ESWATINI

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ABSTRACT

In an effort to combat the effects of climate change, the Ministry of Agriculture and Ministry of Education and Training in Eswatini is piloting climate smart agriculture (CSA) for selected schools in Eswatini. Therefore, there is a need to identify the factors influencing the implementation of Climate Smart Agriculture by agriculture teachers in Senior Secondary Pilot Schools in Eswatini. The study utelized a qualitative approach employing phenomenological research design. The target population were all the agriculture teachers (N=48) in the 24 secondary schools selected for the CSA pilot project. Homogenous purposive sampling was used to draw 24 agriculture teachers from the population. Data were collected using the semi-structured interview guide. Trustworthiness was ensured by addressing issues of credibility, transferability, dependability and confirmability. Ethical issues were addressed by ensuring informed consent, autonomy and privacy, and confidentiality. The data were analysed using thematic analysis. The findings of the study revealed that the factors influencing the implementation of CSA in schools include: characteristics of the teachers, the surrounding agricultural community of the school, the agriculture syllabus, and availability of resources. Thus, the study concluded that there were issues that hinder the effective implementation of CSA by the pilot schools. Therefore, the study recommends that having carefully taken the into considerations the factors influencing the implementation of CSA, this practice must be introduced in all the school having agriculture.

Index words: *climate-smart agriculture, homogenous purposive sampling, pilot school, sustainable development, thematic analysis.*

1.0 Introduction

Climate change poses one of the most significant threats to global food security and rural livelihoods, particularly in regions with limited adaptive capacity such as sub-Saharan Africa. The agricultural sector, being highly dependent on weather patterns, is especially vulnerable to the adverse effects of climate variability. In Eswatini, the impacts of climate change have become increasingly evident, manifesting through erratic rainfall patterns, prolonged droughts, flooding, rising temperatures, and an upsurge in pests and diseases (Manyatsi & Mhazo, 2014; Mhlanga-Ndlovu & Nhamo, 2017). These changes have had severe implications for agricultural productivity, thereby threatening the food security and economic stability of rural communities.

To address these challenges, Climate Smart Agriculture (CSA) has emerged as a transformative and integrative approach that seeks to sustainably increase agricultural productivity, build resilience to climate change, and reduce greenhouse gas emissions

(FAO, 2017). The concept of CSA is particularly relevant in the African context, where climate change is projected to reduce crop yields by up to 20% by mid-century if adaptive interventions are not urgently implemented (IPCC, 2022). In Eswatini, agriculture remains a critical sector for livelihoods, especially in rural areas where more than 70% of the population engages in subsistence farming (World Bank, 2023). As such, the implementation of CSA offers a strategic pathway to climate adaptation and food system sustainability.

CSA encompasses a range of practices and technologies designed to enhance agricultural resilience while promoting environmental sustainability. Key practices include agroforestry, which integrates trees into farming systems to improve soil fertility and biodiversity; conservation agriculture, which emphasizes minimal soil disturbance, crop rotation, and permanent soil cover to maintain soil health; and integrated pest management (IPM), which reduces dependence on chemical pesticides through biological and cultural control methods. In addition, climate-resilient water management techniques such as rainwater harvesting, drip irrigation, and the adoption of drought-tolerant crop varieties are crucial for ensuring water-use efficiency (Rockström et al., 2010; Aryal et al., 2023). Crop diversification and rotation further enhance soil fertility, break pest and disease cycles, and bolster system resilience.

Recognizing the importance of CSA, the Government of Eswatini, through the collaboration between the Ministry of Agriculture and the Ministry of Education and Training, has initiated a pilot programme to integrate CSA practices into selected secondary schools. This initiative is aligned with the country's broader strategy to mainstream climate resilience into its development agenda, particularly by empowering the youth with the knowledge and skills to practice sustainable agriculture. Schools, as institutions of learning and transformation, offer a vital platform for fostering climate awareness, building adaptive capacities, and promoting behavioral change among future generations (Ayanlade & Radeny, 2020).

Despite the potential of CSA, its successful implementation in schools may be influenced by various factors including teacher preparedness, availability of resources, institutional support, community engagement, and the integration of CSA into the school curriculum. Understanding these factors is critical to ensuring the effectiveness and scalability of CSA interventions. While research has been conducted on the implementation of CSA among smallholder farmers in Eswatini and other African countries, limited attention has been given to its application within the educational sector, particularly in secondary schools.

