

Assessing Readiness for Inclusive and High-Integrity Carbon Market in Nigeria's Agricultural Sector

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Abstract

This study, which assesses readiness for inclusive and high-integrity carbon markets in Nigeria's agricultural sector, evaluates whether Nigeria's existing institutional systems and market structure can support transparent, credible, and smallholder-inclusive carbon projects in voluntary carbon market opportunities in Nigeria. Using a realist systematic review of recent literature (2021–2025) and key informant interviews across public and private stakeholders, this study also adopted the PAC assessment tool to construct a readiness index across five pillars: policy and regulation, institutional coordination, finance, market infrastructure, and inclusiveness. The findings reveal uneven progress across these pillars, with policy and regulation scoring 72%, institutional coordination scoring 60%, market infrastructure scoring 58%, inclusiveness scoring 52%, and finance lagging 33%. This produces an overall readiness score of 55%, indicating that Nigeria is in a transitional phase characterized by strong policy intent but weak operational capacity. Despite the presence of guiding frameworks such as the Climate Change Act and the Long-Term Low-Emission Development Strategy, critical gaps persist. These include fragmented institutional mandates, the absence of a unified AFOLU MRV system, unclear carbon ownership rights (particularly on customary lands), and limited access to blended finance mechanisms necessary to support smallholder participation. The study identifies priority interventions: strengthening MRV harmonization, clarifying carbon rights and benefit-sharing frameworks, developing aggregation models, and expanding inclusive financing structures. Addressing these constraints will be essential for lowering transaction costs, improving transparency, and ensuring equitable participation. The paper concludes that translating policy ambition into functional carbon markets requires coordinated institutional reform, targeted investment, and inclusive governance to develop outcomes.

Introduction

Climate change continues to pose significant risks to economic development, environmental sustainability, and human well-being worldwide. These risks are particularly acute in developing countries where climate-sensitive sectors remain central to livelihoods and national economic performance [37]. In Nigeria, agriculture, forestry, and energy underpin rural livelihoods and economic activity, yet they are also highly exposed to climate variability and institutional constraints that limit adaptation and resilience [19].

Agriculture occupies a central position in both Nigeria's economy and its climate challenge. Globally, agricultural activities dominate approximately half of the world's habitable land [16, 48] and provide livelihoods for millions of smallholder farmers. In Nigeria, the sector remains a major source of employment and food security but also contributes substantially to greenhouse gas (GHG) emissions through livestock production, rice cultivation, land-use practices, fertilizer application, and agricultural waste management [18]. According to Nigeria's emissions inventory, agriculture accounts for approximately 25% of national GHG emissions, making it the country's second-largest emitting sector after energy [11, 31]. Between 2000 and 2022, agricultural emissions increased by 82%, driven largely by livestock production, rice cultivation, and land-use change. Despite this contribution, agriculture

accounts for only a small share of Nigeria's identified mitigation potential under NDC 3.0 compared with the energy and land-use sectors. This divergence highlights both the challenges and opportunities of positioning agriculture within Nigeria's emerging carbon market architecture.

At the same time, the sector also presents important opportunities for climate mitigation. Practices such as agroforestry, improved soil management, methane reduction in livestock and rice systems, and broader climate-smart agriculture (CSA) interventions can reduce emissions while increasing productivity and resilience. CSA approaches, including crop rotation, integrated nutrient management, water conservation, and agroforestry, are increasingly promoted as pathways to simultaneously achieve food security, adaptation, and mitigation objectives [2, 5, 41]. However, widespread adoption often remains constrained by financial, technical, and institutional barriers.

The credibility of agricultural carbon markets is increasingly linked to the concept of high-integrity carbon credits. High-integrity credits must demonstrate contribution, permanence, measurability, independent verification, and protection against leakage [34, 10, 25]. These requirements are particularly challenging in smallholder-dominated agricultural systems where farms are fragmented, transaction costs are high, and the technical capacity for monitoring and reporting is often limited. The tension between rigorous carbon accounting standards and the realities of smallholder agriculture remains one of the most significant barriers to scaling agricultural carbon projects across many developing countries.

Recent advances in measurement, reporting, and verification (MRV) systems have improved the feasibility of agricultural carbon markets. Developments in remote sensing, soil organic carbon mapping, modular MRV approaches, and pragmatic sampling methods have reduced some of the technical barriers associated with quantifying carbon benefits at scale [35, 40, 6, 20]. Nevertheless, technological improvements alone are insufficient. Effective participation in carbon markets requires enabling policies, institutional coordination, financing mechanisms, market infrastructure, and governance systems capable of supporting transparent credit generation and equitable benefit sharing.

Nigeria has taken important steps toward establishing such an enabling environment. The Climate Change Act (2021), the Long-Term Low-Emission Development Strategy (LT-LEDS, 2023), and the emerging Nigeria Carbon Market Framework (NCMF) collectively signal a growing policy commitment to carbon market development. The country has already demonstrated participation in voluntary carbon markets through activities such as improved cook stove projects and is developing systems for carbon credit authorization, registry management, and engagement with international carbon trading mechanisms, including Article 6 cooperative approaches [30, 15].

However, the transition from policy ambition to operational carbon markets remains uncertain. Significant implementation challenges persist, including fragmented institutional mandates, weak market infrastructure, limited access to finance, uncertainty surrounding carbon ownership and benefit-sharing arrangements, and insufficient MRV capacity. These constraints are particularly relevant for smallholder farmers, who are increasingly recognized as key participants in agricultural mitigation pathways but continue to face barriers related to aggregation, upfront investment requirements,

technical complexity, and market access [33, 1]. While several policy documents outline Nigeria's carbon market aspirations, there is limited evidence regarding whether existing institutional and market systems are sufficiently prepared to support high-integrity, smallholder-inclusive agricultural carbon projects.

This gap is important because readiness is a prerequisite for both environmental integrity and equitable participation. Weak governance systems can undermine carbon credit credibility, whereas inadequate inclusion mechanisms can exclude the very farming communities expected to deliver mitigation outcomes. Assessing readiness therefore provides an important basis for identifying the institutional bottlenecks, investment priorities, and policy reforms necessary to support effective carbon market development.

Against this backdrop, this study assesses Nigeria's readiness to host high-integrity, smallholder-inclusive agricultural carbon projects by diagnosing gaps across policy, institutional coordination, MRV, finance, market infrastructure, and social inclusion pillars. Building on a realist systematic review and stakeholder consultations, we synthesize the technical literature on MRV and SOC estimation [14, 28], evidence on the drivers of CSA adoption and aggregation [22, 42], and emerging practices in blended finance and national market design [6]. This paper aims to (i) explain which readiness elements are most binding for credible crediting and (ii) propose policy, institutional, and financing steps to accelerate Nigeria's transition from policy intention to operational, high-integrity agricultural carbon markets.

