

Modern Environmental Sustainability Measures: A Critical Evaluation of their Application in Environmental Practice in Southern Kaduna, Nigeria

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Abstract

Modern environmental sustainability measures have emerged as critical instruments for addressing escalating environmental challenges at global, national, and local scales. Despite the proliferation of sustainability frameworks, policies, and regulatory instruments, their practical effectiveness remains uneven, particularly in developing regions. This study critically evaluates the application of modern environmental sustainability measures in environmental practice, with specific focus on five selected Local Governments in Southern Kaduna, Nigeria. The research adopts a mixed-method approach, combining survey data, key informant interviews, field observations, and secondary policy analysis to assess awareness levels, adoption rates, institutional capacity, and environmental outcomes. Findings reveal relatively high awareness of sustainability measures such as waste management policies, land use regulations, climate initiatives, and environmental impact assessment frameworks; however, adoption and effective implementation remain moderate to low. Weak regulatory enforcement, inadequate funding, limited technical capacity, fragmented institutional coordination, and insufficient community participation were identified as major constraints. Empirical results further indicate that while some improvements have been observed in waste management and reforestation initiatives, environmental degradation particularly soil erosion, land degradation, and deforestation persists in many parts of Southern Kaduna. The study concludes that the gap between policy formulation and tangible environmental outcomes is largely driven by governance and implementation deficits rather than policy absence. It recommends

strengthening institutional enforcement, establishing sustainable financing mechanisms, and institutionalizing community-based environmental governance to enhance the effectiveness of sustainability measures. The findings contribute to the discourse on contextualizing global sustainability frameworks within local environmental realities in developing regions.

Keywords: Environmental sustainability, sustainability measures, Southern Kaduna, environmental practice, policy implementation.

1.0 Introduction

1.1 Background to the Study

Environmental sustainability has become a critical global priority in response to climate change, biodiversity loss, and natural resource depletion. International frameworks such as the United Nations Sustainable Development Goals (SDGs) and the Paris Climate Agreement provide structured approaches for sustainable development, emphasizing measurable targets and coordinated action to protect ecological systems (United Nations, 2015; Kates, Parris, & Leiserowitz, 2022). These modern environmental sustainability measures guide countries in adopting policies, monitoring progress, and integrating sustainability considerations into governance and development planning. Despite their global acceptance, scholars note that the success of such measures largely depends on their adaptation to local socio-economic and

environmental contexts. In Africa, environmental sustainability efforts are shaped by continental initiatives such as the African Union Agenda 2063, which seeks to harmonize economic development with environmental conservation (Doodoo et al., 2025). However, studies highlight that implementation across African countries faces challenges including limited institutional capacity, weak enforcement of environmental regulations, and funding constraints (Ambituuni et al., 2024). These obstacles often result in a disconnect between the objectives of global sustainability frameworks and actual environmental outcomes on the continent. Nigeria has developed national policies to address environmental challenges, including the National Environmental Standards and Regulations Enforcement Agency (NESREA) Act and the National Climate Change Policy Response & Strategy (Federal Ministry of Environment, 2021). Despite these frameworks, implementation remains inconsistent due to governance gaps, resource limitations, and uneven stakeholder participation. Sectors such as agriculture, waste management, and forestry continue to experience environmental pressures, highlighting the need for localized evaluation of sustainability measures (Gbenga & Christopher, 2025). Southern Kaduna, a region in northwestern Nigeria, exemplifies the localized challenges of applying modern environmental sustainability measures. The area faces environmental pressures including deforestation, soil erosion, land degradation, and unsustainable agricultural practices, despite the existence of national environmental policies (Achi, 2018; Bukar & Abubakar, 2020). Local communities often rely on traditional environmental management practices, which may not align with formal sustainability frameworks, creating gaps in implementation and effectiveness. Given the importance of understanding both the strengths and limitations of modern sustainability measures at local levels, this study focuses on Southern Kaduna. It examines how global and national sustainability frameworks are translated into practice, evaluates their effectiveness in addressing environmental challenges, and identifies factors that constrain or enhance their application. This localized focus contributes to knowledge on how modern

sustainability initiatives can be tailored to improve environmental outcomes in specific socio-ecological contexts.

