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RESEARCH ARTICLE

Innovative Approaches to Sustainable Land Management: Strategies for Urban Resilience in Lagos, Nigeria

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ABSTRACT

The twin factors of rapid urbanisation and population growth in Lagos have led to significant environmental challenges, including inadequate infrastructure, flooding and land degradation. This paper explores a range of Sustainable Land Management (SLM) practices, including green infrastructure, community engagement and the use of technology for monitoring and managing urban landscapes, with a focus on strategies that promote urban resilience. The conceptual framework rests on the principles of sustainability and resilience, while systematic review of literature was adopted as methodology. A comprehensive analysis of literature from peer-reviewed journals, policy reports and case studies conducted between 2010 and 2023 on efforts in sustainable land management, challenges to innovative approaches in sustainable land management and strategies for sustainable land management reveals an effective action plan that integrates ecological principles with urban planning. Key findings from the systematic review indicate that adaptive governance, stakeholder collaboration and promotion of ecosystem services are essential for fostering resilience against climate-change impacts. Additionally, the incorporation of local knowledge and cultural values significantly enhances community buy-in and sustainable practices. The review underscores the importance of context-specific solutions tailored to the unique socio-economic conditions of Lagos. By identifying best practices and potential pitfalls in implementation, this paper provides valuable insights for policymakers and urban planners seeking to create sustainable urban environments in Nigeria and similar contexts.

Keywords: Sustainable land management, Urban resilience, Green infrastructure, Climate change, Lagos

1.0 Introduction

Sustainable Land Management (SLM) emerged as a response to increasing concerns over land degradation, biodiversity loss and climate change in both the developed and developing countries. In developed nations, its origins can be traced to the environmental movements of the 1960s and 1970s, which led to stronger regulatory frameworks and land-use planning based on ecological principles (World Commission on Environment and Development, 1987). Meanwhile, in the developing world, SLM gained prominence only in the late twentieth century through initiatives addressing desertification, deforestation and soil erosion, often supported by international agencies and NGOs under frameworks such as the United Nations Convention to Combat Desertification (Rackelmann et al., 2024). Although their paths differed, with the developed countries leveraging technology and policy reforms and the developing countries relying on community-based and donor-supported projects, the shared goal has been the integration of environmental, economic and social factors to maintain land productivity for present and

future generations (Food and Agriculture Organisation, 2011).

Sustainable Land Management (SLM) can be described broadly as "the use of land resources, including soils, water, animals, and plants, for the production of goods that meet changing human needs, while ensuring the long-term productive potential of these land resources and maintaining their functional environmental values" (FAO, 2011). In developed countries, SLM will often be defined with emphasis on a more sophisticated approach to land use through advanced land-use planning, precision farming and the implementation of regulatory tools to achieve a balance between conservation and productivity (Organisation for Economic Co-operation and Development, 2006).

In developing countries, however, SLM is typically associated with a 'community-led' approach to development that integrates traditional ecological knowledge with an integrated rural development programme that addresses immediate livelihood needs, while at the same time enhancing the sustainable use of resources and preventing degradation (Rackelmann et al., 2024). The fundamental principles of SLM are consistent across geographical differences: (i) to optimise land productivity, (ii) to protect ecosystem goods and services, and (iii) to build resilience to climate change for present and future generations.

In both developed and developing nations, operationalising sustainable land management (SLM) involves transforming policies and conceptual frameworks into practical actions for the local context. Developed nations typically employ sophisticated monitoring systems, geographic information systems (GIS), precision agriculture and regulatory instruments that incorporate environmental impact assessments into land-use decision making (OECD, 2006; FAO, 2011). By contrast, developing nations often rely on participatory methods, capacity development and low-tech solutions (e.g., agroforestry, soil conservation practices and community-based watershed management) that are often funded by donors, in addition to implementing international frameworks such as the Rackelmann et al. (2024). While levels of technological sophistication and institutional capacity may differ between the two contexts, they both emphasise the importance of stakeholder involvement, adaptive management and accommodating economic/social/ecological objectives in order to achieve long-term productivity and resilience of land to climate change.

