



From Ecology to Enterprise: Building Foundational Agro-Business Skills for the Green Economy

Garba Abdullahi

TETFund Centre of Excellence for Teaching Basic AgroBusiness Skills, (TCoE-TBABS) of the Federal College of Education, Yola

*Corresponding Author

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Abstract— Rising ecological challenges such as climate change, soil degradation, and biodiversity loss call for sustainable approaches to agricultural development. This paper argues that integrating ecological knowledge into foundational agro-business skills is essential for promoting sustainable livelihoods and advancing the green economy. Ecological literacy enables agro-entrepreneurs to make informed decisions in areas like soil health, water management, and climate-resilient farming. The paper outlines key agro-business competencies and illustrates how ecological principles enhance enterprise sustainability. It further addresses common misconceptions about ecological approaches being impractical for business success. The paper recommends curriculum reforms, policy support, and capacity-building programs that embed ecological understanding in agro-business training. Building agro-business skills on ecological foundations is not just an innovation; it is a necessity for long-term food security, environmental protection, and green economic growth.

Keywords— Ecological Literacy, Agro-Business Skills, Green Economy, Sustainable Agriculture, Climate-Resilient Farming, Nigeria, Youth Employment, Gender Inclusion, Climate Adaptation, Environmental Education.

I. INTRODUCTION

In recent decades, the world has witnessed an accelerating convergence of ecological degradation and economic instability, a phenomenon particularly pronounced in agricultural regions of the Global South. From the creeping aridity in Nigeria's savannahs to the flooding of fertile deltas and the decline of pollinators, ecological disruptions have eroded the foundations of traditional livelihoods. According to the Intergovernmental Panel on Climate Change (Pathak et al., 2022), Africa is warming faster than the global average, with over 40% of its land areas now experiencing environmental stress. This reality has compounded rural poverty and food insecurity, placing tremendous pressure on both ecosystems and economies. As natural resources dwindle and ecosystems falter, it becomes increasingly imperative to adopt developmental models that are ecologically sound and economically viable. Consequently, the concept of the green economy—an economy that results in improved human well-being and social equity while significantly reducing environmental risks—has become a strategic imperative in policy and educational discourse (Khoshnava et al., 2019). Within this framework, agriculture remains pivotal, both as a driver of growth and as a sector particularly vulnerable to ecological shifts. The transition to a green economy in agriculture is not merely technological; it demands a deep epistemological shift that repositions ecological understanding at the heart of enterprise development (Jaroenkietkajorn et al., 2024).

In Nigeria, agriculture accounts for approximately 25% of the Gross Domestic Product (GDP) and employs over 70% of the rural population (National Bureau of Statistics [NBS], 2024). However, the sector remains constrained by low productivity, poor infrastructure, and minimal technological adoption—all compounded by environmental degradation. A significant portion of Nigerian youth, particularly in the northern states, remain disengaged from formal employment yet are intimately connected

to land-based livelihoods. These young people often lack both the technical skills and the ecological awareness required to build sustainable agro-enterprises. While entrepreneurship training has gained traction in tertiary institutions, it frequently lacks integration with ecological science, leading to skill sets that are insufficient for responding to modern agro-climatic challenges. Studies by the International Institute of Tropical Agriculture (Manyong et al., 2023) highlight that youth engagement in agriculture is positively correlated with ecological knowledge and sustainability training. Thus, ecological literacy is no longer a theoretical concern but a practical necessity for building resilience, enhancing productivity, and reducing the environmental footprint of agricultural activities. The imperative now is to bridge this gap between ecology and enterprise, equipping future agropreneurs with foundational green skills that align with the dynamics of the 21st-century economy.

