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Urban resilience against environmental disasters: Comparing Lagos and New York

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Abstract

Urban resilience against environmental disasters is a critical aspect of sustainable urban development, particularly in megacities like Lagos and New York, which face diverse environmental challenges. This review examines the comparative analysis of urban resilience strategies in Lagos, Nigeria, and New York City, USA, focusing on their responses to environmental disasters. Both cities encounter distinct environmental hazards, including flooding, hurricanes, and heatwaves, albeit within different socio-economic contexts. Lagos, Africa's most populous city, grapples with rapid urbanization, inadequate infrastructure, and informal settlements, exacerbating its vulnerability to environmental disasters. In contrast, New York City, a global financial hub, confronts challenges posed by its dense urban fabric, aging infrastructure, and coastal exposure. Despite differing contextual factors, both cities strive to enhance their resilience through various strategies. Lagos employs a mix of top-down and bottom-up approaches, emphasizing community engagement, early warning systems, and infrastructure improvements to mitigate flood risks. Initiatives such as the Lagos State Resilience Strategy and the implementation of green infrastructure projects signify efforts to enhance adaptive capacity and reduce vulnerability. Conversely, New York City adopts a multifaceted approach, integrating policy frameworks, technological innovations, and community-based initiatives to bolster resilience. Post-Hurricane Sandy, the city launched the "OneNYC" plan, emphasizing infrastructure upgrades, coastal protection measures, and climate adaptation strategies to withstand future shocks. Comparative analysis reveals both convergences and divergences in urban resilience strategies. While Lagos prioritizes grassroots involvement and low-cost solutions, New York emphasizes institutional coordination and investment in resilient infrastructure. Challenges persist in both contexts, including funding constraints, governance issues, and socio-economic disparities, underscoring the need for holistic and inclusive resilience frameworks. Understanding the nuances of urban resilience in diverse contexts can inform policy interventions and best practices transferable across cities globally. By examining the experiences of Lagos and New York, this review contributes to the discourse on building resilient cities capable of navigating environmental uncertainties and safeguarding the well-being of urban populations.

Keywords: Urban; Resilience; Environmental; Disasters; Lagos; New York

1. Introduction

Urban resilience against environmental disasters is a paramount aspect of sustainable urban development, particularly in megacities grappling with the complexities of climate change and rapid urbanization. Defined as the capacity of cities to withstand, adapt to, and recover from environmental shocks and stresses, urban resilience plays a pivotal role in

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ensuring the well-being and longevity of urban populations amidst increasing environmental uncertainties (Meerow, 2017; Bogunovich, and Auckland, 2016).

Studying urban resilience in megacities holds immense significance due to their unique socio-economic and environmental dynamics. Megacities such as Lagos and New York represent contrasting yet illustrative case studies in this regard. Lagos, Nigeria, Africa's most populous city, faces a multitude of environmental challenges, including frequent flooding, rapid urbanization, and informal settlements (Nsorfon, 2015; Ofoezie, et al., 2022). Conversely, New York City, a global financial hub, confronts its own set of environmental hazards, such as hurricanes, coastal exposure, and aging infrastructure (Zimmerman, et al., 2019; Dawson, 2017). Despite their differences, both cities exemplify the urgent need for effective urban resilience strategies to mitigate the impacts of environmental disasters on their populations and infrastructure.

In this context, this paper aims to conduct a comparative analysis of urban resilience strategies in Lagos and New York. By examining the approaches adopted by these megacities in responding to environmental disasters, valuable insights can be gleaned regarding the effectiveness, challenges, and best practices associated with urban resilience. Through this comparative lens, we seek to identify commonalities and differences in the strategies employed by Lagos and New York, shedding light on the contextual factors shaping their resilience efforts.

This paper will undertake a comparative analysis of urban resilience strategies in Lagos and New York, examining the approaches employed by these megacities to mitigate and adapt to environmental disasters. Through this analysis, we aim to identify key lessons and insights that can inform policy interventions and contribute to the discourse on building resilient cities globally.