GHG Emissions and Nigerian Agricultural Sector

According to the updated 2021 Nationally Determined Contribution (NDC) 3.0 emissions inventory, total greenhouse gas (GHG) emissions were estimated at 347 MMTCO₂e in 2018. The energy sector accounts for the largest share at approximately 60% (208.2 MMTCO₂e), followed by agriculture at 25% (86.8 MMTCO₂e). Emissions from forestry and other land use (AFOLU) contribute approximately 9% (31.2 MMTCO₂e), whereas industrial processes and other product use (IPPU) and waste together represent approximately 5% (17.4 MMTCO₂e) of total emissions. Between 2000 and 2022 (see Fig. 1 - Sectoral Emissions between 2000 and 2022), agricultural emissions increased by 82%, showing strong upwards pressure from livestock, land conversion, and rice production, but this growth remains below that of the energy (111%) and industrial processes sectors (1,236%) over the same period.

The updated emission figures from the BTR1 GHG inventory indicate the following: Nigeria's emissions for the base year of 2018 were 614 MtCO₂e, and the projected emissions for 2030 were 1,052 MtCO₂e. The country aims to reduce emissions by 210 MtCO₂e unconditionally and by up to 494 MtCO₂e conditionally by 2030

The LT-LEDS 2023 provides further clarity on specific activities that contribute to GHG emissions in the agricultural sector. These methods include enteric fermentation in domestic livestock rearing, land use, land-use change and forestry (LULUCF), livestock manure management, rice cultivation, agricultural activities, and soil use, such as liming and fertilizer applications, field burning of crop residues, and on-

farm energy use. However, enteric fermentation and LULUCF account for more than 65% of AFOLU BAU emissions between 2020 and 2060 (Fig. 2), which is responsible for more than half of the national emissions and continues to expand due to oil and gas activities, transport, and power generation.

Figure 3 shows that the emission mitigation potential also highlights the asymmetry between agriculture and other sectors. Under NDC 3.0, the agriculture sector contributes only 2.1 MtCO₂e to Nigeria's mitigation potential, compared with 103.4 Mt from fuel combustion, 31.2 Mt from fugitive emissions, 14 Mt from IPPU, 12.5 Mt from waste, and a dominant 347.9 Mt from LULUCF-driven measures such as reducing deforestation and adopting clean fuels.

These figures demonstrate a structural challenge, indicating that agriculture is less prioritized as a potential national emission mitigation sector, with a focus on over 70% of mitigation opportunities in the land use and energy domain. The agricultural sector is highly fragmented, dominated by smallholders, and deeply intertwined with land-use practices, making its mitigation potential modest compared with the transformative opportunities in the energy, land restoration, and industrial sectors. Nonetheless, agriculture remains essential for carbon market development because of its emission contribution, scalability, co-benefits, and alignment with the rural development priorities highlighted in the LT-LEDS.

CONCEPTUAL FRAMEWORK

Smallholder participation in agricultural carbon markets depends on the successful adoption of climate-smart agriculture (CSA) practices and the ability to generate credible, verifiable carbon outcomes. Three interrelated enablers are particularly important: (i) targeted capacity building and access to essential inputs that lower technical and financial barriers to adoption; (ii) farmer aggregation mechanisms that reduce transaction costs and facilitate standardized project implementation; and (iii) context-appropriate measurement, reporting and verification (MRV) systems that improve accuracy while remaining affordable for group-based interventions [42, 45].

These enabling conditions do not operate in isolation. Their effectiveness depends on broader institutional and market conditions, including supportive policies, coordinated governance arrangements, access to finance, market infrastructure, and mechanisms that ensure equitable participation. These dimensions form the basis of the readiness assessment applied in this study.

The framework (Fig. 4) indicates that the adoption of CSAs to generate high-integrity carbon credits requires governance arrangements that transparently share benefits, manage permanence/additional risks, and maintain frequent, verifiable monitoring supported by hybrid MRV systems (field sampling + remote sensing + targeted in situ sensors). Recent methodological advances, modular MRV frameworks for soil organic carbon, and improved remote sensing and spectral methods for SOC estimation [39, 45] have made group-based, lower-cost MRVs increasingly feasible, provided that project design integrates local capacity building, error margins in SOC estimates, and equitable benefit-sharing arrangements to reduce dropout and dis-adoption risks. These integrated technical-institutional pathways (aggregation +

capacity + modular MRV) [6] are therefore the most promising routes for unlocking socially inclusive, technically credible carbon credits from smallholder agroforestry and CSA interventions.

Methodology

This study adopts a realist systematic review to evaluate the readiness of Nigeria's agricultural sector for high-integrity carbon market participation. The realist approach is particularly well suited for assessing complex interventions such as carbon crediting in low- and middle-income countries (LMICs). The review covered publications from 2021–2025, resulting in the selection and analysis of 40 high-quality studies. The key search terms were structured around the context–mechanism–outcome (CMO) framework (Fig. 5), which posits that specific interventions produce outcomes through identifiable mechanisms that are shaped by the local context. This framework enabled us to trace patterns in carbon market impacts and identify enabling or constraining factors for success.

Essentially, the study integrated stakeholder insights: we conducted semi-structured interviews after we had initially mapped the relevant stakeholders for the research. Key informant interviews (KIIs) were subsequently carried out with 20 stakeholders across the government, the private sector (project developers, agri-tech start-ups), civil society, the extension department, and foreign and local NGOs. These consultations were used to validate insights from the review and to fill data gaps (e.g., understanding on-the-ground challenges in project financing). These stakeholders contributed critical insights into institutional bottlenecks, policy implementation gaps, farmer engagement, and technical feasibility. While not exhaustive, the consultations were designed to reflect a cross-section of perspectives relevant to operationalizing carbon markets in Nigeria's agricultural sector.

This approach was further complemented by the application of the Partnership for Agricultural Carbon (PAC) Investment Readiness Index (IRI) diagnostic tool. The IRI framework assesses national readiness across five interdependent pillars: (1) enabling policy and regulation, (2) institutional coordination and capacity, (3) financial systems and risk instruments, (4) market infrastructure and innovation, and (5) inclusiveness and farmer engagement. Each pillar was scored on a 1–4 ordinal scale (1 = inexistence, 2 = emerging, 3 = operational, and 4 = established) to reflect the stage of development, with aggregated results informing both the readiness baseline and thematic findings of this report. The ordinal scale applied, although reflecting the actual stage of things, could not capture the on-going efforts from one stage of the current state to another. This situation posed a great limitation to the study, making it difficult to present all that is in place to attain a high-integrity carbon market within Nigeria's agricultural carbon market system.