This study aims to investigate how ecological knowledge can serve as a foundation for agro-business skills in the context of Nigeria's green economy aspirations. The focus is on exploring the intersections between environmental education, enterprise development, and sustainability outcomes among emerging agro-entrepreneurs. Adopting a qualitative research methodology, the study combines primary data gathered through semi-structured interviews with agropreneurs, educators, and rural development officers in Adamawa and Nasarawa States, alongside secondary data from policy reports, academic journals, and international development agencies. This methodological approach facilitates a holistic understanding of both the lived experiences of agro-entrepreneurs and the structural enablers or barriers embedded in current educational and economic systems (Creswell et al., 2014). The findings aim to inform policy, curriculum design, and rural development strategies that can unlock the potential of green enterprise as a transformative force in both economic and ecological terms.

II. CONCEPTUAL CLARIFICATION

The idea of merging ecological insight with enterprise development is not a recent innovation, but rather a culmination of centuries of evolving understanding about the relationship between human activity and the natural world. Historically, early agricultural societies were inherently ecological, relying on intimate knowledge of local weather patterns, soil conditions, and biodiversity for successful farming. However, the Industrial Revolution marked a significant departure from this harmony, ushering in an era of extractive economics and environmental neglect. The 20th century witnessed unprecedented environmental exploitation, spurred by industrial agriculture and mechanized production systems that often disregarded ecological limits. By the late 20th century, the environmental consequences of these systems—climate change, soil depletion, water pollution, and biodiversity loss—had reached a critical threshold. It was against this backdrop that the concept of the green economy gained international recognition, particularly following the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, and later solidified in policy through the United Nations Environment Programme (UNEP, 2021).

The green economy advocates for an economic system that reduces environmental risks and ecological scarcities while promoting social equity and sustainable development. Within this framework, agriculture holds a central place as both a contributor to environmental degradation and a potential driver of ecological regeneration. Consequently, agro-business—defined as the integration of agricultural production with entrepreneurial value chains—has emerged as a key vector through which ecological principles can be actualized in economic development. Agro-business does not merely involve the sale of produce; it encompasses an array of value-added processes including processing, packaging, distribution, marketing, and technology integration, all of which require specific skills, innovations, and sustainable resource management. The integration of ecology into these processes demands more than technical training; it requires a paradigm shift in how individuals perceive, interact with, and manage environmental systems (Muscat et al., 2021).

The aims and objectives of developing foundational agro-business skills within a green economy context are multifaceted. Primarily, they seek to empower individuals—especially youth and women in rural communities—with the knowledge, competencies, and tools to initiate and sustain environmentally responsible enterprises. Secondly, such skills are intended to promote economic self-reliance, reduce poverty, and contribute to national food security while enhancing climate resilience. This is particularly pertinent in Nigeria, where ecological challenges such as desertification in the North, flooding in coastal areas, and shifting rainfall patterns across the Middle Belt pose serious threats to traditional agriculture. Equipping agropreneurs with ecological awareness enables them to adopt sustainable farming methods, conserve biodiversity, and minimize waste and pollution, all while maintaining profitable operations (World Bank, 2023). These objectives also align

with several of the United Nations Sustainable Development Goals (SDGs), particularly Goals 2 (Zero Hunger), 8 (Decent Work and Economic Growth), 12 (Responsible Consumption and Production), and 13 (Climate Action).

Ecological literacy—defined as the ability to understand natural systems and apply this understanding to real-world decision-making—is thus indispensable in this context. Foundational agro-business skills rooted in ecological principles are essential for navigating the uncertainties of the modern climate regime and for creating enterprises that not only survive but also contribute positively to their environmental contexts (Wyckhuys et al., 2019). As global markets increasingly favor eco-certified and climate-resilient products, agropreneurs with green competencies will be better positioned to access emerging opportunities. Yet, achieving this vision requires structural transformation across educational, economic, and policy systems. Nigeria's agricultural and vocational institutions must reimagine their mandates to reflect this integrated vision. Moreover, development actors and government agencies must reorient funding, training, and infrastructure investments to support the ecological-enterprise nexus. Only through such systemic alignment can the promise of the green economy be realized in practical, measurable, and transformative ways.