No doubt, the implementation of Sustainable Land Management (SLM) faces significant challenges in both the developed and developing countries owing to rapid urbanisation. Evidently, rapid urbanisation and population growth lead to intense pressure on land and its resources. When growth and development are not managed properly, the inevitable results would be uncoordinated development, infrastructure deficit, encroachment of natural drainage ways and land degradation. Sustainable Land Management can address these problems by promoting coordinated land-use planning that ensures development occurs in a way that reduces environmental risks.

Expectedly, the characteristics and intensity of the challenges related to SLM vary by context. In the developed world, urban expansion and housing developments have led to the loss of agricultural land, fragmented habitats through suburban sprawl, and increased pressure on natural resources, even with strong regulatory frameworks in place (OECD, 2018). In the United States, for example, urban sprawl has resulted in the loss of farmland and disruption of the provision of some ecosystem services within peri-urban areas (United States Department of Agriculture, 2017). In the developing world, urbanisation often occurs in the absence of properly executed land-use planning, resulting in informal settlements and inadequate infrastructure where soil degradation, deforestation and pollution are exacerbated (UN-Habitat, 2020).

Lagos is estimated to have a population of 20 million people, hence its classification as a megacity; consequently, there is intense competition for urban land that is growing at an unsustainable rate and will subsequently impact the state’s rural areas negatively. The challenge is to achieve a balance among economic development, housing demand and infrastructure costs by opting for the sustainable use of ecosystems and the productive capacity of land while promoting future sustainability. Sustainable Land Management

(SLM) is one way to address these challenges while also enhancing climate-change adaptive capacity, providing equitable socio-economic solutions and increasing resilience to climate change. In the light of the foregoing, this paper aims to review innovative SLM approaches that make cities, particularly Lagos, more resilient to these challenges through integrated approaches, stakeholder participation, technological advances and the development of strong policy frameworks.

2.0 Conceptual and Theoretical Review

This study reviews the concepts of sustainability and resilience, as well as their relevance in implementing innovative techniques of sustainable land management for urban resilience in Lagos, Nigeria. The concept of sustainability emerged in the twentieth century, following the publication of the 1987 Brundtland Report by the World Commission on Environment and Development (WCED), which gave prominence to the idea of sustainable development as development that meets the needs of present generations without compromising the ability of future generations to meet their own needs. Historically, it has had its roots in the nineteenth and twentieth century conservation movements, but its contemporary understanding has expanded to include environmental, social and economic aspects (Purvis et al., 2019).

Definitions of sustainability tend to vary based on field. From the spatial perspective, sustainability pertains to land and land use (Alemu, 2016). Towards maintaining environmental health and social equity for all, experts have identified three pillars of sustainability. According to Mensah and Casadevall (2019), sustainable development "'is the ability to maintain our ecological balance, social equity, and economic viability for generations to come." On its part, the FAO (2011) states that sustainability is the utilisation of land resources so that ecosystem services, productivity, socio-economic benefits and resilience to both natural and human pressures are provided for all generations.

Going by the definitions of sustainability in principle, land-management strategies in Lagos State must reflect the need to preserve land and natural resources for the future generation without affecting the provision of land for the present generation. However, the urban renewal exercises being undertaken by the Lagos State Government actually reflect the principles of elimination and replacement. To be sure, the principle of sustainability is violated in any process that allows the displacement of the old generation, who statutorily owned land and natural resources, and their subsequent replacement by a new generation with considerable economic and political power. Thus, resilience is the ability of urban systems, communities and individuals to withstand, adapt and recover from shocks and stresses while maintaining its essential function (Meerow et al., 2016). In Lagos, sustainability is strongly related to urban resilience because of rapid urbanisation, climate-change impacts and pressure on infrastructure (Adelekan, 2016).

Elmqvist et al. (2019) suggest that the significance of resilience is high in relation to land management; as cities grow rapidly, land degradation and climate shocks remain a reality of urbanisation. Noting that the definition of resilience originates from ecosystems, Holling (1973) defines resilience as an ecosystem's ability to resist or absorb disturbances. While the original definition of resilience was grounded in ecology, the concept has been expanded to include applications within other systems such as social, environmental, spatial and socio-technical systems. Within the urban context, the resilience of an urban environment is its capacity or ability to weather stress/shock (Folke, 2006; Meerow et al., 2016).

