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Research

Urban Planning and Climate Change: A Study of Epe Town's Vulnerability and Resilience in Lagos State, Nigeria

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Abstract: Epe town, Lagos State, has been vulnerable to climate change-related disasters, which have adverse effects on the urban planning system. The study examined the impacts of climate change on urban planning, the level of vulnerability, and the strategic adaptation measures sought to address it. The study relied on both secondary and primary data. The primary data were collected through questionnaire administration. The questionnaire targeted residents, both homeowners and tenants, as respondents. A random sampling technique was used to sample vulnerable areas at intervals of every 10th building, identified through observational and environmental surveys during a familiarization tour. A total of 150 copies of the questionnaire were administered to respondents. The questionnaire was structured in a 4-point Likert scale format. The study employed descriptive techniques for data analysis. The findings revealed that residents in the study area have relatively effective adaptation strategies ($\bar{x}$=3.05), possibly due to past experiences with water level changes. Also, the study revealed that increased risk of waterborne diseases necessitates improved sanitation and health planning ($\bar{x}$=2.93). Furthermore, the study revealed that flood-resistant design was incorporated in urban infrastructure development in the study area ($\bar{x}$=2.4). The study recommended the integration of infrastructure, policy, and green spaces to address climate change effects on urban planning in Epe, Lagos.

Keywords: Climate Change, Vulnerable, Adaptation, Urban Planning.

Introduction

The world is experiencing rapid urbanisation, with cities becoming increasingly vulnerable to the impacts of climate change. Urbanisation has greatly contributed to climate change through various activities of humankind to transform livelihoods and overall well-being. Human activities have led to rising temperatures, changing precipitation

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patterns, and more frequent extreme weather events, which pose significant threats to urban infrastructure, economies, and populations. Meanwhile, as urban centres continue to witness expansion in land use and population, it is essential to integrate climate change considerations into urban planning to ensure the development of climate-resilient and sustainable urban environments for all.

Urban areas are centres of economic activity, innovation, and cultural diversity; however, they are also centres of greenhouse gas emissions, energy consumption, and waste generation due to large population concentrations. The significant concentration of people, infrastructure, and economic assets in cities makes them particularly vulnerable to climate-related hazards, such as heatwaves, droughts, floods, and storms. Climate change tends to exacerbate the existing challenges facing cities, including poverty, inequality, and social injustice, implying the need for inclusive and equitable climate-resilient urban planning. Climate change adds a new dimension to urban planning, requiring planners to consider the potential impacts of climate change on urban areas (Zanon & Verones, 2013).

The importance of integrating climate change into urban planning cannot be overemphasised. Giving consideration to climate change during urban planning could help to ameliorate the excessive impacts of extreme events of climate change on residents and the environment. Furthermore, effective urban planning can help mitigate the causative factors of climate change and adapt to its impacts by enhancing the resilience of urban areas and infrastructure (Hamin & Gurran, 2009). However, due to the complex nature of urban systems, climate change projections and uncertainty tend to pose challenges to developing and implementing climate-resilient urban plans.

The findings of this research will contribute to the development of more sustainable, resilient, and liveable cities, ultimately improving the general well-being of urban dwellers and supporting global efforts to address climate change. The well-being of residents can be positively affected if the recommendations made by this study are strictly complied with and implemented. The study will provide a foundation for integrating climate change into urban planning in Nigeria. This study will help cities navigate the consequences of climate change and build a more sustainable future for future generations.

The world is witnessing an unprecedented rate of urbanisation, with cities in developing countries bearing the brunt of climate change impacts. Epe Town, located in Lagos State, Nigeria, is no exception. As a coastal town, Epe is highly vulnerable to climate-related hazards such as flooding, coastal erosion, and saltwater intrusion. These impacts pose significant challenges to urban planning, development, and the livelihoods of residents. Urban planning in Epe Town faces numerous challenges in addressing climate change. The town's rapid population growth, inadequate infrastructure, and limited resources exacerbate its vulnerability to climate-related stresses. Existing urban planning frameworks and practices may not be equipped to address the complexities of climate change, leading to increased risks and vulnerabilities.

According to Sharma (2025), the 21st century is witnessing tremendous and remarkable changes across the globe, one of which is urbanisation, primarily shaping the environmental dynamics and climate change in urban centres. Despite this growing recognition of the impacts of climate change on urban areas worldwide, there is a dearth of knowledge regarding the specific vulnerabilities and resilience of Epe Town. There is a need to understand how climate change affects urban planning, development, and land use in Epe Town, and how the town can build resilience to these impacts. Therefore, this study investigated the vulnerability and resilience of Epe Town to climate change, with a focus on urban planning and development.