Therefore, this study seeks to investigate the factors influencing the implementation of CSA in pilot secondary schools in Eswatini. By identifying enabling and constraining elements, the research aims to provide insights that can inform policy, improve the design of future programs, and ensure the sustainability of CSA practices in the education system. Given the urgent need to enhance resilience to climate change, especially among vulnerable communities and youth, this study contributes to a critical discourse on sustainable agricultural development and climate change education in Eswatini.

2.0 Purpose and Objectives of the Study

The purpose of the study was to assess the implementation of climate smart agriculture by teachers at secondary schools in Eswatini.

The objectives were to

1. identify factors influencing the implementation of CSA by pilot schools;
2. describe experiences of the agriculture teachers on the implementation of CSA;
3. identify challenges faced by agriculture teachers in the implementation of CSA; and
4. identify strategies to enhance the implementation of CSA by agriculture teachers.

3.0 Conceptual Framework

This study investigates the factors influencing the implementation of Climate Smart Agriculture (CSA) by pilot secondary schools in Eswatini, guided by Rogers' (2003) Diffusion of Innovation Theory. According to Rogers, adoption is defined as the decision to make full use of an innovation as the most appropriate solution to address a specific need. In the context of this study, CSA is considered an innovative approach to agriculture education, aiming to increase productivity, build resilience to climate change, and reduce greenhouse gas emissions. The successful implementation of CSA in schools, therefore, depends on how well the innovation is adopted by key stakeholders such as teachers, students, and administrators. The theory posits that the adoption of any innovation is influenced by five key characteristics: relative advantage, compatibility, complexity, trialability, and observability. These attributes determine the rate and extent of innovation uptake. In this study, relative advantage refers to the perceived benefits of CSA over traditional agricultural practices. Compatibility involves how well CSA aligns with existing curricula and local agricultural contexts. Complexity addresses the perceived difficulty in understanding or applying CSA practices. Trialability reflects the extent to which CSA can be tested on a small scale before full implementation, while observability relates to the visibility of CSA outcomes and benefits. This framework thus provides a theoretical lens through which the facilitators and barriers to CSA adoption in Eswatini's pilot schools can be systematically examined.

4.0 Methodology

This study employed a phenomenological qualitative research design to explore the lived experiences and perceptions of agriculture teachers regarding the implementation of Climate Smart Agriculture (CSA) in pilot secondary schools in Eswatini. The phenomenological approach was deemed suitable as it focuses on understanding how participants make meaning of a shared phenomenon—in this case, CSA adoption in the educational context. The target population comprised agriculture teachers from 24 secondary schools (N=24) actively involved in the CSA project across Eswatini. Using homogenous purposive sampling, all 24 agriculture teachers were selected based on their direct engagement with CSA implementation, ensuring that participants possessed rich and relevant experiences for the study.

Data collection was conducted in July 2020 through semi-structured interviews guided by a carefully developed interview schedule. This approach allowed for in-depth exploration of participants' perspectives while maintaining flexibility to probe emerging themes. To ensure the trustworthiness of the findings, several strategies were employed. Credibility was reinforced through triangulation of data sources and methods, as well as regular debriefing sessions to reflect on the interview process. Transferability was supported by providing thick descriptions of the research context, particularly the nature of assessing practical agricultural subjects. Dependability

was enhanced through methodological triangulation, and confirmability was ensured by maintaining a clear audit trail documenting all stages of the research process.

Ethical considerations were rigorously observed. Informed consent was obtained from all participants following full disclosure of the study's purpose and procedures. Confidentiality was maintained by concealing participants' identities and reporting findings collectively. Privacy and autonomy were respected by avoiding intrusion into sensitive personal or institutional information. The study posed no harm to participants. The data were analyzed using thematic analysis, which involved coding interview transcripts, identifying patterns and themes, and interpreting these in relation to the study's research questions and theoretical framework.