Resilience provides a framework for cities to remain viable in times of stress and it highlights the importance of adaptation, redundancy and transformability (Ahern, 2011; Folke, 2006). Holling (1973) also observes that the concept has been adopted across various contexts, such as disaster management, climate adaptation and urban planning, with a focus on the concepts of adaptability and recovery. The Resilience Alliance and other authors from the 2000s have expanded the definition of resilience to include socio-ecological systems, showing the interdependence of humans and the environment.

Expectedly, there has been increased application of these principles of resilience to cities, specifically in

terms of climate-change adaptation and sustainable land management in the Lagos metropolis. Meerow et al. (2016) notes that urban resilience is the ability of cities to withstand, adapt to and evolve owing to chronic stressors and acute shocks. On their part, Folke (2006) identifies socio-ecological resilience as the ability of interlinked human-environmental systems to absorb shocks while continuing to operate as intended.

Reconciling resilience with SLM is about how well urban land systems can continue to provide productive use and ecosystem services while also providing a good quality of life for people who live in cities despite the pressures of climate change and urbanisation. A major feature of resilient cities is their ability to adapt to changes and shocks while being flexible in responding. Because the understanding of resilience varies across disciplines, the idea of variability in urban resilience may be misunderstood (Brand & Jax, 2007). Variability has led to the emergence of a situation where many resilient economies benefit from wealthier locations, while more vulnerable communities continue to suffer severe impact (Davoudi et al., 2012). Since measuring urban resilience is a complicated process, limitations remain around the monitoring and evaluation of urban resilience (Meerow et al., 2016). Constraints to implementing SLM and building urban resilience strategies in Lagos include limited funding, governance and limited technical expertise.

In the Lagos context, the land-management resilience goals are intended to reduce the vulnerability of areas that are susceptible to flooding, coastal erosion and sea-level rise. The aim is to increase the city's ability to cope with changes (environmental and socio-economic), leading to improved infrastructure, housing and energy systems, achieving a sustainable balance between land use, development and conservation, increasing the capacity of institutions for integrated urban and land management, and the provision of a greater opportunity for local community participation in planning/sustainable land-use decisions (Adelekan, 2016).

According to Folke (2006), there are four essential principles in developing urban resilience in land-use planning, viz: (i) systems thinking the concept that various social, ecosystem and infrastructural systems are interconnected and interdependent; (ii) providing the ability to be flexible and adaptable by creating the means to allow for real-time responses to unexpected events; (iii) redundancy and diversity creating multiple sources of service delivery to avoid single points of failure (Meerow et al., 2016); (iv) participatory/inclusive planning involving local community members/stakeholders in all aspects of the planning process (UN-Habitat, 2020); and adopting ecosystem-based methodologies (i.e., incorporating green infrastructure, nature-based solutions and climate-sensitive urban design) (Kabisch et al., 2017).

Certainly, resilience in sustainable land management allows for the consideration of adaptive approaches to managing land and its use. As cities face an unceasing array of challenges while striving for improvement, they must ensure that the land and spaces are liveable and can be adapted and modified to meet changing conditions through sustainable land management (Elmqvist et al., 2019).

3.0 Materials and Methods

Lagos is located at approximately Longitude 20° 421" E and 30° 401" E of the Greenwich Meridian and Latitude 60° 231" N and 60° 401" N of the Equator. It is bordered to the north and northeast by Ogun State, to the west by the Republic of Benin and to the south by the Atlantic Ocean, as shown in Figure 1. Lagos is a strategic location that allows transport by road, rail or air to and from Lagos, having a major waterway that connects to the Atlantic Ocean. Its rapid growth can be attributed to its proximity to major infrastructures located within and outside the country; as such, it has had a corresponding variety of sustainable SLM practices, including green infrastructure, community engagement and the use of technology to monitor and manage the urban landscape in the bid to build resilience (Balogun, Bako & Adeoye, 2023).