Significantly, this study aimed to contribute to the development of effective strategies for building climate resilience in Epe Town and informing urban planning practices that prioritise sustainability and adaptability. Ultimately, the study sought to enhance the well-being and livelihoods of residents of Epe Town and promote sustainable development in the face of climate change.

Study Area

Epe Local Government Area of Lagos State is located at Latitude 6° 34' 59.99" N of the equator, as well as Longitude 3° 58' 59.99" E of the Meridian. Its headquarters is situated in Epe town, on the north side of the Lekki Lagoon. It experiences a tropical climate with high temperatures and humidity levels throughout the year. The region has two distinct seasons: the dry season (November to March) and the wet season (April to October). The climate is generally warm and humid.

The soil in Epe is suitable for farming and agriculture. Its topography is relatively flat, with some areas featuring sandy beaches and coconut-fringed coastlines along the Atlantic Ocean. The landscape of Epe is also characterised by hills that demarcate the town into equal parts. Epe is surrounded by water bodies, including Lekki Lagoon and the Atlantic Ocean, which provide opportunities for fishing and other seafood harvesting. The economy of Epe is primarily driven by fishing, agriculture, and commerce. Therefore, the study area provides both primary and secondary services to the public. Its population is predominantly of the Yoruba ethnic group. According to the 2006 census, the population of the study area was 181,409. However, a more recent projection estimates the population to be around 269,000 as of the year 2022. The map analysing the study area is presented in Figure 1.

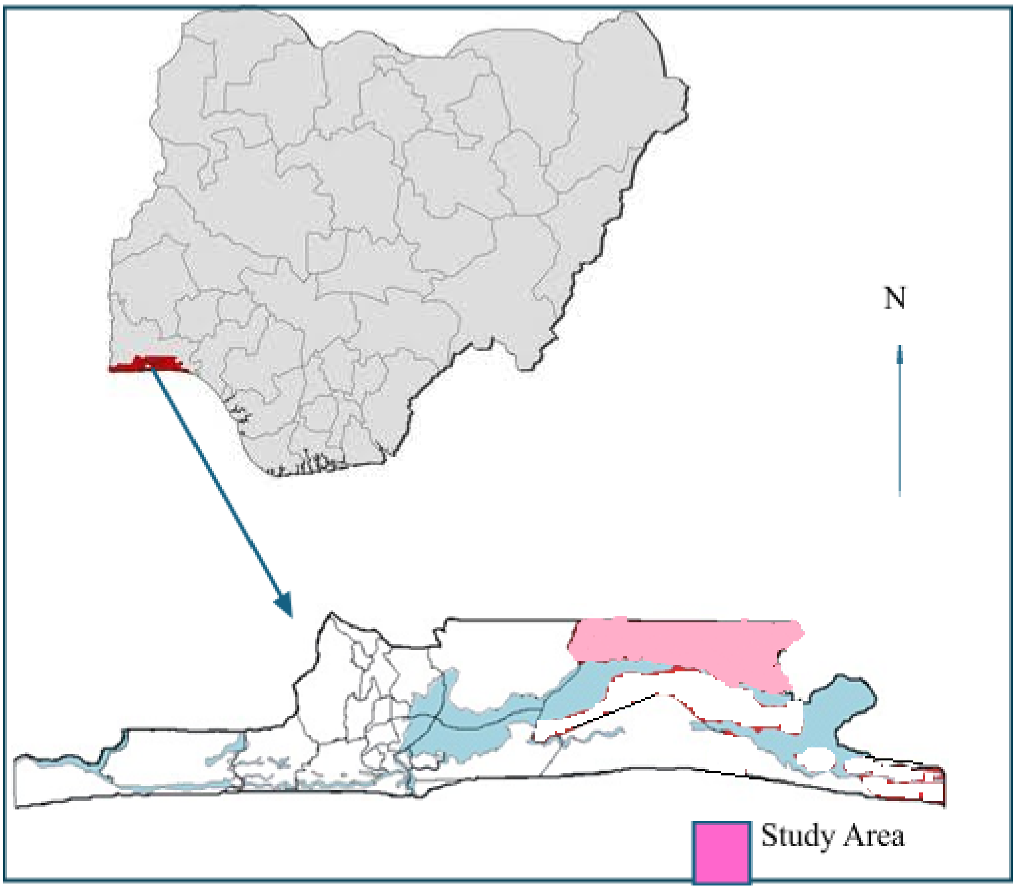

Figure 1: Map of Nigeria showing Lagos State and the study area.

Source: Author's fieldwork, 2026.