Study Limitations

This study methodology has several limitations. Many of the most relevant projects are still in early stages, and their long-term impacts on communities and on emissions reductions are yet to be fully assessed. This makes it difficult to quantify the impact vis-à-vis the proposed target. Additionally, the

study approach did not capture field-level data analysis, limiting the scope to secondary reporting. Additionally, the stakeholder consultation sample was constrained by time and access, limiting direct smallholder representation and subnational disaggregation. Finally, while the PAC IRI offers a structured approach to readiness assessment, scoring decisions are based on publicly available documentation, interview insights, and expert judgment rather than direct assessment. These limitations underscore the need for future participatory and field-based studies to expand on this diagnostic baseline.

Results and Discussions

Government and Market Readiness Assessment

Table 1 presents the readiness pillar indicator scores on the basis of reviews and consultations with stakeholders. Considerable efforts have been made towards establishing a viable framework for carbon credit opportunities by leveraging global standards. Although current institutional reforms present Nigeria as a responsive nation with high readiness to unlock carbon credit opportunities, a standardized global approach needs to be applied to validate Nigeria's efforts vis-à-vis the ambition to generate income from the carbon market, particularly in the agricultural sector. Key readiness gaps persist in regulatory clarity, institutional coordination, and MRV infrastructure, especially in agriculture. The government capacity to support project validation, benefit-sharing mechanisms, and carbon rights enforcement is still evolving, whereas private-sector confidence is constrained by unclear frameworks and limited pipelines of investable, high-integrity projects. Bridging these readiness gaps will be critical for unlocking climate finance and ensuring inclusive participation.

To this end, this assessment adopts the Partnership for Agricultural Carbon (PAC, 2025) diagnostic readiness module, which provides a comprehensive framework for evaluating national preparedness. The application of the PAC Investment Readiness Index (IRI) diagnostic tool is justified, as it offers a structured, evidence-based approach to assessing the foundational elements required for establishing a credible and functional agricultural carbon market in Nigeria. The IRI's five-pillar framework captures the multidimensional nature of readiness, recognizing that market functionality depends not only on policy signals but also on institutional alignment, financial architecture, technological infrastructure, and social inclusiveness. The analysis is structured around five key pillars: (i) enabling the policy and regulatory environment; (ii) institutional and coordination capacity; (iii) financial systems and risk-mitigation instruments; (iv) market ecosystem and innovation readiness; and (v) inclusiveness, farmer engagement, and safeguard. Together, these dimensions offer a holistic lens for assessing Nigeria's ability to scale high-integrity, smallholder-inclusive agricultural carbon initiatives.

Enabling Policy and Regulatory Environment

Nigeria's carbon market readiness is anchored in a rapidly evolving policy landscape. The 2021 Climate Change Act established the National Council on Climate Change (NCCC), mandated carbon budgeting, and authorized market-based instruments such as emissions trading. The Long-Term Low-Emission Development Strategy (LT-LEDS) outlines Nigeria's net-zero pathway to 2060 and highlights agriculture

and land use as priority areas. NDC 3.0 raises national ambition, committing to 29% and 32% emission reductions by 2030 and 2035, respectively, with increased emphasis on climate-smart agriculture.

Table 1 shows that while Nigeria has established a legal basis for carbon crediting (Score 3), key infrastructure such as the carbon registry and bilateral Article 6 framework remain in early stages (Scores 2 and 1, respectively). Agricultural and forestry sector mitigation instruments are also rated as emerging (Score 2), indicating the need for sector-specific regulatory development. The Carbon Market Activation Plan and proposed National Carbon Market Framework target over US\$2.5 billion in investment by 2030 but lack clear provisions on carbon rights, benefit-sharing, and smallholder safeguards, which are critical for agriculture-led crediting.

By comparison, countries such as Ghana and Senegal have developed Article 6 roadmaps with clear sectoral focus and bilateral agreements in place [46–47]. For Nigeria, advancing regulatory depth, particularly around AFOLU carbon rights and implementation rules, will be key to de-risking projects and attracting investment. A strengthened enabling environment ensures alignment between national targets (see Appendix 1) and credible, inclusive market mechanisms.

Institutional Coordination and Capacity

Institutionally, Nigeria has laid foundational structures to coordinate its carbon market, particularly through the National Council on Climate Change (NCCC), which oversees climate governance and administers the Climate Change Fund. The Federal Ministry of Environment (FMEnv) and the Federal Ministry of Agriculture and Food Security also play key roles in climate policy and AFOLU sector interventions. A notable development is the creation of a carbon market oversight body (CMOB) under the NCCC, tasked with regulatory oversight and linkage to Article 6 mechanisms. This progress is reflected in the high readiness score (3 - Established) for “clear institutional roles.”

However, other institutional indicators remain underdeveloped. The national MRV framework for the AFOLU and registry oversight mechanisms were both rated as “emerging” (score = 2), highlighting gaps in the technical infrastructure and role clarity. Although efforts have begun to define AFOLU MRV protocols, they are yet to be systematized nationally, limiting the ability to track emission reductions accurately or validate carbon credits. Legal enforcement capacity scored higher (score = 3), indicating a moderate foundation for rule enforcement, although further resourcing is needed for full operationalization.

These gaps contrast with more advanced institutional models in countries such as Kenya and Ghana, where dedicated carbon market units and inter-ministerial coordination have streamlined governance and Article 6 implementation. Nigeria’s progress, while promising, must now shift toward institutional integration and technical readiness to achieve full market functionality.

Financial Systems and Risk-Mitigation Instruments

Nigeria's climate finance architecture for agricultural carbon markets remains nascent, with notable initiatives but significant structural gaps. As shown in Table 2, only one indicator, access to results-based finance (RBF), is moderately established (Score 3), reflecting limited but growing experimentation. Notably, Carbon Vista, a US\$50 million joint venture between the Nigeria Sovereign Investment Authority (NSIA) and Vitol, targets high-quality carbon projects, including agriculture, and demonstrates Nigeria's capacity to mobilize private financing aligned with carbon outcomes. Other elements of the finance ecosystem, however, are underdeveloped. The national carbon fund outlined in the Climate Change Act remains in its early stages (Score 2), and while incentives for agroforestry and climate-smart agriculture (CSA) exist in policy, they are not yet integrated into a dedicated investment window (Score 2). Critically, no formal agricultural carbon risk mitigation instruments, such as insurance or guarantees, are operational (Score 1), and this deters both private-sector developers' and smallholder participation.

While specific projects such as ACREsAL and the Acorn–ThriveAgric agroforestry programme illustrate the potential of blended finance and carbon revenue sharing, which target over 1.3 million tCO₂e and US\$50 million in farmer earnings, such models remain the exception rather than the norm. Without stronger de-risking mechanisms and pre-finance support, Nigeria's agricultural carbon pipeline will remain thin and exclusionary. Countries such as Kenya and India have made strides by embedding RBFs and micro-insurance into CSA strategies, offering potential templates for adaptation.