1.2 Statement of Problem

Despite the adoption of modern environmental sustainability measures at global and national levels, environmental degradation remains persistent in many regions, including Southern Kaduna. International frameworks such as the SDGs and national policies like NESREA are designed to regulate resource use, monitor environmental quality, and guide sustainable development. However, empirical evidence suggests a significant gap between policy formulation and on-the-ground implementation. This gap is often exacerbated by inadequate institutional coordination, limited financial and technical resources, and insufficient engagement with local communities. Consequently, environmental challenges such as deforestation, soil erosion, and waste mismanagement continue to undermine sustainability goals. In Southern Kaduna, the practical application of modern sustainability measures is particularly constrained. Although national environmental policies exist, local realities including rural livelihoods dependent on agriculture and fuelwood, community reliance on traditional resource governance, and weak enforcement structures—limit the effectiveness of sustainability initiatives (Achi, 2018; Bukar & Abubakar, 2020). Additionally, many modern sustainability indicators are standardized and may not reflect local environmental priorities or socio-cultural conditions, further reducing their relevance and adoption. These challenges underscore the urgent need to critically evaluate the application of modern environmental sustainability measures in Southern Kaduna to identify gaps, assess effectiveness, and recommend context-specific strategies for improvement.

1.3 Aim and Objectives of the Study

The aim of this study is to critically evaluate modern environmental sustainability measures and assess their effectiveness, applicability, and limitations in environmental practice, with a specific focus on Southern Kaduna, Nigeria. The Objectives includes,

- i. Examine key modern environmental sustainability measures applied globally and nationally, and their relevance to Southern Kaduna.
- ii. Assess the implementation of contemporary sustainability policies and regulatory instruments in Southern Kaduna, including institutional capacity, policy enforcement, and stakeholder involvement.
- iii. Evaluate the effectiveness of sustainability measures in addressing environmental challenges such as deforestation, soil erosion, land degradation, and waste management in Southern Kaduna.
- iv. Identify socio-economic, institutional, and governance challenges constraining the practical application of sustainability measures in Southern Kaduna.
- v. Propose context-specific strategies and policy recommendations for enhancing adoption and effectiveness of modern sustainability measures.

1.4 Research Questions:

To guide the empirical investigation of this study, the following research questions are formulated:

- i. What are the key modern environmental sustainability measures currently applied globally, nationally, and in Southern Kaduna?
- ii. How are contemporary sustainability frameworks implemented in Southern Kaduna's environmental governance system?
- iii. To what extent have modern sustainability measures been effective in addressing environmental challenges in Southern Kaduna?
- iv. What institutional, socio-economic, and governance factors influence the application of sustainability measures in Southern Kaduna?
- v. What gaps exist between sustainability policy formulation and tangible environmental outcomes at the local level in Southern Kaduna?
- vi. How can modern environmental sustainability measures be improved to enhance their effectiveness and contextual relevance in Southern Kaduna?

1.5.Literature Review

1.5.1Global Environmental Sustainability Frameworks

Modern environmental sustainability frameworks are rooted in globally agreed targets and policies that guide nations toward sustainable development. The United Nations Sustainable Development Goals (SDGs) remain central, as they integrate economic, social, and environmental dimensions and establish 17 goals with measurable targets and indicators to monitor progress (United Nations, 2015). SDG 12 on responsible consumption and production and SDG 13 on climate action, for example, have shaped national sustainability agendas by compelling countries to adopt standardized sustainability measures and reporting practices. Global initiatives also link environmental sustainability with corporate governance and transparency. For instance, Nigeria recently announced a requirement for businesses to adopt eco-friendly reporting standards aligned with international sustainability disclosure frameworks, reflecting global investor demand for environmental, social, and governance (ESG) accountability (Reuters, 2024). Such policies are designed to integrate sustainability into private sector strategies, highlighting how modern sustainability measures extend beyond government policy into corporate practice. Despite these global frameworks, implementation often encounters barriers at national and local levels due to differences in capacity, governance structures, and socio-economic priorities (Okafor et al., 2024). Studies emphasize that sustainability measures must be adapted to local contexts to achieve meaningful environmental outcomes, as one-size-fits-all global indicators may not fully capture local environmental priorities or socio-cultural dynamics.