This study is a systematic literature review involving desk-based (secondary) material. It reviews, pools, evaluates and synthesises the material in that order, alongside literature related to the various historical attempts at innovative approaches to sustainable land management,

challenges experienced and the current and future use of urban sustainability as an urban planning goal. We used a comprehensive set of search parameters while accessing academic databases such as Scopus, Google Scholar, and JSTOR. We used the keywords "sustainable land management", "urban resilience", "Lagos" and "Nigeria". The selected works were peer-reviewed articles, reports and other grey literature published between 2010 and 2023 about sustainable land management, challenges to innovative approaches and the summary strategies regarding sustainable land-management efforts, challenges and innovative approaches. Thus, document analysis was the basis for identifying, reviewing and synthesising the available literature, including studies examining innovative land management, in the bid to determine the possible implications for urban resilience in Lagos. The sustainable land-management approach is the independent variable, operationalised by the practices or strategies discussed, such as participatory land management as well as green infrastructure and technology.



Figure 1: Map of Lagos State in the Context of Nigeria

Source: Bako and Adeoye (2023)

4.0 Findings and Discussion

4.1 Past efforts in Sustainable Land Management in Lagos

Since there needs to be a balance between land use and environmental conservation, sustainable land management (SLM) has become an important tool to achieve this balance. Exploring past and present innovative SLM strategies, this study reports that, while some of these efforts may not be considered innovative, they represent commendable attempts at land management. As a country with many cities and urban centres, Nigeria faces the usual urbanisation problems. In particular, Lagos faces the serious challenge of high population density, which leads to the proliferation of informal settlements and rising resource scarcity. Between 2010 and 2023, the Lagos State Government (LSG) implemented several strategies to help resolve these challenges and ultimately create an environmentally sustainable urban area.

In response to finding the balance between land use and conserving the environment, the LSG designed a series of policies and legal documents that promote and develop SLM. For instance, the Lagos State Environmental Protection Law (2017) focuses on creating a sustainable and environmentally friendly way to manage the land in Lagos by regulating land use and providing options for waste management (Lagos State Government, 2017). There is also the Lagos State Development Plan (2012-2025), which is a long-term plan of action designed to facilitate the successful implementation of SLM in the state through integrated urban planning and providing guidelines for an efficient process, as well as to develop sustainable land-use projects and infrastructure within the state (Lagos State Ministry of Physical Planning and Urban Development, 2012). Additionally, the Lagos State Climate Action Plan (2020) outlines various strategies for creating a sustainable urban environment by emphasising the need to properly manage the land and conserve natural resources through a comprehensive afforestation programme (Lagos State Government, 2020).

The LSG has set out to improve infrastructure and housing while also promoting environmental sustainability through a number of major initiatives that drive the framework for policies related to innovative approaches to sustainable land management. One of such initiatives is the Eko Atlantic City project, which is intended to develop a new urban area from land that is going to be reclaimed while proposing new measures for the control of flood and erosion (Lagos State Government, 2018). Besides, zoning regulations and land-use planning have been reviewed periodically as a way to promote sustainable urban development. In this regard, the Lagos State Physical Planning Permit Authority (LASPPPA) is one of the key organisations that regulate land use and ensure that planning standards are met (Odugbesan & Adebayo, 2020).

To be sure, the Lagos State Government has been engaging in public-awareness campaigns and education programmes to help promote community involvement. Through community engagement and education, the importance of local communities in sustainable land management has been recognised. One of such initiatives is the "Green Lagos" campaign, which focuses on tree planting and community participation in protecting the environment (Lagos State Parks and Gardens Agency, 2021).

The government has also undertaken many slum-upgrade initiatives in the bid to improve living conditions in informal settlements. For example, the Lagos State Urban Renewal Agency (LASURA) (2019) has engaged in improving infrastructure for slum communities while providing them with social services (Olayiwola, 2019). Furthermore, since the 1970s, the government has been releasing urban development master plans, including the Lagos State Regional Plan (2005-2025), which integrates environmental issues into spatial planning as a way to guide growth while also protecting environmentally sensitive areas such as wetlands (Akinola, 2010).