Market Ecosystem and Innovation Readiness

Nigeria's agricultural carbon market infrastructure is emerging, with promising pilot initiatives and expanding developer interest. Table 3 reflects progress in verified agricultural carbon projects and developer presence, both of which are now operational (Score 4). Projects such as the GIZ's Carbon Offsetting Rice Emissions (CORE), Acorn–Rabobank's agroforestry scheme, and GIZ's ClimA initiative are piloting credible methodologies and farmer-benefit models. These efforts signal growing private-sector engagement and momentum behind proof of concept.

However, challenges remain. The AgriTech ecosystem supporting measurement, reporting, and verification (MRV) is still at an early stage (Score 1), with limited availability of localized digital tools and data systems. The mobile financing infrastructure for carbon payments exists in principle but has not yet been integrated into project workflows, constraining scalability and transparency. There are still relatively few verified carbon projects, and they are concentrated, scoring just as early as possible (Score 2). As Nigeria scales its carbon ambition, investment in MRV digitization, policy alignment for project approval, and data infrastructure will be essential to deepen its credibility. Countries such as Kenya and India have advanced similar efforts by integrating digital farmer registries and remote sensing into their MRV systems. Nigeria can draw lessons from these models while tailoring its ecosystem to local realities.

Inclusiveness, Farmers' Engagement, and Safeguards

Inclusiveness is paramount to a credible and equitable agricultural carbon market, especially in a country such as Nigeria, where more than 70% of agricultural producers are smallholders. While climate policy

instruments such as Nigeria’s NDC 3.0 and sectoral strategies acknowledge the centrality of smallholders, women, and youth in climate-smart agriculture and resilience building, implementation remains nascent. According to the readiness assessment table, Nigeria scores low across key indicators of inclusiveness and safeguards. Specifically, the inclusion of smallholders in national climate programs and gender/youth engagement are still in the “emerging” stage (score = 2), whereas property rights for carbon ownership are currently “inexistent” (score = 1). The absence of a legally codified framework clarifying carbon rights, especially on communal and customary lands, poses a major risk for elite capture and undermines trust in carbon projects. Similarly, benefit-sharing arrangements are still emerging (score = 2), with no national standards or ratios guiding the equitable distribution of carbon revenues among farmers, aggregators, and government actors. Evidence from pilot initiatives such as the CORE rice methane project and the Acorn–Rabobank agroforestry program shows that smallholder inclusion is possible when proper aggregation models, extension support, and revenue-sharing mechanisms are in place. However, these remain isolated examples rather than systemic features. Moreover, gender and youth inclusion, although emphasized in national rhetoric, is often not explicitly translated into operational project design. Women and youth continue to face additional barriers in terms of access to land, finance, and technical information. Capacity-building efforts focused on carbon literacy, rights awareness, and grievances are still in early stages, both within farmer cooperatives and government extension systems. To ensure a high-integrity and socially embedded carbon market, Nigeria must prioritize inclusion as a core regulatory requirement. This includes embedding safeguards within registry design, setting minimum inclusion standards in project approval criteria, and developing Article 6 cooperation templates that incorporate gender-responsive and youth-inclusive principles. Without addressing these foundational gaps, efforts to scale agricultural carbon markets will remain exclusionary and vulnerable to backlash.

Overall Readiness Score

Table 4 describes the overall readiness score. Each pillar is evaluated via specific globally accepted elements/indicators that reflect regulatory clarity, institutional mandates, monitoring, reporting, and verification readiness, financing instruments, and inclusiveness (see Table 2 for details of the assessment). For specific pillars’ elements/indicators, an ordinal scale was used to measure actual readiness, ranging from 1-inexistence, 2-in-progress/emerging, 3-established, to 4-operational (see Table 1 for details). The assigned weights were adapted from the PAC module. As a result, weighted values were distributed at equal intervals across indicators, except for the legal element/indicator for carbon crediting, which was given greater importance because of its significance in ensuring a clear regulatory framework. Thus, we estimated the weights by dividing 1 by the number of elements per pillar. The legal element, however, takes an already defined proportion of 0.4, unlike the remaining elements/indicators.

The weighted score is a product of the indicators’ scores and weights. The average weighted score was computed by dividing the sum of weighted scores by the expected largest scale attainable, which is 4. Readiness nuances (midpoint or intermediate values between indicators) were not captured to enable us to present the current state of things, free of ambiguity. However, efforts currently underway amid

intervals were captured in the findings to enhance contextual robustness. This scoring approach provides a diagnostic snapshot, identifying gaps and enabling policymakers to identify high-impact intervention areas to strengthen Nigeria's institutional readiness for agricultural carbon markets. The scoring relies on a review of Nigeria's climate-policy documents, country-specific literature (2021–2025), and global best practices (Kenya, Ghana, Costa Rica, Rwanda, etc.), insights from stakeholder consultations, and measurement indicators adapted from international readiness frameworks for agricultural-led carbon markets.

After applying the PAC readiness module, Nigeria's readiness index for the agricultural carbon market revealed an index of 55%, indicating that the current institutional reforms and investment pathways require a critical review to accommodate the gaps. The next section of this report presents information on efforts and gaps identified along each of the assessment pillars. In addition, key actions that need to be taken to ensure rapid and effective realization of the Nigerian agricultural carbon market potential are highlighted.

Readiness score summary

Strengths

Nigeria's carbon market landscape is underpinned by a robust and evolving legal and policy framework that provides a credible foundation for scaling climate finance, particularly within the agriculture, forestry, and other land use (AFOLU) sector. The enactment of the Climate Change Act (2021) marked a significant milestone, institutionalizing climate governance and establishing the National Council on Climate Change as the central coordinating body. This is complemented by Nigeria's updated Nationally Determined Contribution (2021), which outlines ambitious mitigation and adaptation targets aligned with global climate commitments under the United Nations Framework Convention on Climate Change. Further strengthening this policy ecosystem is the Carbon Market Activation Policy (2025), which provides a strategic direction for leveraging carbon markets as a tool for sustainable development. Together, these frameworks create regulatory clarity and investor confidence, particularly for AFOLU-based carbon projects that have high potential for emissions reduction and removal. In addition, the clear delineation of regulatory mandates between the National Council on Climate Change and the Federal Ministry of Environment enhances the governance structure, whereas the emergence of a Carbon Market Activation Plan demonstrates forward-looking policy intent. Nigeria is also witnessing a growing innovation ecosystem, with early-stage AgriTech pilots and digital monitoring, reporting, and verification (MRV) tools gaining traction. Strategic partnerships such as Acorn–ThriveAgric illustrate how private sector actors are beginning to align with national climate priorities, signalling strong policy momentum and increasing alignment with international carbon market standards.