5.0 Findings and discussions

5.1 Factors influencing the implementation of CSA in schools

5.1.1. Characteristics of the teachers

The success of CSA implementation was strongly linked to specific teacher attributes. Participants emphasized the importance of teacher creativity and innovativeness, which allowed them to adapt CSA concepts to local contexts. Teachers who were competent and practically oriented inspired learner interest through hands-on demonstrations and integration of real-life agricultural practices. Moreover, commitment to the CSA goals and good communication skills were seen as vital in mobilizing both students and the wider school community. One participant stated that *"Teachers who are passionate and committed make CSA work in our school as they don't wait for perfect conditions."* Another participant noted that *"It takes innovation and practical thinking to teach CSA with the limited resources we have."* The successful implementation of Climate Smart Agriculture (CSA) was found to be closely tied to key teacher characteristics such as creativity, innovativeness, and practical competence. Teachers who could adapt CSA content to local realities and engage students through hands-on methods were more successful in fostering learner participation and enthusiasm. This aligns with Rogers' (2003) Diffusion of Innovation Theory, which highlights the role of individual characteristics in the adoption of innovations. Additionally, teachers' communication skills and commitment to CSA goals proved essential in mobilizing both learners and school communities, echoing findings by Adu et al. (2020) that educators who exhibit professional dedication and contextual adaptability tend to enhance the uptake of agricultural innovations.

5.1.2 Learners' perception towards CSA

The way learners perceived CSA significantly influenced its uptake. Where learners viewed CSA as a modern, relevant and empowering practice, engagement levels were high. Conversely, where CSA was seen as an added burden or disconnected from examination success, enthusiasm was limited. One learner submitted that *"Learners enjoy CSA when they see it producing food or solving problems—they want relevance. However, some learners think it's extra work, not part of real learning."* It can be noted that learner perception played a vital role in determining CSA's impact. Where students saw CSA as a forward-looking and beneficial approach, engagement increased. However, in contexts where it was perceived as irrelevant or labor-intensive, learners showed low motivation. This is consistent with studies showing that learners' attitudes toward agriculture shape their willingness to engage in related activities (Ngolow & Tumbo, 2021). Positive

framing and experiential learning were suggested to improve student perceptions.

5.1.3 Access to CSA information

Teachers noted disparities in their access to CSA-related materials, training, and updates. Limited access hampered implementation, while schools with better linkages to the CSA pilot project benefited from updated knowledge and technical support. One teacher submitted that *"Some schools are better informed—training really makes a difference."* Disparities in access to CSA information, including training and technical updates, significantly affected implementation. Teachers with better linkages to project coordinators or extension services were more equipped to implement CSA effectively. Access to relevant and updated information is a crucial aspect of the communication channels dimension in Rogers' theory (2003), which facilitates knowledge flow and innovation adoption.

5.1.4 Administrative support

Strong support from school leadership emerged as a critical enabler. Administrators who prioritized agriculture and allocated time, resources, and space for CSA activities fostered a more conducive environment for implementation. One participant noted that *"The principal supports us with land and time. Without leadership backing, CSA activities are sidelined."* One can note that the role of school administrators is central to CSA success. Leadership that actively supported agriculture through time allocation, space, and budgeting provided an enabling environment. Existing literature indicates that administrative backing legitimized CSA as a school priority, reinforcing its integration into school activities (Adu et al., 2020).

5.1.5 Surrounding agricultural community of the school

The presence of a supportive agricultural community around the school such as farmers, extension officers, or local projects—was found to be influential. These communities served as sources of practical knowledge, inputs, and demonstration sites. A teacher was quoted saying that *"Our school is surrounded by farmers practicing CSA and we learn from them. We also rely on nearby extension officers for support."* The influence of the surrounding agricultural community with nearby farmers, extension officers, and agribusinesses cannot be denied. These external linkages served as informal learning networks and reinforced real-world relevance, enhancing the school's CSA efforts (Mawonde & Togo, 2016).

5.1.6 Agriculture Syllabus

Participants raised concerns about the alignment between the CSA initiatives and the national agriculture syllabus. Where CSA content aligned with syllabus expectations, implementation was smoother. However, gaps in integration posed a challenge for teachers juggling curricular requirements. One participant of the study asserted that *"CSA is useful, but it's not fully captured in the syllabus. Teachers try to squeeze it into practical topics."* The observed challenges in aligning CSA practices with the existing national syllabus posed a threat on its implementation. The findings of the are consistent with existing literature on the concerns regarding the CSA content. Better curriculum integration would ensure smoother implementation and greater legitimacy within formal learning structures. (Taylor, 2018).

5.1.7 Availability of Resources

Resource availability was a recurring theme, encompassing access to land, tools, inputs, and funding. Inadequate resources severely

constrained implementation, especially in under-resourced schools. One participants of the study mentioned *"Without basic tools, CSA remains theory. Inputs like compost materials or seeds are not always available*." It can be noted that resource constraints is the most limiting factor for CSA implementation. Schools lacking land, tools, or funds struggled to conduct CSA activities, often resorting to theoretical instruction. This issue resonates with previous findings that inadequate infrastructure undermines practical agricultural education (Ngolow & Tumbo, 2021).