Technology can also help reduce habitat loss and ensure orderly development through the use of regulated zoning and land-use mapping (Oduwaye, 2009). Also quite significantly, since the late 1990s, Lagos has been using Geographic Information Systems (GIS) for land administration. The Lagos State Ministry of Physical Planning and Urban Development has engaged private consultants to digitise land records and monitor land-cover changes (Fabiyi, 2011). According to Abiodun et al. (2017), GIS application has facilitated the detection of illegal land conversions, improved the efficiency of

Certificate of Occupancy issuance, and reduced the number of land disputes.

Given the state's proximity to the coast, hence its vulnerability to flooding, the LSG has been investing in storm water drainage rehabilitation, shore protection and mangrove restoration. Although controversial in a number of respects, the Eko Atlantic City Project includes sea walls to offer protection against erosion and sea-level rise. Adelekan (2016) found that an integrated approach to flood management (combining engineered approaches and wetland preservation) reduced estimated annual flood losses by 15% in the studied communities.

Again, the Lagos State Slum Electrification and Sanitation Programme (2007–2013) was meant to address informal settlements through in-situ upgrading, providing basic infrastructure and regularising tenure. According to UN-Habitat (2014), these projects improved living standards for over 1.2 million residents and ensured more secure land tenure. Moreover, the Lagos State Environmental Management and Protection Law (2017) has strengthened environmental consciousness in land-use planning. It demands Environmental Impact Assessment (EIA) reports for major developments and promotes adoption of sustainable construction practices. Badejo (2020) notes that regular follow-up after project approval has helped improve developers' compliance with Environmental Impact Assessment (EIA) requirements, encouraging greater environmental responsibility.

Thus, experiences from Lagos suggest a gradual transition from largely reactive measures to more forward-looking and coordinated approaches to sustainable land management. Despite ongoing challenges such as rapid urban expansion and weak enforcement, the available evidence points to clear gains from deliberate planning, better use of technology, stronger environmental regulation and community-based upgrading initiatives.

4.2 Challenges Faced during Past Efforts in Sustainable Land Management

While the LSG has made notable efforts to ensure sustainable land management through urban master plans, GIS integration, environmental laws and slum upgrading, these efforts continue to be hampered by several recurrent challenges. As a megacity, Lagos persistently experiences rapid urbanisation due to massive population growth, leading to encroachment on natural habitats and increased pressure on land resources (World Bank, 2021). Related to this is the challenge of informal settlements, with large numbers of residents living in unplanned settlements, thus making it difficult to enforce land-use policies (UN-Habitat, 2022). Significant issues of environmental degradation also remain, such as flooding, waste management and erosion, all of which require long-term strategies to mitigate (Nwokoro, 2023).

As a result of the Lagos growth rate of around 6% annually (UN-Habitat, 2014), planning frameworks are currently not sufficient to support the future growth expected within that planning period. Thus, the emergence of informal settlements continues to outpace formal land allocation processes. In empirical work, Badejo (2020) reported that despite the existence of an Environmental Management and Protection Law (2017) in the state, only 58% of large-scale developments submitted Environmental Impact Assessments (EIA), with little penalty for non-compliance. Budgetary constraints have also negatively impacted large-scale public projects such as drainage rehabilitation and the development of a Geographic Information System (GIS) for land administration. The limited availability of funding has delayed the full implementation of the Sustainable Land Management (SLM) strategies and created gaps in infrastructure. Fabiyi (2011) noted that by 2010 only 40% of the planned GIS digitisation for land records was completed owing to budgetary challenges, resulting in fragmented data for land management.

Moreover, statutory and customary land allocation systems have frequently been in conflict, leading to uncertainty for landowners. This situation increases conflict and deters investment in sustainable methods. According to Abiodun et al. (2017), up to 35% of assessed parcels in some Lagos districts had unresolved ownership conflicts, hence the limited effectiveness of land regularisation initiatives. Regrettably, some of the accomplishments in SLM in Lagos have been compromised by coastal erosion, flooding and wetland degradation, particularly where adaptation strategies have been insufficient or exclusive. The Eko Atlantic City

Project and others have been criticised for prioritising upscale development over the preservation of natural habitats.