Fragmented areas

Despite these notable strengths, Nigeria's carbon market system is significantly fragmented, which could hinder its scalability and effectiveness if not addressed. While institutional mandates are formally

defined across key agencies, including the National Council on Climate Change, the Federal Ministry of Environment, and the Federal Ministry of Agriculture and Food Security, coordination among these entities remains weak and often ad hoc. This fragmentation is particularly evident in the management of carbon registries, approval processes, and enforcement mechanisms, which are still only partially operational and lack full interoperability. As a result, project developers and investors face uncertainty regarding procedural requirements and accountability structures. In parallel, Nigeria's MRV ecosystem is still in an early stage of development. While there are promising advances in digital MRV tools and pilot initiatives, these systems are not yet standardized or integrated at the national level, particularly with existing agricultural data platforms. This creates data silos and limits the ability to generate high-quality, verifiable carbon credits at scale. The absence of a unified MRV framework also raises concerns about transparency, credibility, and alignment with international verification standards, which are critical for participation in global carbon markets. Without stronger institutional coordination and system integration, these fragmented elements risk undermining the efficiency and integrity of Nigeria's carbon market architecture.

Areas for improvement

To unlock the full potential of carbon markets in Nigeria, several critical gaps must be addressed through targeted policy and institutional reforms. One of the most pressing challenges lies in the underdevelopment of climate finance architecture. Currently, there are no dedicated national carbon funds to aggregate and deploy climate financing at scale, and results-based financing (RBF) mechanisms remain weak or inconsistently applied. In addition, the absence of robust de-risking instruments, such as climate insurance products, credit guarantees, and blended finance structures, limits the bankability of carbon projects, particularly for smallholder-focused interventions in the AFOLU sector. Beyond finance, the broader market ecosystem remains nascent, with limited platforms to effectively connect farmers, project developers, financial institutions, and carbon buyers (Fig. 6). As a result, the pipeline of verified carbon projects is still small, and the degree of integration among AgriTech solutions, MRV systems, and financial mechanisms remains low. Social inclusion also represents a significant area of concern. Smallholder farmers, who are central to Nigeria's agricultural economy, are largely excluded from carbon market opportunities because of barriers related to land tenure security, access to finance, and limited awareness. There is an urgent need to develop inclusive frameworks that ensure equitable benefit sharing, promote gender inclusion, and safeguard community rights. Finally, the operational alignment between agricultural carbon activities and the National Carbon Market Framework (NCMF) remains weak, resulting in inconsistencies in implementation and missed opportunities for synergy. Addressing these gaps will be essential to building a transparent, inclusive, and fully functional carbon market system capable of delivering both climate and development outcomes.

Conclusion

Figure 6 presents the radar chart for Nigeria's agricultural carbon market pillar performance, showing Nigeria's performance on the scale of 0–4. Nigeria stands at a critical inflection point in the development

of its agricultural carbon market. The country has made substantial progress in establishing enabling climate policies, including the Climate Change Act, LT-LEDS, NDC 3.0, and the Carbon Market Framework. Agriculture, although not the largest emitting sector, offers unique mitigation opportunities through agroforestry, soil carbon enhancement, methane reduction, and integrated crop–livestock systems that align strongly with rural livelihoods, food security, and ecosystem restoration.

However, the assessment reveals that Nigeria’s agricultural carbon market remains constrained by institutional fragmentation, weak MRV infrastructure, limited access to upfront financing, unclear carbon rights, and underdeveloped benefit-sharing mechanisms. Nigeria’s overall readiness score of 55% reflects its position in a transitional stage, showing strong policy intent and some emerging systems but still facing significant implementation challenges. Bridging these gaps will be essential for transforming policy ambition into high-integrity, scalable, and inclusive agricultural carbon projects that can attract premium buyers and deliver meaningful benefits to smallholder farmers.

Policy recommendations

Nigeria should urgently operationalize a nationally harmonized agricultural carbon market framework under the leadership of the National Council on Climate Change. This framework clearly defines carbon ownership and equitable benefit-sharing arrangements for smallholder farmers and community lands while providing standardized project development templates, safeguards, and AFOLU-specific MRV protocols. Clear institutional roles should also be established for intermediaries, such as aggregators, cooperatives, NGOs, and private developers, to manage transaction costs and certification processes on behalf of farmers. A nationally coordinated, digitally enabled MRV architecture is essential to ensure scalability and credibility. Such a system should be interoperable, cost-effective, and adaptable to smallholder realities, combining remote sensing with community-based data systems to address constraints such as low connectivity and fragmented landholdings. Strengthening MRV systems will enhance transparency, reduce verification costs, and increase investor confidence. To unlock finance at scale, Nigeria must transition from donor-driven pilots to structured blended finance mechanisms. Drawing lessons from countries such as Zimbabwe, Uganda, and Rwanda, the government should establish a national carbon aggregation facility and integrate financial institutions, including the Central Bank of Nigeria, into carbon market financing frameworks. Finally, ensuring market integrity and inclusiveness is critical. This requires strengthening farmer cooperatives, promoting performance-based contracts, and embedding safeguards such as FPIC, gender inclusion, grievance mechanisms, and transparent revenue sharing. Aligning national standards with international frameworks such as the Integrity Council for the Voluntary Carbon Market and the Voluntary Carbon Markets Integrity Initiative will further increase credibility, attract global buyers, and position Nigeria as a competitive supplier in the voluntary carbon market.

Declarations

Credit authorship contribution statement

Adeoye M, Adetoye: Conceptualization, Methodology, Editing & Review, Supervision. Foluke C, Olatoye: Methodology, Analysis, Writing, Editing & Review. Motole A, Oknokwo: Writing, Methodology, Writing, Editing. Adebisi C, Adewole: Writing, Methodology, Editing. O, Okonkwo: Writing, Methodology, Editing.

Declaration of competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Consent to Publish Declaration

Not applicable

Consent to Participate

Not applicable

Ethics Declaration

Not applicable

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Tables

Tables 1 to 4 are available in the Supplementary Files section.