1.1. Environmental challenges faced by Lagos and New York:

Lagos, Nigeria, grapples with significant flooding issues, exacerbated by both natural and man-made factors. The city's low-lying topography, coupled with inadequate drainage systems and rapid urbanization, make it highly susceptible to flooding during the rainy season (Oluduro, 2014; Oyefara, and Alabi, 2016). Additionally, Oyefara, and Alabi, 2016. The proliferation of informal settlements, often situated in flood-prone areas and lacking proper infrastructure and services, poses a major challenge to urban resilience in Lagos. These settlements are characterized by overcrowding, poor sanitation, and limited access to clean water, exacerbating the vulnerability of residents to environmental disasters such as flooding and disease outbreaks (Wilkinson, et al., 2020; Dos Santos. et al., 2017). Lagos experiences rapid population growth and urban expansion, leading to increased pressure on land resources and infrastructure. Unplanned urbanization results in the proliferation of informal settlements, encroachment on wetlands and green spaces, and inadequate provision of basic services, further exacerbating the city's vulnerability to environmental hazards (Braithmoh, and Onishi, 2007; Nwankwo et al., 2024; Auwalu, and Bello, 2023).

New York City faces the threat of hurricanes and tropical storms, particularly during the Atlantic hurricane season. Events like Hurricane Sandy in 2012 highlighted the city's susceptibility to storm surge, coastal flooding, and wind damage, causing widespread devastation to infrastructure, homes, and businesses along the coastline. With its extensive coastline along the Atlantic Ocean, New York City is highly exposed to the impacts of sea-level rise, storm surge, and coastal erosion. Climate change exacerbates these risks, posing threats to critical infrastructure, waterfront developments, and densely populated areas located in flood-prone zones (Gomes, et al., 2015; Gornitz, et al., 2017). New York City's infrastructure, including its transportation systems, water and wastewater networks, and buildings, faces challenges associated with aging and deterioration. Decades-old infrastructure is increasingly vulnerable to the impacts of extreme weather events, highlighting the need for upgrades, retrofits, and resilience measures to enhance the city's adaptive capacity and reduce vulnerability to environmental disasters (Zimmerman, et al., 2019; Wilbanks, et al., 2013; Solecki, 2012).

Community engagement plays a crucial role in building urban resilience in Lagos. By involving local communities in decision-making processes, planning, and implementation of resilience initiatives, stakeholders can harness local knowledge, resources, and capacities to effectively address environmental challenges. Engaging communities fosters ownership, enhances social cohesion, and promotes sustainable solutions tailored to the needs and priorities of residents (Gill, et al., 2021; Leys, and Vanclay, 2011; Odunaiya et al., 2024).

Implementing early warning systems is imperative for enhancing preparedness and reducing the impacts of environmental disasters in Lagos (Yekeen, et al., 2020; Olokesusi, et al., 2015). These systems utilize various technologies, such as weather monitoring, sensors, and communication networks, to provide timely alerts and advisories to residents and authorities. Early warning systems enable proactive responses, evacuation planning, and

resource allocation, thereby saving lives and minimizing property damage during extreme weather events and floods (Adedeji, et al., 2012; Tula et al., 2024; Okoye et al., 2023).

Investing in infrastructure improvements is essential for enhancing urban resilience in Lagos. This includes upgrading drainage systems, constructing flood barriers, retrofitting buildings, and improving transportation networks to withstand the impacts of environmental disasters. By enhancing the resilience of critical infrastructure, Lagos can mitigate disruptions, ensure continuity of services, and facilitate rapid recovery in the aftermath of disasters (Ajibade, et al., 2013).

The Lagos State Resilience Strategy is a comprehensive framework aimed at enhancing the city's resilience to environmental disasters and socio-economic challenges (Abubakar, and Aina, 2019). Developed in collaboration with international partners, the strategy identifies key priority areas, such as flood management, urban planning, and community resilience, and outlines actionable interventions and initiatives to build resilience at the local level. Lagos is increasingly investing in green infrastructure initiatives to mitigate the impacts of flooding and improve urban resilience. These initiatives include the construction of green spaces, rain gardens, and permeable pavements to absorb stormwater runoff, reduce erosion, and enhance biodiversity. By integrating nature-based solutions into urban planning and development, Lagos can enhance resilience while promoting environmental sustainability and ecosystem health (Douglas, 2018; Akerele, 2017).