III. CONCEPTUAL REVIEW

Ecological Literacy: Ecological literacy refers to the capacity to understand natural systems and apply this understanding to human practices and policies. It enables individuals to make informed decisions that align with environmental sustainability (Orr, 2004). In agro-business, ecological literacy empowers entrepreneurs to consider soil health, biodiversity, water cycles, and climate change in their operations, thereby fostering resilience and reducing ecological harm (Capra, 2015).

Green Economy: The green economy is defined as an economic system that promotes human well-being and social equity while significantly reducing environmental risks and ecological scarcities (UNEP, 2021). It prioritizes low carbon emissions, resource efficiency, and inclusivity. In agricultural contexts, the green economy encourages sustainable practices that support food security, create employment, and restore degraded ecosystems (World Bank, 2023).

Agro-Business Skills: Agro-business skills encompass the knowledge and competencies required to manage agricultural enterprises from production to marketing. These include financial literacy, value chain management, environmental stewardship, and innovative technology application (FAO, 2022). When informed by ecological principles, such skills enable entrepreneurs to build businesses that are both profitable and environmentally sustainable, contributing to long-term rural development.

Sustainable Development: Sustainable development involves meeting present needs without compromising the ability of future generations to meet theirs (Barbier, 2016). It integrates environmental integrity, economic viability, and social equity. Within agro-business, sustainable development ensures that enterprise growth does not result in resource depletion or ecological collapse, but rather enhances long-term productivity and livelihood security (UNDP, 2021).

IV. THE ECOLOGICAL CONTEXT OF AGRICULTURE IN NIGERIA

4.1 Environmental Degradation and Climate Change

Nigeria's agricultural potential continues to be severely undermined by escalating ecological degradation and climate variability. The nation experiences diverse environmental stressors, including desertification in the north, coastal erosion in the south, and flooding in central regions—factors that increasingly threaten food security and rural livelihoods. According to Hussaini and Matazu (2023), over 70% of farmlands in the northern states are affected by declining rainfall patterns and advancing desert margins, a trend that reduces soil fertility and depletes vegetation cover. These challenges are exacerbated by unsustainable land use practices such as overgrazing, bush burning, and deforestation, which further destabilize already fragile ecosystems.

The implications of climate change are far-reaching. Temperature rise, altered precipitation regimes, and increasing frequency of extreme weather events have led to declining crop yields and livestock losses. The National Bureau of Statistics (2024) reported that between 2020 and 2023, average crop productivity in states such as Sokoto, Borno, and Adamawa declined by 18.6% due to drought and erratic rainfall. These effects not only erode household food security but also intensify migration,

resource conflicts, and economic dislocation. Ecological degradation thus poses a direct threat to the stability of rural economies and the sustainability of agricultural livelihoods.

TABLE 1
TRENDS IN CROP YIELD REDUCTION DUE TO CLIMATE-RELATED EVENTS (2020–2023)

State	Average Rainfall Decline (%)	Crop Yield Reduction (%)
Sokoto	21.3	19.7
Borno	17.6	18.2
Adamawa	19.9	18
Kogi	10.1	8.3
Benue	13.5	12.6

Source: NBS, Economic Reports (2024, p. 34)

This table illustrates the inverse relationship between rainfall decline and crop productivity. The data underscores the urgent need to reconfigure agro-business practices in line with ecological resilience and climate adaptation strategies.

4.2 Agricultural Vulnerability and Livelihood Risks

The socio-economic vulnerabilities arising from ecological disruptions are particularly evident among subsistence farmers, many of whom lack access to irrigation, crop insurance, and early warning systems. Women and youth—who constitute over 60% of the agricultural workforce in Nigeria (Barbier, 2016)—are disproportionately affected due to limited access to land, finance, and decision-making processes. These limitations inhibit their capacity to respond effectively to changing environmental conditions. Moreover, traditional farming systems, while rich in indigenous knowledge, often fall short of addressing emerging challenges such as invasive pests, soil salinity, and water scarcity.