Figures

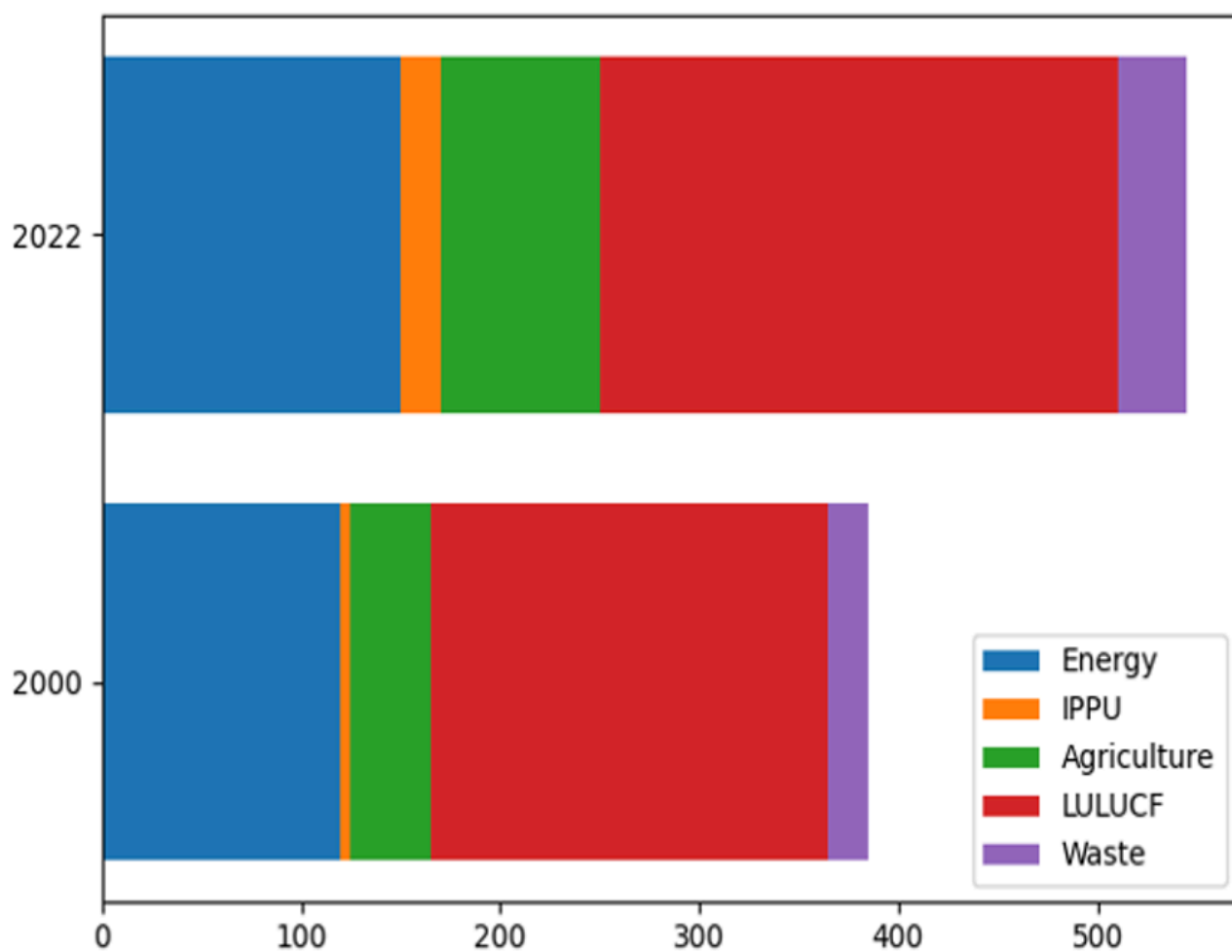


Figure 1

Sectoral Emissions between 2000 and 2022

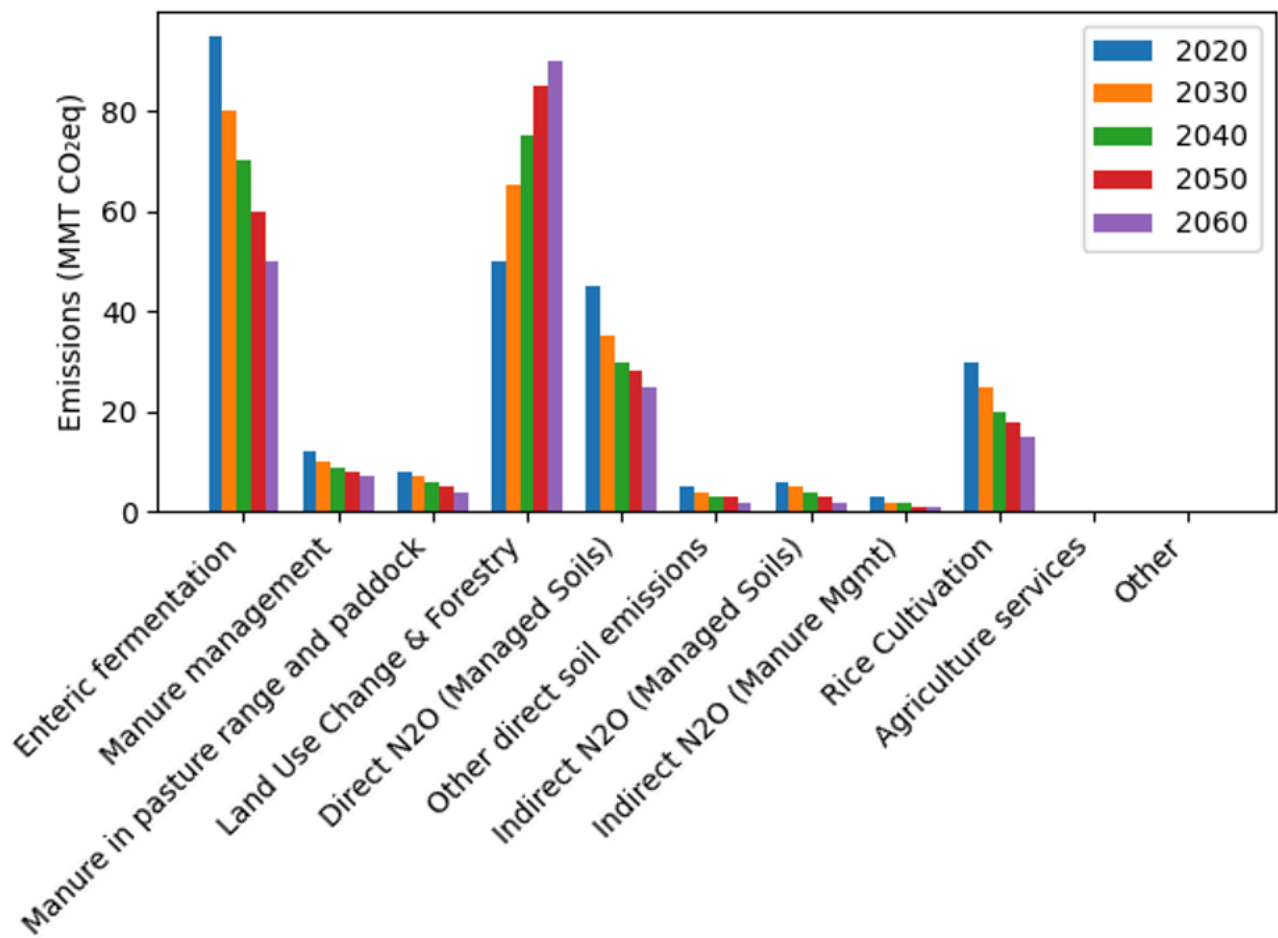


Figure 2

Emission causing agricultural activities from 2020-2060