1.2. Urban resilience strategies in New York

New York City has implemented robust policy frameworks and institutional mechanisms to enhance urban resilience. The city's resilience initiatives are guided by comprehensive plans and strategies that integrate climate adaptation, disaster risk reduction, and sustainability goals into urban development policies. Institutional coordination across government agencies, stakeholders, and sectors facilitates the alignment of efforts, resource allocation, and implementation of resilience measures to address complex environmental challenges.

Leveraging technological innovations is essential for strengthening urban resilience in New York City. The adoption of advanced technologies, such as Geographic Information Systems (GIS), remote sensing, and predictive modeling, enables accurate risk assessment, early warning, and decision support for disaster preparedness and response. Additionally, innovative solutions, such as smart infrastructure, resilient design, and green technologies, enhance the city's adaptive capacity and resilience to environmental hazards (Hölscher, et al., 2019; Agboola, and Tunay, 2023; Escap, 2022).

Community-based initiatives are integral to building urban resilience in New York City. Engaging local communities, grassroots organizations, and vulnerable populations empowers residents to actively participate in resilience planning, advocacy, and implementation efforts. Community-based approaches foster social cohesion, equity, and inclusivity, ensuring that resilience strategies address the diverse needs and priorities of New Yorkers while promoting community resilience, capacity-building, and social capital (Cubol, 2021).

The OneNYC plan is a comprehensive resilience strategy launched by New York City to address the interconnected challenges of climate change, population growth, and socio-economic inequality. The plan outlines ambitious goals and initiatives across various sectors, including infrastructure, transportation, housing, and public health, to enhance resilience, sustainability, and equity. By prioritizing investments in resilient infrastructure, green spaces, and social services, OneNYC aims to create a more resilient, inclusive, and livable city for all residents (Beaupre, 2017; Jourdain, 2019).

2. Infrastructure upgrades and coastal protection measures post-Hurricane Sandy:

Following the devastation caused by Hurricane Sandy in 2012, New York City initiated significant infrastructure upgrades and coastal protection measures to enhance resilience to future storms and sea-level rise. Projects such as the East Side Coastal Resiliency Project, the Staten Island Bluebelt Program, and the Rockaway Boardwalk Reconstruction demonstrate the city's commitment to investing in resilient infrastructure, coastal defense systems, and natural flood mitigation measures to protect communities, critical assets, and infrastructure from the impacts of climate change and extreme weather events (Brady, 2015; Rosenzweig, and Solecki, 2014).

2.1. Comparative Analysis of Resilience Strategies

Urban resilience strategies in Lagos and New York exhibit both convergences and divergences shaped by contextual factors such as governance structures, resource allocation, and socio-economic disparities. This analysis aims to elucidate the commonalities and differences in resilience approaches between the two cities.

Both Lagos and New York recognize the pivotal role of community engagement in building urban resilience. In Lagos, community participation is integral to resilience initiatives, with local residents actively involved in decision-making, planning, and implementation processes. Similarly, New York City fosters community partnerships through initiatives like Community Emergency Response Teams (CERT) and neighborhood resilience hubs, empowering residents to take ownership of resilience efforts. The emphasis on community involvement enhances social cohesion, strengthens networks, and facilitates the dissemination of critical information during disasters (Mogo, 2016; Wakefield, 2020).

Both Lagos and New York prioritize the establishment of early warning systems to enhance preparedness and response to environmental disasters. In Lagos, initiatives such as the Lagos State Flood Early Warning System (FEWS) utilize technology and community-based monitoring to provide timely alerts and advisories to residents in flood-prone areas (Nkwunonwo, 2020; Danjibo, et al., 2019; Akintoye, et al., 2016). Similarly, New York City invests in sophisticated early warning systems, including the Coastal Storm Plan and the Notify NYC program, to disseminate information and coordinate emergency responses during hurricanes and coastal storms (Servetz, 2012; Bui, 2023). Early warning systems enable proactive measures, evacuation planning, and resource allocation, thereby saving lives and minimizing property damage.