1.5.2.Environmental Sustainability in Africa

In Africa, environmental sustainability efforts are shaped by global commitments as well as regional development agendas. The African Union's Agenda 2063 incorporates sustainable development principles to harmonize economic growth with environmental protection. However, implementation challenges remain

widespread across the continent due to financial constraints, weak institutional frameworks, and limited enforcement capacity, leading to sub-optimal outcomes in areas such as land management and waste governance. Research shows growing attention to energy transitions and climate action within sub-Saharan Africa, particularly in relation to sustainable energy and climate change mitigation. A 2025 bibliometric analysis highlights how scholarly work on sustainable energy transitions and climate action in Nigeria and across sub-Saharan Africa has expanded, reflecting the increasing urgency of aligning local policies with global climate agendas (Obanor et al., 2025). This body of research suggests that energy and climate strategies are becoming central components of sustainability measures in the region. Nonetheless, translating these frameworks into effective practice remains difficult. For example, plastic waste management policies are being updated in Nigeria, with phased bans on single-use plastics intended to reduce pollution and promote a circular economy, yet implementation and enforcement still lag behind policy announcements (Reuters, 2024). This underscores the persistent gap between sustainability policy formulation and effective implementation in African contexts.

1.5.3.National Environmental Sustainability Policies in Nigeria

Nigeria has developed a variety of modern environmental policies aimed at promoting sustainability, including climate change mitigation strategies and pollution control regulations. Recent research on Nigeria's environmental policies highlights an ongoing shift toward integrated solutions that address climate vulnerability, sustainable development, and decarbonization pathways (Okafor et al., 2025). These national frameworks reflect the country's commitment to meeting global sustainability targets while addressing local environmental challenges. In addition to policy frameworks, Nigeria has prioritized structural reforms that impact environmental sustainability. For instance, the country's planned ban on single-use plastics and mandates for eco-friendly corporate reporting are efforts to strengthen environmental governance, reduce pollution, and align corporate behaviour with

sustainability principles (Reuters, 2024). Such initiatives illustrate how modern environmental sustainability measures are being mainstreamed within national public and private sector strategies. Despite these policy advances, implementation challenges persist at the national level. Reviews of integrated strategies for environmental sustainability note persistent issues such as inadequate funding, weak enforcement, and limited public awareness, which collectively hinder the effectiveness of sustainability policies in practice (Kodiya et al., 2025). This highlights the need for effective institutional coordination and resource allocation to bridge the gap between policy intent and environmental outcomes.

1.5.4.Local Implementation Challenges in Southern Kaduna and Similar Nigerian Contexts

While national sustainability frameworks exist, their translation into effective local action is often weak, particularly in rural and peri-urban areas like Southern Kaduna. Empirical research on biodiversity and sustainability in Southern Kaduna's local government areas reports significant declines in forest cover, wildlife populations, and aquatic species, driven by land-use change, deforestation, and weak enforcement of environmental regulations (Amba et al., 2025). These challenges demonstrate that formal sustainability measures are frequently undermined by socio-economic pressures and governance gaps at the local level. Local studies reveal that community-based conservation is essential for improving sustainability outcomes in regions like Southern Kaduna, where traditional land management practices still play a major role in shaping environmental behaviour. Field observations and stakeholder surveys show that communities participating in conservation activities achieve better environmental results than areas relying solely on top-down policy enforcement (Amba et al., 2025). This suggests that integrating local knowledge with formal sustainability frameworks can improve effectiveness.

Weak enforcement of environmental laws and insufficient public education compound local sustainability challenges. Research on Nigeria's environmental pollution highlights that policy implementation is often limited by inadequate institutional capacity and resources, resulting in continued degradation despite the presence of regulatory frameworks (Kodiya et al., 2025). This underscores the importance of strengthening local governance structures, enhancing environmental education, and fostering multi-stakeholder engagement to support sustainable practices.