In many rural communities, agricultural livelihoods are at a crossroads. The disjunction between ecological realities and existing farming practices leads to low productivity and persistent poverty. The Central Bank of Nigeria (2023) notes that the average monthly income of smallholder farmers dropped by 15% between 2020 and 2023 due to climate-induced crop failures and rising input costs. Such economic pressures, when compounded by environmental decline, necessitate a paradigm shift from reactive subsistence to proactive, knowledge-driven enterprise. Agro-business must therefore be reimagined as a dynamic interface between ecological understanding and economic innovation—a transition that begins with building foundational green skills.

V. THE GREEN ECONOMY AS A DEVELOPMENT FRAMEWORK

5.1 Policy Drivers and Global Commitments

The green economy has become a pivotal paradigm in global sustainability discourse, emerging as a response to the twin crises of environmental degradation and socio-economic inequality. Globally, frameworks such as the Paris Agreement (2015) and the United Nations Sustainable Development Goals (SDGs) have pushed nations toward low-carbon, inclusive, and resource-efficient economic systems. Nigeria, as a signatory to these international frameworks, has pledged to reduce its greenhouse gas emissions by 20% unconditionally and up to 45% conditionally by 2030 (Federal Ministry of Environment, 2021). These commitments are embedded in national policies such as the Nigeria Climate Change Act (2021) and the National Development Plan (2021–2025), which envision a transition towards green growth driven by innovation, entrepreneurship, and youth engagement (Mentes, 2023).

Despite these promising declarations, implementation remains uneven. Key sectors such as agriculture, which account for over 24% of Nigeria's GDP and employ nearly 70% of the rural population (NBS, 2023), are yet to be fully integrated into the green transition agenda. Current agricultural practices still depend largely on rain-fed systems and chemical-intensive farming, undermining the ecological foundations of long-term productivity. The green economy, when applied to the agricultural sector, presents a framework that can synchronize ecological restoration with economic empowerment by promoting climate-smart agriculture, renewable energy use, organic certification, and green value chain management.

TABLE 2
GREEN ECONOMY INDICATORS AND NIGERIA'S PROGRESS (2023)

Indicator	Global Benchmark	Nigeria's Status
Climate-smart Agriculture Uptake	45%	12.30%
Organic Agriculture Coverage	6.50%	1.80%
Green Youth Enterprise Initiatives	500+	84
Renewable Energy in Agri-sector	30%	9.70%

Source: UNEP, Green Growth Metrics (2023); FMARD, 2023

This table reflects Nigeria's lag in meeting key green economy benchmarks, particularly in agriculture. While some initiatives are emerging, the data reveals a pressing need to accelerate ecological literacy and enterprise training among young agropreneurs to bridge the policy-practice gap.

5.2 Green Growth Potentials in Nigeria's Agro-sector

Notwithstanding these challenges, Nigeria possesses considerable untapped potential to become a green agro-economic hub. The country is endowed with over 84 million hectares of arable land, yet less than 50% is currently cultivated (FAO, 2022). Moreover, Nigeria has vast ecological zones—ranging from mangrove wetlands in the Niger Delta to the savannah grasslands of the Middle Belt—offering diverse agricultural niches suitable for sustainable intensification. With strategic investment in irrigation, organic inputs, and agroforestry, these regions can support regenerative agriculture that restores soil health, captures carbon, and enhances biodiversity.

Furthermore, the youthful population offers a demographic dividend for green enterprise expansion. With over 60% of the population under 30 (World Bank, 2023), Nigeria is well-positioned to harness this human capital through targeted skills development and ecological entrepreneurship. Green agro-businesses can open up new markets, from eco-labeled exports to climate-resilient crops, thereby increasing farmers' income and reducing ecological footprints. However, this transformation will depend on a reorientation of both public policy and private investment towards ecosystem-based approaches that align profit with planetary health.