Lagos and New York exhibit significant differences in governance structures, which influence the formulation and implementation of resilience strategies. Lagos operates within a complex governance framework characterized by overlapping jurisdictions, bureaucratic inefficiencies, and limited institutional capacity, which pose challenges to effective coordination and implementation of resilience initiatives. In contrast, New York City benefits from a more centralized governance structure, with strong leadership and institutional frameworks facilitating coordination across agencies and stakeholders. The hierarchical governance system in New York enables streamlined decision-making, resource allocation, and implementation of resilience measures, enhancing the city's adaptive capacity and response to environmental disasters (Ajibade, et al., 2013; Welle, and Birkmann, 2016).

Resource allocation and funding mechanisms differ between Lagos and New York, impacting the scale and effectiveness of resilience efforts. Lagos faces significant challenges in securing adequate funding for resilience projects, with limited financial resources, competing priorities, and reliance on external assistance hindering investment in infrastructure upgrades and resilience measures (Olajide, 2015). In contrast, New York City benefits from robust financial resources, diverse funding mechanisms, and access to federal grants and disaster relief funds, enabling substantial investments in resilience initiatives. The availability of funding enables New York to undertake large-scale infrastructure projects, implement innovative solutions, and enhance resilience across various sectors, mitigating the impacts of environmental disasters (Gotham, 2008).

2.2. Challenges and Limitations

Both Lagos and New York encounter funding constraints that hinder the implementation of resilience strategies. In Lagos, limited financial resources, budgetary constraints, and competing priorities restrict investment in resilience projects, leading to delays in infrastructure upgrades and vulnerability reduction measures. Similarly, New York City faces fiscal challenges, particularly in the wake of economic downturns and budgetary constraints, which may impede the allocation of resources to resilience initiatives. Addressing funding constraints requires innovative financing mechanisms, public-private partnerships, and international cooperation to mobilize resources and sustain resilience efforts (Gotham, 2008; Olajide, 2015).

Governance issues pose significant challenges to urban resilience in both Lagos and New York. In Lagos, governance shortcomings, including corruption, political instability, and weak institutional capacity, undermine effective coordination, planning, and implementation of resilience measures. Similarly, New York City grapples with governance challenges, such as bureaucratic red tape, inter-agency coordination gaps, and regulatory barriers, which hamper the efficient delivery of resilience services and projects. Overcoming governance issues necessitates institutional reforms, capacity-building initiatives, and improved governance frameworks to enhance coordination, accountability, and transparency in resilience governance (Lumumba, 2016; Park, 2019; Sturtevant, et al., 2015).

Socio-economic disparities exacerbate vulnerability to environmental disasters in Lagos and New York, disproportionately affecting marginalized communities and vulnerable populations. In Lagos, socio-economic

inequalities, including poverty, informal settlements, and inadequate access to basic services, exacerbate vulnerability to flooding and environmental hazards, with marginalized communities bearing the brunt of disaster impacts. Similarly, in New York City, socio-economic disparities, such as income inequality, racial segregation, and housing affordability issues, amplify vulnerability to climate change and extreme weather events, with disadvantaged communities facing disproportionate risks and limited access to resources and support. Addressing socio-economic disparities requires inclusive resilience strategies, equitable resource allocation, and targeted interventions to reduce vulnerability and enhance the resilience of marginalized populations (Oyefara, and Alabi, 2016; Herreros-Cantis, et al., 2020).

Technological limitations pose challenges to urban resilience in both Lagos and New York, affecting the effectiveness and reliability of early warning systems, infrastructure, and communication networks. In Lagos, inadequate technological infrastructure, unreliable data, and limited access to technology hinder the development and implementation of early warning systems and disaster management tools, limiting the city's ability to anticipate, monitor, and respond to environmental hazards. Similarly, in New York City, technological limitations, such as outdated infrastructure, cybersecurity risks, and digital divide issues, pose challenges to the resilience of critical systems and services, compromising the city's ability to withstand and recover from disasters. Overcoming technological limitations requires investment in digital infrastructure, capacity-building initiatives, and technology adoption strategies to enhance resilience, improve data collection and analysis, and facilitate effective decision-making and response coordination (Yekeen, et al., 2020; Mohebbi, et al., 2020).