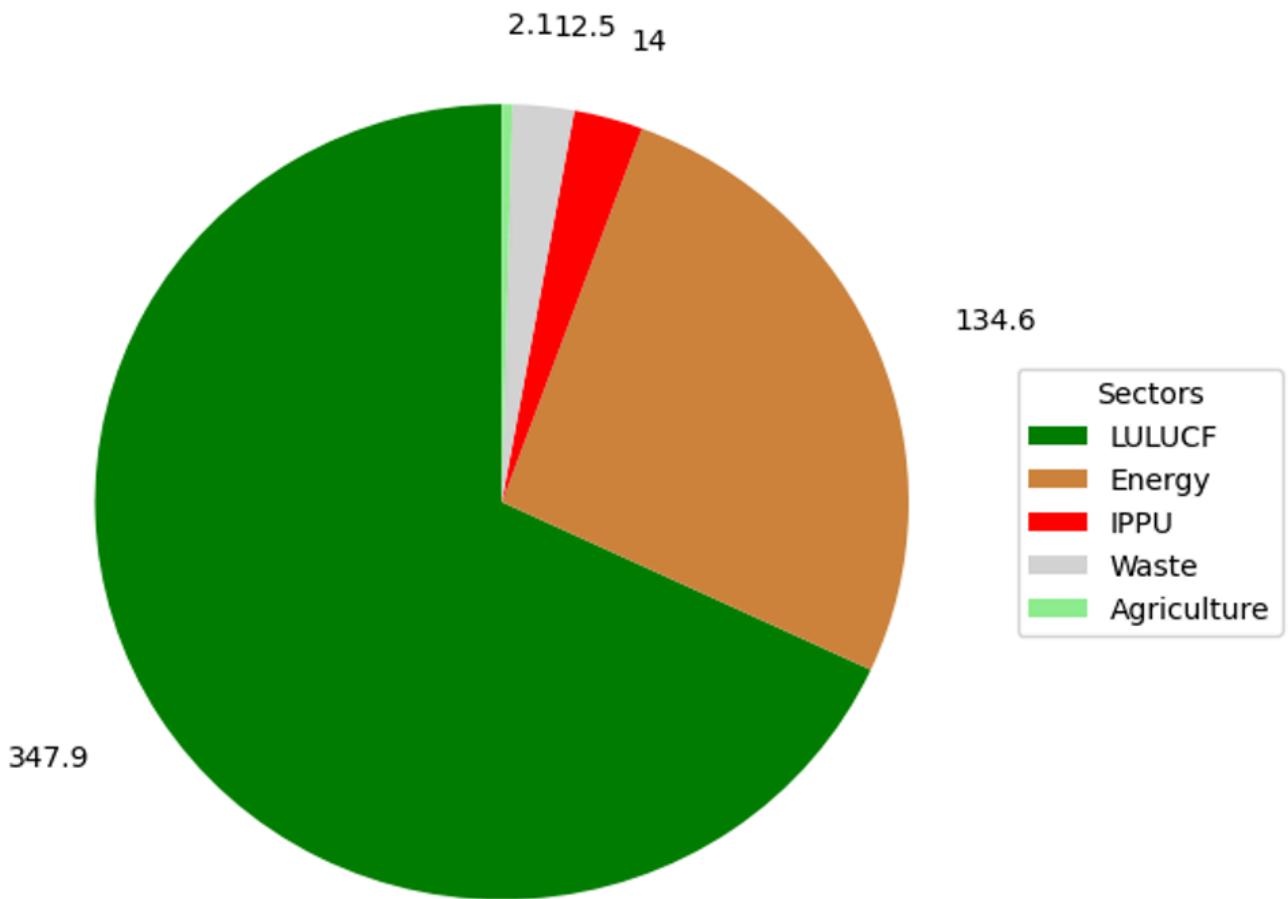


Figure 3

Sectoral emission mitigation potentials

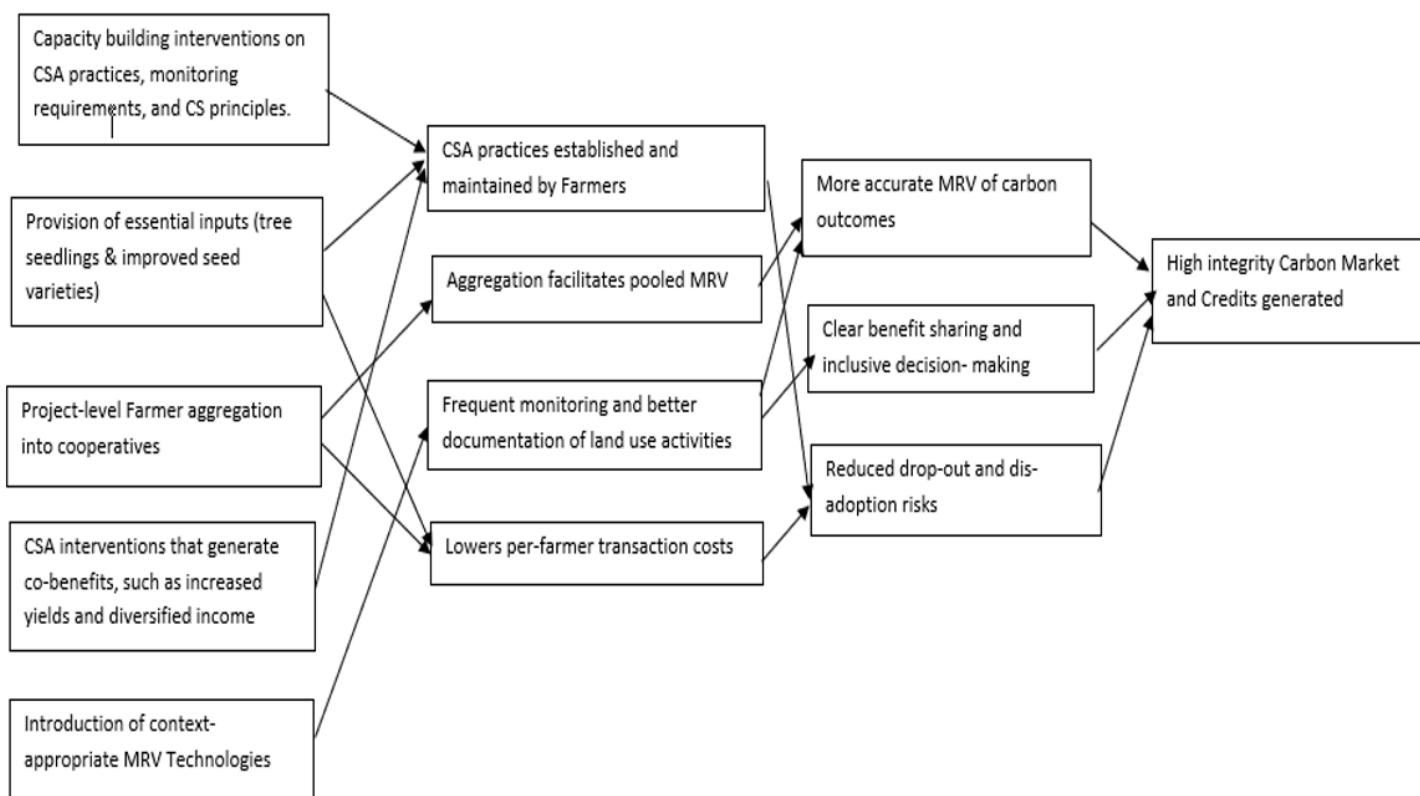


Figure 4

Conceptual framework

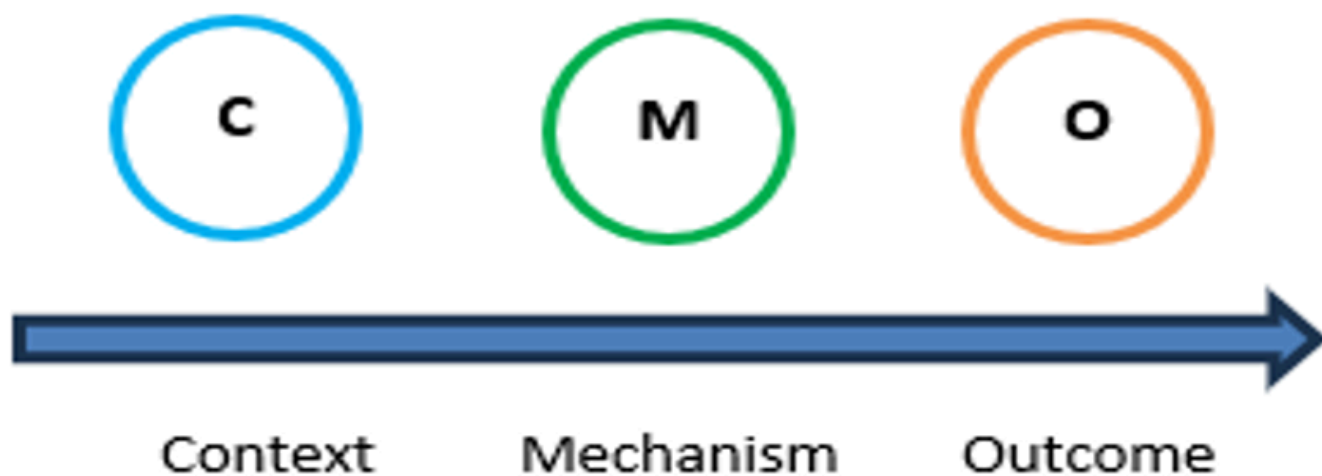


Figure 5