5.2 Experiences of the agriculture teachers on the implementation of CSA

5.2.1 Teaching Methods Used

Agriculture teachers reported employing a variety of learner-centred and practical teaching methods in delivering CSA concepts. These included demonstrations, group projects, field visits, and experimental plots. Teachers emphasized the importance of learning by doing, which aligned with CSA's hands-on nature. One participant said *"We use practicals and group work. Learners plant and manage plots using CSA techniques."* Another participant noted that *"Demonstrations are effective as they observed the results of mulching or intercropping firsthand."* It can be observed that the teaching approaches used, enabled students to interact directly with CSA techniques, reinforcing the idea that "learning by doing" is essential for agricultural education. Such strategies align with constructivist pedagogy, which emphasizes active student engagement and contextual learning (Kolb, 1984).

5.2.2 Mastering of Conservation Agriculture

Teachers gained a deeper understanding and mastery of conservation agriculture, one of the core elements of CSA. They reported improved skills in techniques such as mulching, minimum tillage, crop rotation, and intercropping. One teacher submitted that *"Before the project, I had only read about conservation agriculture. Now I practice it with confidence. We've mastered how to apply these techniques and explain them to learners practically."* Through the CSA project, teachers enhanced their knowledge and skills in conservation agriculture, including mulching, minimum tillage, crop rotation, and intercropping. This deeper understanding allowed them not only to teach more effectively but also to model sustainable practices. This practical mastery contributed to both teacher confidence and credibility in the classroom (Thakrar et al., 2021).

5.2.3 Benefits of CSA to the Environment

Teachers expressed strong awareness of the environmental benefits of CSA. These included improved soil health, moisture retention, reduced erosion, and biodiversity preservation. Such benefits were often used to motivate both students and surrounding communities to adopt CSA practices. One teacher argued that *"CSA protects the soil and promotes sustainability. We teach students to farm without degrading the land. Even during dry spells, our plots survive because of conservation methods."* The recognition of the benefits of CSA to the environment was used as persuasive tools to encourage students and local communities to embrace it. This illustrates a critical link between environmental education and community-based learning (Tilbury, 1995).

5.2.4 Improved teachers' adaptability

Participation in the CSA project improved teachers' adaptability and openness to innovation. Teachers became more flexible, responsive to environmental challenges, and proactive in integrating new ideas into their teaching. A participant of the project stated

that *"CSA taught us to be adaptive, as conditions change, and we must respond with better techniques. We've learned to be more innovative, especially when resources are limited."* The findings of CSA to improve teachers' adaptability has been reported by previous studies. They become more responsive to environmental changes, willing to try new teaching strategies, and proactive in modifying content to reflect real-world challenges. This adaptability is essential in promoting sustainable agricultural education in a changing climate (Ngugi et al., 2020).

5.2.5 Benefits of CSA to Farmers

Teachers observed that farmers in surrounding communities benefitted from CSA practices through improved yields, resilience to climate stress, and sustainable land use. They noted that schools often served as demonstration hubs, influencing community practices. One of the teachers was quoted saying that *"Local farmers are copying what we do at the school because they see the benefits. CSA is improving yields and reducing dependence on chemicals among community farmers."* The benefits of the CSA as observed by farmers functions as knowledge transfer hubs, bridging formal education with community development (Speranza et al., 2014).

5.2.6 Problems encountered

Despite the positives, teachers highlighted several challenges. These included lack of CSA resources (e.g., tools, inputs), limited time for CSA activities due to curriculum pressure, and insufficient training. Some also mentioned poor learner attitude and inconsistent support from school administration. The participants were quoted pointing at the following problematic areas in the implementation of CSA: *"We lack tools and materials; CSA needs inputs to succeed; the syllabus is packed as CSA has to compete with examinable content; not all learners take CSA seriously, and sometimes management doesn't prioritize it.* The issue of problems encountered when implementing CSA echo previous studies that highlight logistical and institutional barriers in integrating practical innovations in school curricula (Ngolow & Tumbo, 2021).