Despite government's drainage and coastline protection measures, Adelekan (2016) reported, seasonal flooding still impacts over 20% of households in low-lying areas, indicating modest resilience benefits. In most cases, impacted communities were not consulted on projects, leading to little or no community ownership, opposition to policies and inadequate infrastructure upkeep, as local stakeholders do not feel accountable for maintaining changes. According to Akinola (2009), lack of participatory governance contributed to the failure of many community upgrading programmes. Indeed, systemic issues such as growing urbanisation, lax enforcement, budget shortages, tenure disputes, environmental hazards and low community involvement have hampered previous attempts at sustainable land management in Lagos State. To tackle these challenges, however, it will be necessary to ensure harmonised policy frameworks, inclusive planning, sufficient funding and climate-resilient tactics.

4.3 Challenges to Innovative Approaches in Sustainable Land Management

Innovative approaches to sustainable land management, such as the integration of Geographic Information Systems (GIS), participatory planning, climate-resilient infrastructure, land-use planning, community engagement, public-private partnerships, the use of technology for monitoring and evaluation, and smart urban policies offer promising pathways for solving Lagos's land-use crises. However, their effectiveness has been constrained by socio-economic, institutional and technical barriers.

Utilising innovations such as GIS and remote sensing requires high-level skills; however, as Lagos continues to struggle with a shortage of experts and training opportunities, these tools cannot be explored to their full potential. As Fabiyi (2011) found, fewer than 25% of surveyed planning staff in Lagos agencies had adequate GIS training, making delays and errors inevitable in land record digitisation. Innovative SLM often demands substantial initial investments in technology, infrastructure and research. However, budget restrictions in Lagos narrow the scope of projects, causing incomplete or stalled initiatives. Abiodun et al. (2017) noted that the Lagos GIS project launched in 2007 was only 60% complete by 2016 owing to funding shortages, hence its limited usefulness for land-use monitoring.

It should also be noted that multiple agencies oversee land use, environmental management and urban planning often without harmonisation (Oduwaye, 2009). This leads to a duplication of policies and inefficient resource use. Oduwaye (2009) also observed that overlapping mandates between the Ministry of Physical Planning, the Ministry of Environment, and the Lands Bureau caused conflicting directives in development control, thereby stalling innovative SLM interventions. Innovative SLM approaches, especially participatory planning and inclusive digital systems, often face resistance from traditional landholders, developers and political actors who benefit from the status quo. Akinola (2009) found that participatory slum upgrading models failed in some Lagos districts because community members lacked trust in government-led digital mapping exercises, perceiving them as a threat to informal land tenure.

It is clear that effective innovation depends on comprehensive, reliable data; however, Lagos struggles with this because of fragmented record-keeping and outdated surveys. There is no doubt that tools lose their effectiveness when there is no reliable baseline information, advanced modelling and planning. Badejo (2020) found inconsistent environmental impact datasets in Lagos' EIA repository, making it difficult to integrate predictive analytics into land planning. Innovations geared toward climate resilience (e.g., coastal defences, green infrastructure) are undermined by the increasing intensity of floods, sea-level rise and environmental degradation. Thus, the need for constant adaptation makes it difficult for any stand-alone strategy to maintain its effectiveness.

As already noted, Adelekan (2016) found that despite the presence of engineered coastal barriers, low-lying areas in Lagos continue to experience seasonal floods, showing that innovative infrastructure alone cannot overcome

environmental vulnerabilities without broader sustainability measures. In reality, land-management policies in Lagos have not been quite coherent. With various governmental agencies operating with overlapping mandates, conflicts and inconsistencies in policy implementation impede effective SLM efforts (Agbola & Jinadu, 2018). The absence of a strong legal framework to guide land use and management often leads to confusion and inefficiency. Inadequate infrastructure is also a significant challenge in Lagos, even as the rapid pace of urbanisation has outstripped the capacity of existing infrastructure, leading to congestion, poor drainage systems and inadequate waste management. These factors worsen environmental degradation and further complicate SLM efforts (Ogunnaike, 2021).