1.5.5.Strategies and Innovations for Enhancing Environmental Sustainability

Emerging research suggests that innovative approaches are needed to improve the effectiveness of sustainability measures in practice. Technological and data-driven solutions, such as advanced monitoring systems and integrated land use analyses, are increasingly recognized as important tools for environmental sustainability. For example, systematic reviews of land use and cover change in Nigeria highlight the importance of accurate data and analytical platforms to inform evidence-based land management and sustainability planning (Alegbeleye et al., 2024). Integrated strategies that combine policy reform, technological innovation, and community participation are becoming prominent in the sustainability discourse. Holistic approaches—such as those linking climate adaptation with waste management and public health outcomes—have demonstrated potential to address multiple sustainability challenges simultaneously (Onicha et al., 2024). These multi-sector strategies provide a template for integrated sustainability measures that go beyond traditional regulatory approaches. Finally, strengthening institutional capacity at local and national levels remains vital for operationalizing sustainability measures. Policy reviews consistently argue for enhanced enforcement mechanisms, greater public awareness campaigns, and participatory governance frameworks to ensure that modern sustainability initiatives achieve

meaningful environmental outcomes (Kodiya et al., 2025; Onwe et al., 2024). Together, these strategies reinforce the need for context-specific, integrated, and inclusive sustainability practices.

2.0 Materials and Methods

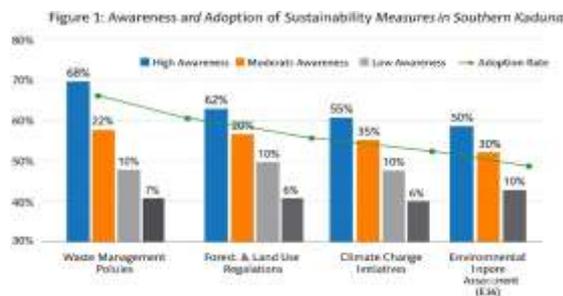
2.1 Study Area

Southern Kaduna is located in the southern part of Kaduna State, within the North-West geopolitical zone of Nigeria. It lies approximately between latitudes 9°00'N and 10°30'N and longitudes 7°00'E and 8°30'E. The region is strategically positioned between the northern savannah belt and the Middle Belt zone of Nigeria, giving it both ecological and cultural diversity. Geographically, Southern Kaduna shares boundaries with Nasarawa State to the south, Plateau State to the southeast, and Kogi State to the southwest. To the north, it connects with other parts of Kaduna State, including the state capital, Kaduna. Major towns within Southern Kaduna include Kafanchan, Zonkwa, Kagoro, Kachia, and Jema'a and Gwantu, which serve as administrative and commercial centers. The region is characterized by undulating plains, hills, and portions of the Jos Plateau extension, with elevations ranging between 600 and 1,200 meters above sea level. It falls within the Guinea Savannah ecological zone, experiencing a tropical wet-and-dry climate with distinct rainy (April–October) and dry (November–March) seasons. Southern Kaduna's topography, vegetation, and climatic conditions make it agriculturally significant but also environmentally sensitive to issues such as soil erosion, deforestation, and land degradation factors central to environmental sustainability studies in the area. Southern Kaduna provides a suitable case study due to the coexistence of formal environmental sustainability policies at the national level and persistent environmental challenges at the local level. This makes it appropriate for evaluating the gap between sustainability frameworks and practical implementation.

3.0 RESULTS AND DISCUSSION

3.1 Awareness and adoption of modern environmental sustainability measures

The first objective of the study was to examine awareness and adoption of modern environmental sustainability measures in Southern Kaduna. The findings presented in figure 1 indicate that awareness levels of sustainability instruments such as waste management policies (68%), forest and land use regulations (62%), climate change initiatives (55%), and Environmental Impact Assessment (50%) are relatively high among respondents. However, adoption rates remain moderate, ranging from 38% to 55%.



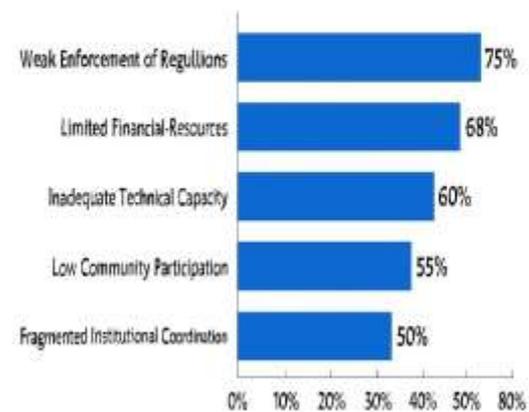
This gap between awareness and practical application confirms that policy visibility does not automatically translate into implementation. Similar observations have been made in Nigerian sustainability research, where scholars report that environmental policies are often well-articulated but weakly operationalized due to structural and socio-economic constraints (Okafor et al., 2025; Kodiya et al., 2025). The findings therefore align with the study's objective of evaluating the effectiveness of sustainability measures and reveal a critical implementation deficit.