5.3 Challenges for implementation of CSA Project

5.3.1 Inadequate Equipment and Resources

One of the most frequently cited challenges was the lack of essential equipment and resources needed to effectively implement CSA activities. This included limited access to farming tools, protective gear, composting materials, quality seeds, and infrastructure like water harvesting systems or fenced demonstration plots. One teacher noted that *"We are expected to teach CSA practically, but without the necessary tools and inputs, it becomes difficult. Sometimes we improvise, but it limits the quality of the learning experience."* Without the essentials, CSA activities are limited to theoretical instruction, reducing the hands-on, experiential learning that is central to CSA pedagogy. Similar findings were reported by Adu et al. (2020), who noted that resource scarcity is a key barrier to implementing practical agricultural programs in schools.

5.3.2 Insufficient Time

Teachers highlighted time constraints due to an already congested curriculum and the prioritization of examinable content. CSA activities, being mostly practical, require time for planning, implementation, and observation, which is often unavailable in the school timetable.

One teacher submitted that *"There's not enough time allocated to agriculture to fully implement CSA practices. We try our best during club periods or after school, but it's not sustainable."* As already indicated, the

insufficient time reduced opportunities for meaningful engagement. This mismatch between curriculum structure and the demands of practical innovations is a common challenge in education reform (Ngolow & Tumbo, 2021).

5.3.3 Unsatisfying Support from Stakeholders

Teachers noted that limited or inconsistent support from key stakeholders, including school management, ministry officials, and project coordinator as a challenge. This affected resource provision, planning, and follow-up. One teacher stated that *"Stakeholder support is not always guaranteed. Sometimes you're left on your own to implement the project. There should be more collaboration and follow-up from the people who introduced the project."* Existing literature indicates that stakeholder collaboration is essential for scaling up agricultural innovations, and its absence often leads to stalled or unsustainable initiatives (Klerkx & Aarts, 2013).

5.3.4 Learners' Negative Attitude Towards CSA

Another significant challenge was the negative attitude of some learners towards CSA. This was often attributed to a lack of awareness, the physical demands of CSA practices, and the perception that it is not 'modern' or prestigious. Some teachers noted that *"Some learners don't see CSA as valuable as they associate it with hard labour or old-fashioned farming. Changing learners' mindsets takes time as they want quick, high-tech solutions*. As Ajibola and Akinbode (2021) noted that reshaping youth perception of agriculture through awareness campaigns and incentives is vital for long-term engagement.

5.4 Strategies to enhance the implementation of CSA

5.4.1 Curriculum Audit

Teachers emphasized the need for a comprehensive curriculum audit to identify gaps and integrate CSA principles more systematically into the national agriculture syllabus. This would ensure CSA is not seen as an add-on but a core component of agricultural education. One teacher contended that *"CSA content should be aligned with what we teach in the syllabus, not as an extra topic. A curriculum review would help embed CSA in examinable content."* Research underscores that curriculum alignment is essential for institutionalizing innovations in education, particularly in the context of sustainability and climate adaptation (Taylor, 2018; FAO, 2013).

5.4.2 Teacher involvement in the generation of CSA ideas

Participants stressed the importance of involving teachers in the design and development of CSA activities, resources, and strategies. This would promote ownership, contextual relevance, and innovation. A teacher stated that *"We need to be part of the planning and not just implementers. We have practical ideas that can work. Our involvement would ensure CSA fits the real school context."* This participatory approach resonates with findings by Leal Filho et al. (2021), who emphasized that teacher involvement enhances the adaptability and sustainability of climate education initiatives. Similarly, UNESCO (2017) highlights that educational strategies for sustainable development are most effective when teachers contribute their local knowledge and pedagogical expertise to curriculum development.

5.4.3 Establishment of a CSA Fund

The creation of a dedicated CSA fund was proposed to address financial constraints.

Such a fund would support procurement of materials, set up demonstration plots, and maintain CSA activities sustainably. One participant said *"With a CSA fund, we could budget and plan better for activities. Lack of money limits implementation"* Existing literature indicates as financial limitations are widely acknowledged as a key barrier to integrating CSA into education; a dedicated fund would allow schools to institutionalize CSA practices, making them more consistent and less dependent on ad-hoc donor support or inconsistent government funding (FAO, 2013; Leal Filho et al., 2020). Mbow et al. (2014), argue that local financing mechanisms are crucial for scaling up CSA practices and ensuring they are embedded into educational and agricultural systems.