Besides, land-tenure insecurity remains a critical obstacle to SLM in Lagos. Competing claims to land, lack of formal documentation and traditional land ownership systems create a complex web of challenges that hinders effective land management and sustainable development. Even more, uncertainty in land rights discourages investment in sustainable practices (Ola-Adetokun et al., 2019). Just as well, socio-economic factors of poverty, unemployment and lack of education also play a significant role in hindering innovative SLM practices. In such situations, vulnerable populations often resort to unsustainable land-use practices in the absence of alternative livelihoods, thus complicating land degradation (Otegbeye, 2020).

Additionally, public awareness of sustainable practices is low, thereby limiting community participation in SLM efforts. As such, Lagos faces the adverse impacts of climate change, including rising sea levels and increased flooding. These challenges not only affect land use and management but also disrupt the lives of millions. Consequently, the failure to integrate climate resilience into SLM strategies has resulted in vulnerability for both urban and rural communities (Adeyemi et al., 2022).

Although Lagos has tried some innovative approaches to sustainable land management, their implementation has been hampered by limited technical capacity, high costs, weak institutional coordination, resistance to change, poor data quality and climatic pressures. For innovations to succeed, Lagos must prioritise capacity building, adequate funding, agency collaboration, transparent data systems and community trust.

4.4 Innovative Approaches to Sustainable Land Management

In recent times, Lagos has adopted innovative, technology-driven and participatory land-management strategies to address rapid urbanisation, environmental pressures and complex tenure systems. These approaches seek to balance economic growth with environmental preservation and social inclusion. The state has deployed GIS and satellite imagery to monitor land-use changes, digitise land records and detect illegal developments. Abiodun et al. (2017) showed that GIS mapping reduced land disputes in pilot districts by 40% within five years owing to improved accuracy in plot boundary definitions. Innovative in-situ slum upgrading projects have also combined community participation with infrastructure provision in informal settlements, avoiding forced evictions while improving living standards. The World Bank-supported Lagos Metropolitan Development and Governance Project (2006–2013) established the precedent for participatory land governance.

In the mid-2000s, the Lagos State Ministry of Physical Planning & Urban Development utilised this technology to improve urban planning accuracy. According to a 2014 UN-Habitat report, involving residents in planning decisions led to a 25% increase in tenure security and significantly better access to sanitation in upgraded communities. In response to flooding and coastal erosion, Lagos has invested in green infrastructure such as rain gardens, retention ponds and urban mangrove restoration, and has integrated them into land-management plans. Projects such as the Lagos Drainage Master Plan integrate natural solutions with engineered systems. Adelekan (2016) found that the combination of engineered drainage and urban wetland preservation reduced flood-impact incidents in targeted low-lying districts by 15% between 2010 and 2015.

Furthermore, efforts to streamline transactions and reduce corruption drive platforms such as the Lagos State e-C of O. Badejo (2020) observed that this initiative cut title processing times from an average of 24 months to under 9 months, enhancing transparency

and reducing illegal allocations. Similarly, Lagos has leveraged PPPs for land reclamation and environmental remediation. The Eko Atlantic City Project, while controversial, incorporates modern coastal protection technologies. Fabiyi (2011) found that PPP-based shoreline defence systems helped reclaim over 5 km² of land lost to erosion, although social inclusion aspects remain debated. The LSG has also begun implementing Integrated Coastal Zone Management (ICZM) strategies to balance development with marine and coastal ecosystem protection, which is critical in a megacity surrounded by water. Oduwaye (2009) noted that initial ICZM trials in Lagos reduced unregulated sand-mining activities along the Lekki coastline by 30%, thereby enhancing coastal stability.

Given the foregoing observations, integrated urban planning is essential for effective SLM. Lagos has witnessed unregulated urban expansion, leading to the loss of green spaces and increased vulnerability to flooding (Eguavoen et al., 2021). An integrated approach incorporates land use, transportation, infrastructure and environmental considerations, thus facilitating holistic development. By employing Geographic Information Systems (GIS), planners can analyse spatial data to optimise land use, promote green spaces and protect vulnerable areas (Mogaji et al., 2020).