2.3. Lessons Learned and Implications

The comparative analysis of resilience strategies in Lagos and New York highlights the importance of identifying and sharing best practices that can be transferable across cities globally. While the specific context and challenges may vary, lessons learned from successful initiatives in Lagos and New York can inform resilience efforts in other urban areas facing similar environmental hazards. For example, the emphasis on community engagement and early warning systems demonstrated in both cities can be replicated and adapted to suit local contexts, fostering community resilience and enhancing preparedness for disasters. By promoting knowledge exchange, peer learning, and South-South cooperation, cities can leverage insights from diverse experiences to develop tailored resilience strategies that address their unique needs and challenges (Kumar, et al., 2018; Leal Filho, et al., 2024).

The comparative analysis underscores the importance of integrating resilience considerations into urban planning, policy development, and governance frameworks to build resilient cities globally. Policy implications derived from the experiences of Lagos and New York include the need for holistic and multi-sectoral approaches, robust institutional coordination mechanisms, and long-term investment in infrastructure and capacity-building. Policies that prioritize climate adaptation, disaster risk reduction, and sustainable development can help cities mitigate the impacts of environmental disasters, enhance adaptive capacity, and foster long-term resilience. Furthermore, policies aimed at addressing socio-economic disparities, promoting equity, and ensuring inclusive participation can enhance the resilience of vulnerable populations and communities, reducing the risk of marginalization and exacerbating disparities in times of crisis (Siller, and Aydin, 2022; Harkins, 2020).

The comparative analysis emphasizes the importance of adopting holistic and inclusive resilience frameworks that address the interconnected social, economic, and environmental dimensions of urban resilience. Resilience strategies should be integrated across sectors, stakeholders, and scales, incorporating diverse perspectives, local knowledge, and community priorities. By adopting a holistic approach, cities can identify synergies, trade-offs, and co-benefits between resilience measures, maximizing their effectiveness and sustainability. Inclusive resilience frameworks ensure that the needs and priorities of all residents, especially marginalized and vulnerable populations, are considered in decision-making processes and resource allocation, promoting social equity, cohesion, and resilience (Sharifi, 2022; Grafakos, et al., 2016).

3. Recommendations

The comparative analysis of resilience strategies in Lagos and New York highlights both commonalities and differences in approaches to urban resilience. Convergences include the emphasis on community involvement and early warning systems, while divergences stem from differences in governance structures and resource allocation mechanisms. Despite challenges such as funding constraints, governance issues, socio-economic disparities, and technological limitations, lessons learned from Lagos and New York offer valuable insights and implications for building resilient cities globally.

The comparative analysis contributes to the urban resilience discourse by providing insights into the factors shaping resilience strategies in diverse urban contexts. By examining the experiences of Lagos and New York, policymakers, practitioners, and researchers can gain a deeper understanding of the challenges and opportunities associated with building resilience in megacities. The comparative approach facilitates cross-learning, knowledge exchange, and capacity-building, enabling cities to develop context-specific resilience strategies that are effective, inclusive, and sustainable.

Future research on urban resilience should focus on advancing interdisciplinary approaches, integrating social, economic, and environmental dimensions of resilience. Additionally, there is a need for more empirical studies and case analyses to assess the effectiveness and impacts of resilience strategies over time. Research should also explore innovative financing mechanisms, technological solutions, and governance reforms to address funding constraints, governance issues, and technological limitations. Furthermore, research on the transferability of best practices and policy implications for building resilient cities globally can inform decision-making and shape resilience agendas at local, national, and international levels.

4. Conclusion

In conclusion, the comparative analysis of resilience strategies in Lagos and New York offers valuable insights and lessons for building resilient cities worldwide. By embracing holistic, inclusive, and adaptive approaches, cities can enhance their resilience to environmental disasters, promote sustainable development, and safeguard the well-being of urban populations for generations to come.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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