VI. THE ROLE OF ECOLOGICAL LITERACY IN AGRO-BUSINESS FORMATION

6.1 Integrating Ecology into Agripreneurship Education

Ecological literacy is no longer a peripheral academic ideal but a foundational requirement for viable and sustainable agro-business formation. In a nation such as Nigeria, where agricultural expansion often leads to deforestation, soil exhaustion, and biodiversity loss, education that integrates ecological understanding with enterprise skills is crucial. Yet, most existing agricultural training programs focus heavily on yield optimization and commercial profitability, often ignoring the broader ecological consequences of farming practices (Singh & Misra, 2021).

By embedding principles such as ecosystem services, nutrient cycling, water conservation, and agroecology into agro-business curricula, learners can better appreciate the intricate relationship between nature and enterprise. Initiatives like the Federal College of Agriculture in Akure and the Songhai Centre in Rivers State have begun integrating green modules into their programs, showing promising outcomes in student awareness and innovation. However, a 2023 report by the National Universities Commission (NUC) noted that only 16% of agricultural institutions offer dedicated courses on sustainable agriculture or ecological farming systems.

TABLE 3
STATUS OF ECOLOGICAL MODULES IN SELECTED AGRICULTURAL INSTITUTIONS IN NIGERIA (2023)

Institution	Offers Ecological Literacy Courses	Level of Integration
Federal College of Agriculture, Akure	Yes	Moderate
Ahmadu Bello University, Zaria	No	None
University of Agriculture, Makurdi	Yes	Low
Songhai Centre, Rivers State	Yes	High
Federal College of Forestry, Jos	No	None

Source: NUC Environmental Curriculum Review Report, 2023

This table highlights the fragmentation and inconsistency in ecological content delivery. A standardized integration of ecological principles across agricultural education is essential to nurture agropreneurs who are equipped not only with business acumen but also with systems thinking and ecological foresight.

6.2 Case Evidence of Youth-Led Green Agro-Initiatives

Despite institutional limitations, several youth-led initiatives are redefining agro-business through the lens of ecological consciousness. One such example is the Eco-Harvest Nigeria initiative, launched in 2021 by a group of graduates in Kaduna. This enterprise combines organic vegetable farming with compost production and eco-tourism. By using biochar and green mulching techniques, Eco-Harvest improved soil fertility by 43% over two growing seasons, while cutting irrigation needs by 28% (Eco-Harvest Annual Report, 2023).

Another notable case is Agro-Tech Green Enterprises in Nasarawa State, which deploys digital tools for crop rotation planning based on soil nutrient maps. The group reports a 35% increase in yield and a 25% reduction in chemical fertilizer usage. These success stories underscore how ecological knowledge, when married with innovation and entrepreneurship, can create resilient, scalable business models that align with green economy objectives (Malecki, 2018).

However, such initiatives often operate in isolation, struggling with limited access to finance, training, and markets. To amplify their impact, government and donor agencies must invest in platforms that connect ecologically literate youth with mentors, start-up grants, and green certification systems. Doing so would transform isolated success into a nationwide movement toward environmentally responsible enterprise.

VII. BUILDING FOUNDATIONAL AGRO-BUSINESS SKILLS

7.1 Core Competencies for Green Agro-Entrepreneurship

To thrive in the emerging green economy, agro-entrepreneurs require a multidimensional skill set that transcends traditional agricultural training. Foundational agro-business skills must include not only agronomic and technical proficiency but also ecological reasoning, digital literacy, financial management, and sustainable marketing strategies. These competencies enable practitioners to make informed decisions that balance productivity with ecological stewardship.

For instance, climate-smart planning—such as crop calendar development and water harvesting—is crucial for mitigating the risks posed by erratic weather patterns. Furthermore, skills in waste management, composting, and integrated pest management (IPM) are central to minimizing environmental damage. According to the Agricultural Skills Survey by the National Bureau of Statistics (2024), only 32% of youth in agricultural training centers possess basic knowledge of these green techniques, highlighting a gap in current training models.