The adoption of technology in SLM is essential for enhancing urban resilience as Smart city technologies can provide real-time data on land-use changes, thus enabling timely interventions (Eresia-Eke et al., 2022). For instance, using drones for aerial surveys aids in monitoring environmental changes, just as use of mobile applications for reporting illegal land use can enhance transparency and accountability in land management. Incorporating Green Infrastructure (GI) into urban planning can significantly improve the environmental quality of Lagos, helping to address challenges such as flooding and air pollution (Ogunlela & Mukhtar, 2020). GI initiatives, such as green roofs, permeable pavements and urban forests can enhance storm water management, while also providing recreational spaces for residents. Although the Lagos State Government has begun investing in GI projects, more efforts are needed to incorporate these measures systematically into urban development plans. Getting SLM strategies to work effectively also requires a comprehensive policy framework.

The Lagos State Government's "Integrated Development Master Plan" aims to create a sustainable urban environment but requires further alignment with SLM principles (Lagos State Government, 2019). But it must be noted that it is only by strengthening governance structures to ensure collaboration between stakeholders, government, the private sector and civil society that policy coherence and enforcement can be achieved. Furthermore, incorporating local knowledge and adaptive management practices into policies can considerably improve resilience outcomes.

Indeed, engaging local communities in land-management practices fosters ownership and sustainability. As experience has shown, community-led projects, such as urban gardening and waste management, have produced positive outcomes in enhancing urban resilience (Afolabi & Ajuwon, 2019). No doubt, initiating public awareness campaigns to promote environmental stewardship will empower citizens in Lagos to actively participate in SLM efforts. Collaborations with local NGOs can strengthen these initiatives further, ensuring that land management reflects community needs and aspirations.

5.0 Conclusion and Recommendations

Innovative SLM approaches in Lagos, including GIS mapping, participatory upgrading, climate-resilient infrastructure, smart governance, PPPs and ICZM, have produced measurable benefits from reduced land disputes to improved flood resilience. However, scaling up these strategies requires sustained funding, technical capacity development and stronger integration between environmental and urban policies. This review focused on the importance of an approach that engages stakeholders on different fronts if a resilient urban future is to be built for Lagos. Further research and collaboration are required to ensure effective implementation of these strategies.

As the review found, from 2010 to 2023, the Lagos State Government made notable strides in sustainable land management, characterised by the design of initiatives and policies aimed at balancing development and environmental sustainability. However, Lagos faces unprecedented challenges stemming from rapid urbanisation, making it

necessary to pursue urban resilience through innovative approaches to sustainable land management. To be sure, such innovative approaches constantly face challenges, particularly policy inconsistencies, infrastructure deficits, land-tenure issues, socio-economic factors and climate-change impacts. Ongoing challenges illustrate the need for continuous improvement in strategies and community involvement to foster a more sustainable future for Lagos. Integrated urban planning, community participation, technological innovations, green infrastructure and coherent policy frameworks are key to fostering sustainability.

In addressing these challenges, the following recommendations may be considered:

1. policy harmonisation that establishes a comprehensive and cohesive land-management framework that aligns with the Sustainable Development Goals (SDGs);
2. investing in infrastructure, particularly in waste management and drainage systems, to support effective SLM;
3. strengthening land-tenure security that implements programmes to formalise land ownership and strengthen land-tenure security to encourage investment in sustainable practices;
4. community engagement and education that promotes community participation and education on sustainable practices to foster a culture of sustainability among residents;
5. climate resilience integration/development strategies that enhance the climate resilience of land-management practices to mitigate the impact of climate change on land use;
6. stable financing for long-term sustainable land-management implementation public-sector investment and financing through public-private partnership are sustainable means to fund these initiatives;
7. continuous capacity building through targeted training of personnel in geospatial technologies, which will facilitate land-use planning and data-driven decision-making;
8. integration of green infrastructure, such as urban green spaces, green roofs and permeable pavements into the land-management process, which will enhance infrastructure development, reduce flood risks and enhance storm water management.

The adoption of these strategies will not only foster a resilient and sustainable future for Lagos but also guide other cities aiming to achieve resilience.

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Conflict of interest

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