Context-Mechanism-Outcome

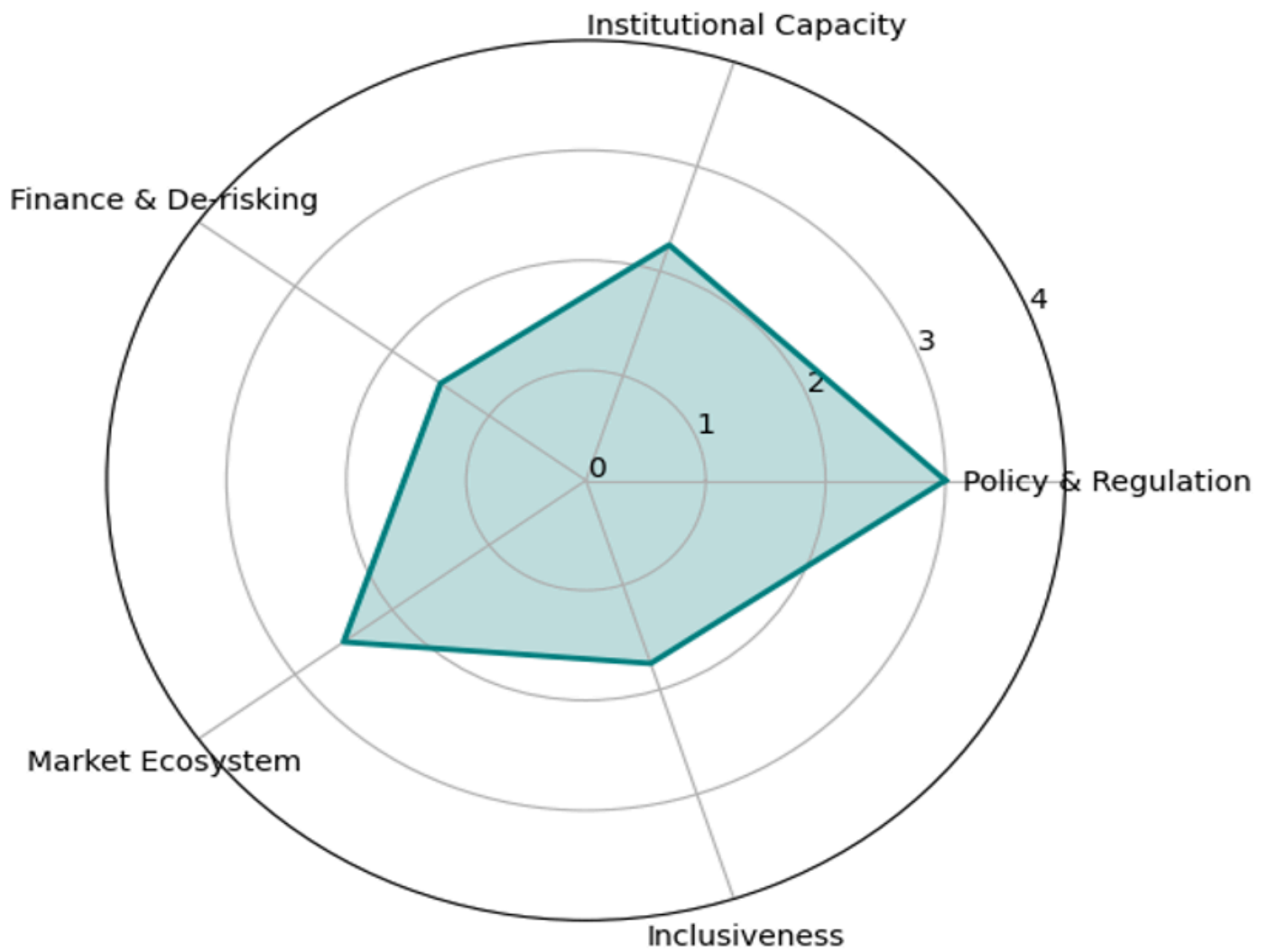


Figure 6

Radar chart for Nigeria's agricultural carbon market pillar performance

Supplementary Files

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