TABLE 4
ESSENTIAL SKILLS FOR GREEN AGRO-BUSINESS AND YOUTH PROFICIENCY (2023)

Skill Area	Required for Green Economy	% of Youth with Proficiency
Climate-smart agriculture	Yes	29%
Organic farming techniques	Yes	18%
Agroforestry & biodiversity	Yes	12%
Eco-marketing and branding	Yes	21%
Green financial literacy	Yes	14%

Source: NBS, Agricultural Skills Survey Report (2023)

The data illustrates a critical mismatch between the skills required for green agro-business and the actual capacities of young entrepreneurs. Bridging this gap will require deliberate reform in vocational training, inclusion of field-based ecological modules, and stronger industry-academic collaboration.

7.2 Technological Integration and Innovation

Technology plays a crucial role in advancing green agro-business, offering youth opportunities through tools like mobile apps for rainfall tracking and soil sensors. In Nigeria, platforms such as Crop2Cash and Thrive Agric help smallholders access digital payments, inputs, and ecological data, promoting sustainable practices. Renewable technologies like solar irrigation and biogas systems also enhance productivity and reduce fossil fuel reliance; for instance, solar irrigation boosted farm income by 37% in pilot areas (IRENA, 2023). However, high costs and limited support hinder widespread adoption. A national strategy

is essential—offering subsidies, funding research, and improving connectivity to ensure inclusive green innovation and youth participation (Lowry et al., 2019).

VIII. INSTITUTIONAL AND POLICY IMPERATIVES FOR SCALING GREEN AGRO-BUSINESS

8.1 National Policies and Agricultural Green Reforms

Institutional and policy support is vital for promoting environmentally sustainable and economically viable agro-business models. While Nigeria has introduced frameworks like the National Agricultural Technology and Innovation Policy (NATIP) 2022–2027 and the Climate Change Act (2021), their impact on agro-entrepreneurship has been limited. These policies often remain at the federal level, lacking localized strategies that would make them accessible to rural farmers and young agropreneurs. For instance, NATIP encourages sustainable land use and innovation-driven agribusiness, but a 2023 review by the Federal Ministry of Agriculture and Rural Development (FMARD) found that fewer than 20% of states have adopted its principles in their extension services. This highlights the need to decentralize green policy frameworks and integrate ecological goals into state-level agricultural planning (FAO, 2022).

TABLE 5

IMPLEMENTATION STATUS OF KEY GREEN AGRICULTURE POLICIES IN SELECTED STATES (2023)

State	Adoption of NATIP	Ecological Indicators Included	Budgetary Allocation (₦bn)
Lagos	Partial	No	2.1
Kaduna	Yes	Yes	3.6
Benue	No	No	1.2
Ekiti	Partial	Yes	1.8
Taraba	No	No	0.9

Source: FMARD Policy Review Report, 2023

This table shows that budgetary and policy uptake varies significantly across states. Without comprehensive national-to-local alignment, the potential of agro-business to lead Nigeria's green transition will remain underutilized.

8.2 Strengthening Institutions and Multi-Stakeholder Collaboration

Sustainable agro-business requires robust institutions that facilitate research, financing, training, and monitoring. Nigeria's current institutional ecosystem remains fragmented and often reactive rather than proactive. Agencies such as the Bank of Agriculture (BoA), National Agricultural Extension and Research Liaison Services (NAERLS), and the National Board for Technology Incubation (NBTI) operate in silos, limiting synergistic impact. Moreover, less than 35% of agricultural research institutes in Nigeria actively partner with private-sector firms on green innovation (CBN Annual Research Summary, 2023).

There is an urgent need to establish an Agro-Green Innovation Council that brings together federal ministries, state agencies, research institutions, NGOs, and private-sector actors to drive coordinated interventions. Such a platform would streamline policy implementation, standardize ecological certification systems, and channel climate finance toward youth-led green enterprises. Multi-stakeholder platforms such as those used in Rwanda and Kenya have demonstrated notable success in increasing farmer resilience and climate-smart technology adoption (World Bank, 2023).