3.1 Key Institutional Governance Challenges

As reflected in Figure 2, weak enforcement of regulations (75%) ranked as the most significant constraint, followed by limited financial resources (68%), inadequate technical capacity (60%), low community participation (55%), and fragmented institutional coordination (50%). These findings strongly correspond

with existing literature which identifies governance and enforcement gaps as primary barriers to environmental sustainability in Nigeria and other sub-Saharan African contexts. Scholars have consistently argued that sustainability outcomes depend less on policy formulation and more on enforcement strength, inter-agency coordination, and local institutional capacity (Onicha et al., 2024; Alegbeleye et al., 2024).

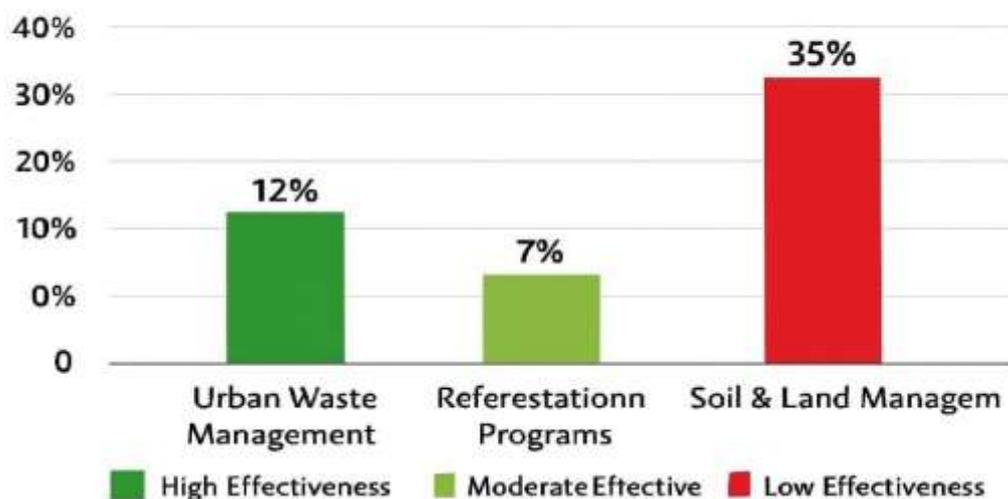
Figure 2: Key Institutional and Governance Challenges in Southern Kaduna



The prominence of enforcement challenges in Southern Kaduna therefore reinforces broader academic consensus regarding institutional weaknesses in environmental governance systems.

3.2 Effectiveness of Sustainability Measures

Figure 3 shows modest improvements in urban waste management (12%) and reforestation initiatives (7%), while land degradation and soil erosion remain significant concerns (35% persistence rate). These results suggest partial but insufficient effectiveness of current measures. The findings are consistent with empirical studies in similar Nigerian regions, where targeted interventions such as reforestation projects yield localized benefits but fail to produce large-scale environmental transformation due to limited funding and monitoring mechanisms (Amba et al., 2025).

Figure 3: Effectiveness of Sustainability Measures

Consequently, the study affirms that while modern sustainability measures are present in Southern Kaduna, their environmental impact remains constrained by scale, enforcement capacity, and inadequate community integration. Overall, the findings substantiate the study's objectives by demonstrating that the core challenge lies not in policy absence, but in institutional and contextual limitations affecting practical environmental outcomes.