5.4.4 Provision of CSA Manual

Teachers suggested the distribution of a CSA manual to standardize implementation across schools and support lesson planning, especially for practical sessions. One participant stated that *"A CSA manual would be very helpful as it would guide both new and experienced teachers."* *"Having a reference document would improve our confidence in teaching CSA."* Research affirms that clear curricular guidelines and teacher reference materials play a critical role in supporting effective classroom delivery, especially when introducing new and technical content such as CSA (UNESCO, 2017; FAO, 2021). Additionally, manuals and resource packs have been shown to aid lesson planning, foster pedagogical innovation, and improve the integration of sustainability practices in agriculture curricula (Leal Filho et al., 2019). The availability of a CSA manual would therefore promote pedagogical coherence and equip teachers to deliver contextually relevant, practice-oriented instruction.

5.4.5 Provision of incentives

The introduction of incentives for both teachers and learners was seen as a motivator to boost engagement and commitment. These could include awards, recognition, or material support.

One participant said that *"Incentives would motivate teachers to go the extra mile. Also, learners would take CSA more seriously if there were competitions or prizes."* This aligns with findings from educational research indicating that extrinsic motivation, when appropriately structured, can enhance intrinsic motivation, especially in contexts involving new or additional responsibilities (Ryan & Deci, 2000). Furthermore, programs that include recognition and reward mechanisms have been shown to increase teacher performance and learner participation in environmental and agricultural education (UNESCO, 2020; FAO, 2013). Competitions and recognition events also provide visibility and validation for CSA practices, reinforcing their importance in both the school and wider community.

5.4.6 Provision of resources

Effectiveness in the implementation of CSA can be enhanced by timely and adequate provision of physical and instructional resources. These include tools, seeds, protective clothing, irrigation kits, and learning materials. One participant mentioned *"We need proper CSA kits as without tools, practical work becomes theory. "If the resources are there, implementation becomes smoother."* This perspective reflects a widely acknowledged principle in agricultural education—that practical, hands-on learning is essential for meaningful engagement and skill development (Mukembo et al., 2014). The lack of adequate materials limits experiential learning, reduces motivation, and can compromise the fidelity of CSA practices taught in schools. According to FAO (2013), the availability of context-specific, climate-smart tools and

inputs is fundamental to both demonstration and adoption of CSA practices. Moreover, UNESCO (2017) stresses that appropriate resources must accompany curriculum innovations to ensure their successful integration and sustainability.

5.4.7 CSA Training Programme

Teachers proposed regular training programmes on CSA to build capacity, update knowledge, and share best practices across schools. One teacher said that *"We need refresher courses on CSA because it's a dynamic area. Training would help standardize understanding and improve delivery."* This view is supported by literature emphasizing that ongoing teacher training is essential for successful curriculum implementation and innovation, especially in technical subjects like agriculture (UNESCO, 2015; Leal Filho et al., 2020). Furthermore, capacity development workshops and peer learning forums enhance teacher confidence, promote instructional coherence, and foster collaboration across institutions (FAO, 2013). Training also provides opportunities to align school-based CSA practices with national climate and education policies.

6.0 Conclusions

The study concluded that while the Climate Smart Agriculture (CSA) project presents significant potential for enhancing sustainable agricultural education, several issues hinder its effective implementation in pilot secondary schools in Eswatini. A key finding was that the successful adoption of CSA relies heavily on the attributes of agriculture teachers—specifically their creativity, innovation, competence, and commitment to practical teaching. Additionally, the lack of cooperation and support from crucial stakeholders, including learners and school administrators, emerged as a significant barrier. The study also highlighted that inadequate resources, such as teaching materials, equipment, and financial support, substantially limit the ability of schools to implement CSA activities effectively. Therefore, addressing these challenges is essential for the long-term success and sustainability of CSA in the school system

7.0 Recommendations

Based on the findings and conclusions of the study, the following recommendations were made:

1. The Ministry of Education and Training of Eswatini should review the secondary agriculture syllabus to include CSA
2. The University of Eswatini should include a course on climate-smart agriculture for the Faculty of Agriculture students
3. The Ministry of Education and Training in collaboration with the Ministry of Agriculture should provide the necessary resources for CSA in schools.
4. The Eswatini government should establish a fund to cater for climate-smart projects in the country.
5. The Ministry of Agriculture should be formulated a CSA manual to provide information to learners and farmers.
6. CSA as a pilot project can be enrolled to all the schools having agriculture in Eswatini.

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