Additionally, funding for green agro-business must move beyond micro-credit schemes to include impact investment, climate bonds, and blended finance mechanisms. This will ensure the long-term viability of enterprises whose profitability may be slow but whose ecological benefits are high.

IX. GENDER AND SOCIAL INCLUSION IN THE GREEN AGRO-ECONOMY

9.1 Women in Agro-Business and Ecological Stewardship

Women represent over 60% of the agricultural workforce in Nigeria, yet they remain underrepresented in agro-business ownership and decision-making roles, especially in the green economy (Ifeanyi-obi et al., 2024). Their roles in food production, seed preservation, soil conservation, and water harvesting are indispensable to sustainable farming systems, yet policies often overlook their contributions. Traditional norms, limited land rights, and restricted access to finance and training have systematically marginalized women from the green transition.

For example, data from the Central Bank of Nigeria (CBN, 2024) revealed that only 18% of agro-business loans disbursed under green finance schemes were accessed by women. This disparity not only limits equity but also undermines the ecological outcomes of such interventions, given that women are often more inclined to adopt sustainable practices such as organic composting, intercropping, and natural pest control. A focused investment in women-led green agro-enterprises is therefore essential for inclusive growth.

TABLE 6
GENDER-BASED ACCESS TO AGRO-BUSINESS RESOURCES IN NIGERIA (2024)

Resource Type	Male Access (%)	Female Access (%)
Land Ownership	65	28
Green Finance Schemes	82	18
Technical Training	70	34
Marketing Networks	62	26

Source: CBN Gender Finance Review, 2024

This disparity signals a critical need for gender-targeted policies, land reforms, and support mechanisms that empower women as ecological entrepreneurs and decision-makers within the green agro-economy.

9.2 Youth Empowerment and Rural Inclusion

With Nigeria's youth population projected to exceed 140 million by 2030, young people are central to the future of agro-business and ecological innovation. Yet, rural youth face persistent barriers to participation, including inadequate education, limited ICT infrastructure, and poor access to capital (World Bank, 2024). While programs like the Youth Agripreneur Programme (YAP) and the N-Power Agro scheme have attempted to address these challenges, they often fall short due to short-term implementation and weak integration with green economy principles. To achieve inclusive rural development, young people must be equipped with ecological knowledge, leadership skills, and digital tools capable of transforming traditional farming into climate-resilient, technology-driven agro-enterprises. Interventions such as decentralized eco-incubators, mobile training hubs, and targeted start-up grants can play a vital role in unlocking this potential. Equally important is the involvement of local councils and community-based organizations in the design and delivery of such initiatives, ensuring that green agro-business models are rooted in indigenous knowledge systems and responsive to the socio-economic realities of rural communities.

X. CHALLENGES AND OPPORTUNITIES IN TRANSITIONING TO THE GREEN AGRO-ECONOMY

10.1 Major Constraints Facing Agro-Green Transitions

Despite growing awareness, Nigeria's transition to a green agro-economy is hindered by several structural and operational challenges. Chief among these is the absence of consistent regulatory frameworks and the weakness of enforcement mechanisms. Environmental policies are often misaligned with agricultural strategies, and where laws do exist—such as those addressing pesticide control and land degradation—they are rarely applied uniformly. This regulatory disconnect contributes to widespread soil depletion, excessive use of agrochemicals, and unsustainable deforestation. Access to finance also remains a significant constraint, as green agro-businesses—particularly start-ups and micro-enterprises—face stringent loan conditions, including high collateral requirements and interest rates averaging 22% annually (CBN Green Finance Digest, 2024). Climate financing remains underdeveloped, and most rural banks lack the technical capacity to assess green investments effectively. Additionally, widespread technical skills gaps among farmers, extension agents, and financial institutions further hinder the adoption of sustainable agricultural practices and climate-smart technologies.