4.4 Discussion

The findings reveal a significant gap between awareness and practical adoption of modern environmental sustainability measures in Southern Kaduna. While a considerable proportion of respondents demonstrated high awareness of policies such as waste management regulations, land use controls, climate initiatives, and environmental impact assessment (EIA) frameworks, actual implementation levels remain comparatively low. This disparity suggests that awareness alone does not automatically translate into behavioral change or institutional compliance. The results align with broader sustainability scholarship which emphasizes that policy visibility must be accompanied by enabling institutional structures, enforcement mechanisms, and economic incentives to drive meaningful environmental outcomes. In Southern Kaduna, awareness appears to be largely policy-driven, but operational

integration into daily environmental practice remains weak. The study also highlights governance and institutional constraints as the most critical barriers to effective sustainability implementation. Weak enforcement of environmental regulations ranked highest among identified challenges, followed by limited financial resources and inadequate technical capacity. These findings indicate that environmental sustainability in Southern Kaduna is not constrained by policy absence, but rather by systemic implementation deficits. Fragmented coordination among relevant agencies further reduces policy coherence and efficiency. Such governance weaknesses explain why environmental degradation particularly soil erosion, deforestation, and land degradation continues despite existing sustainability frameworks. The results therefore reinforce the argument that institutional strengthening and regulatory consistency are central to improving environmental practice outcomes. Furthermore, the measured effectiveness of sustainability measures shows uneven progress across sectors. Modest improvements in urban waste management and localized reforestation programs demonstrate that targeted interventions can yield positive results when properly supported.

However, persistent land degradation and erosion indicate that current strategies remain insufficient in scope and scale. This suggests the need for more integrated, community-driven, and context-specific approaches that combine regulatory enforcement with grassroots participation. Overall, the discussion underscores that modern environmental sustainability measures in Southern Kaduna require stronger institutional backing, improved funding mechanisms, and participatory governance to bridge the gap between policy intentions and environmental realities.

4.0 Summary, Conclusion and Recommendation

4.1 Summary

This study critically examined the application of modern environmental sustainability measures in Southern Kaduna, Nigeria. At the global level, sustainability frameworks such as the SDGs provide guidance, while national policies like NESREA and the Climate Change Policy establish legal and institutional mechanisms for environmental protection. The findings revealed that awareness of sustainability measures is relatively high among government and environmental practitioners but lower among community stakeholders, and adoption lags behind awareness. The study also found that the effectiveness of sustainability measures varies by sector. Urban waste management and reforestation initiatives showed measurable improvements, whereas soil and land management programs remain largely ineffective. Key challenges include weak enforcement, limited funding, inadequate technical capacity, low community engagement, and fragmented institutional coordination. Local adaptation and integration of traditional practices were identified as critical factors for improving sustainability outcomes. Furthermore, technological innovations, such as GPS mapping for environmental monitoring and digital tools for waste tracking, show promise but require capacity building and investment to be widely effective. Overall, the study demonstrates that while modern sustainability measures provide a structured framework, their practical impact in Southern Kaduna is constrained by institutional, socio-economic, and governance limitations.

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4.2 Conclusion

The study concludes that modern environmental sustainability measures, while conceptually robust and globally aligned, are only partially effective in Southern Kaduna. The gap between policy design and implementation is largely due to weak institutional capacity, limited funding, insufficient community participation, and inadequate local adaptation of national and global frameworks. Sustainability outcomes are more successful when programs actively engage local communities and integrate indigenous practices with formal measures. To achieve meaningful environmental sustainability in Southern Kaduna, interventions must be context-specific, participatory, and supported by stronger governance structures and technical capacity. Bridging the gap between policy and practice is essential for achieving both national and global environmental targets in the region.

4.3 Recommendations

First, there is a strong need to strengthen institutional enforcement and regulatory coherence at both state and local government levels in Southern Kaduna. Although modern environmental sustainability policies exist in Nigeria, weak enforcement remains a major barrier to effective implementation. The Kaduna State environmental authorities, in collaboration with local government councils in Southern Kaduna, should establish a decentralized environmental monitoring and compliance unit equipped with trained personnel, digital reporting systems, and periodic environmental audits. Clear performance indicators tied to Sustainable Development Goals (SDGs) should guide implementation. In addition, environmental impact assessments (EIA) must be strictly enforced for agricultural expansion, mining activities, and infrastructure projects within the region, with penalties applied consistently for non-compliance. Strengthening institutional coordination between ministries responsible for environment, agriculture, forestry, and rural development will reduce fragmentation and improve policy coherence. Second, sustainable financing mechanisms should be developed to support environmental sustainability measures in Southern Kaduna.

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management cooperatives can enhance accountability and improve long-term sustainability outcomes. By embedding sustainability within local governance structures and cultural systems, policy-driven measures can achieve durable environmental resilience in Southern Kaduna.

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