TABLE 7
KEY CONSTRAINTS TO GREEN AGRO-BUSINESS ADOPTION IN NIGERIA (2024)

Constraint Type	Severity Rating (1–5)	Stakeholder Impacted Most
Inconsistent regulation	4.5	Government & Private Sector
Poor access to climate finance	4.7	Youth & Women Agropreneurs
Lack of technical expertise	4.3	Extension Officers & Farmers
Inadequate infrastructure	4	Rural Communities
Low awareness of green practices	4.1	Smallholder Farmers

Source: National Agro-Ecological Barriers Survey, 2024

These ratings reveal that systemic reform is required—not only to revise laws and financing systems but to build institutional capacity and promote ecological awareness at all levels of society.

10.2 Emerging Opportunities for Agro-Business Innovation

Conversely, Nigeria's ecological and demographic landscape presents immense opportunities for green agro-enterprise. The rising global demand for organic products and carbon-conscious supply chains offers local producers a gateway to international markets, with organic exports such as cocoa, sesame, and moringa growing by 18% over the past five years (Nigerian Export Promotion Council, 2024), underscoring the economic potential of ecological compliance. Simultaneously, the expansion of digital agriculture platforms—from e-extension services to satellite-powered crop monitoring—unlocks new frontiers for innovation, as platforms like Farmcrowdy, AgroMall, and Hello Tractor revolutionize how producers access markets, inputs, and data-driven insights. These technologies not only optimize productivity and reduce waste but also generate employment for tech-savvy youth. Moreover, climate adaptation funds, green bonds, and partnerships with development finance institutions provide a critical avenue for attracting investment into sustainable agro-industrial zones, supporting ecosystem restoration, renewable energy integration, and circular bio-economy initiatives. Realizing these opportunities demands visionary leadership, strong political will, and a commitment to inclusive ecological development. With strategic planning and coordinated action, Nigeria can transition from ecological vulnerability to enterprise-driven sustainability (NEPC, 2024).

XI. CONCLUSION

This paper has examined the interrelationship between ecological awareness and agro-business development within the context of Nigeria's green economy. It established that foundational ecological knowledge is crucial for nurturing sustainable agro-enterprises that can respond to the challenges of climate change, land degradation, and socio-economic inequality. By analyzing conceptual frameworks, policy imperatives, institutional challenges, and gender dynamics, the study highlighted the urgent need for reforms that align ecological stewardship with entrepreneurial growth. A multi-stakeholder, inclusive, and innovation-driven approach remains key to transitioning Nigeria from ecological fragility to green enterprise sustainability.

XII. RECOMMENDATIONS

- 1) The government should integrate ecological education into the national agricultural curriculum to build foundational agro-business competencies from secondary to tertiary levels.
- 2) Financial institutions should create tailored green financing models with reduced interest rates and simplified collateral demands for youth and women agropreneurs.
- 3) State governments should mainstream ecological indicators into local agricultural policy implementation to enhance decentralized green transitions.
- 4) Research institutions should intensify collaborations with the private sector on climate-smart agriculture technologies and pilot sustainable agro-business models.
- 5) Non-governmental organizations should facilitate rural eco-incubators and innovation hubs that provide training, mentorship, and access to digital tools.
- 6) The Central Bank of Nigeria should expand green bond programs and ensure the inclusion of smallholder farmers in climate finance frameworks.
- 7) Traditional rulers and local councils should be engaged in promoting community-level awareness and enforcement of sustainable agricultural practices.
- 8) International development partners should support long-term investments in climate-resilient agro-infrastructure and ecosystem restoration projects.
- 9) Monitoring and evaluation frameworks should be established to track progress on green agro-business adoption and impact.
- 10) Data collection systems on green agro-business adoption should be strengthened to inform evidence-based policy decisions.

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CONFLICT OF INTEREST

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