Literature Review

Vulnerability assessment

Climate change poses significant threats to urban areas, particularly in coastal regions like Epe Town. Rising sea levels, increased temperatures, and unpredictable weather patterns exacerbate the vulnerability of urban systems (Jiang, Hou, Shi, & Gui, 2017). A vulnerability assessment is crucial in understanding the risks and impacts of climate change on urban areas. It involves evaluating the susceptibility of a system to climate-related hazards and stressors, taking into account factors such as exposure, sensitivity, and adaptive capacity (Smit & Wandel, 2008). Climate change vulnerability assessment is an essential tool for identifying regions that are most susceptible to the impacts of climate change and designing effective adaptation actions that can reduce vulnerability and enhance the long-term resilience of these regions (Nyashilu, Kiunsi & Kyessi, 2024).

Likewise, assessment of climate change risks and vulnerability is essential in order to inform and implement appropriate adaptation strategies (Cavan, Kingston, Lindley, Kazmierczak, Carter, Gong, & Handley, 2010). The preparation of these strategies emphasised the risks and vulnerability of climate change in urban areas. According to Blanco, Torres & Zorita (2021), from the climate change adaptation perspective, risk is understood as a function of hazard, exposure and vulnerability. However, Jurgilevich (2021) argued that urban form and socio-economic activities can potentially amplify cities' vulnerability to climate change. This demonstrates the extent to which poor layout planning exposes citizens to the impacts of extreme events related to climate change. Especially in urban areas, the effects of climate change are becoming increasingly complex because of the interactions between human activities and environmental conditions (He, Zhou, Ma & Wan, 2019).

The Intergovernmental Panel on Climate Change (IPCC, 2014) defines vulnerability as the propensity or predisposition to be adversely affected. Vulnerability assessments consider the complex interplay between biophysical and socioeconomic factors, including demographic characteristics, economic resources, infrastructure, and institutional capacity (Adger, 2006). By analysing these factors, researchers and policymakers can identify areas and populations that require targeted interventions to enhance resilience and adaptive capacity. Empirical studies have demonstrated the importance of vulnerability assessments in understanding the impacts of climate change on human and ecological systems. For example, research on coastal communities has shown that vulnerability assessments can inform the development of early warning systems, climate-resilient infrastructure, and adaptive management strategies (Hinkel, Lincke, Vafeidis, & Levermann, 2014). By integrating vulnerability assessments into decision-making processes, policymakers can reduce the risks associated with climate change and promote sustainable development.

Urban Planning and Climate Change

Urban planning and climate change are two interconnected issues that require immediate attention. Cities are hubs of economic growth, innovation, and cultural diversity, but they are also significant contributors to greenhouse gas emissions and are vulnerable to the impacts of climate change (Bulkeley & Betsill, 2005). Urban planning plays a critical role in mitigating and adapting to climate change by shaping the built environment, influencing human behaviour, and promoting sustainable development.

Climate change poses significant challenges to urban planning, including increased temperatures, more frequent natural disasters, and altered precipitation patterns. These impacts can have considerable economic, social, and environmental consequences, particularly for vulnerable populations such as low-income communities, children, and the elderly (McGranahan, Balk, & Anderson, 2007). Urban planners must therefore prioritise climate change mitigation and adaptation in urban planning decisions and work closely with stakeholders to develop and implement effective climate change strategies. Urban planning can also play a critical role in promoting climate change adaptation by incorporating climate resilience into urban design and infrastructure. This can include designing cities that can absorb and adapt to climate-related shocks and stresses, and promoting ecosystem-based adaptation strategies such as green infrastructure and urban forestry (Hansen, Lierop, Rolf, Gantar, Erjavec, Rall, & Pauleit, 2021). By prioritising climate resilience in urban planning, cities can reduce the risks associated with climate change and promote sustainable development.

Empirical studies have also shown that urban planning can promote sustainable development by reducing the environmental impacts of urbanisation, promoting social equity, and enhancing economic resilience (Campbell, 1996). Urban planners can use a range of tools and strategies to promote sustainable development, including land use planning, transportation planning, and urban design. By prioritising sustainable development in urban planning, cities can reduce the risks associated with climate change and promote human well-being. Empirical studies have shown that urban planning can reduce greenhouse gas emissions by promoting compact and walkable cities, and by incorporating green infrastructure such as parks, green roofs, and green walls (Jabareen, 2006). Urban planning can also enhance urban resilience by designing cities that can withstand and recover from climate-related disasters such as floods, heatwaves, and droughts (Meerow & Stults, 2016). For example, urban planners can use spatial analysis and scenario planning to identify areas of high vulnerability and develop targeted adaptation strategies.

Climate change is having a profound impact on urban areas, affecting the lives of millions of people worldwide. Rising temperatures, changing precipitation patterns, and increased frequency of extreme weather events are altering the way cities function and impacting the health, well-being, and livelihoods of urban residents (IPCC, 2014). Urban areas are particularly vulnerable to climate change due to the concentration of people, infrastructure, and economic assets, which can amplify the impacts of climate-related disasters (Rosenzweig et al., 2011). One of the most significant impacts of climate change on urban areas is the increased risk of heat-related illnesses and mortality. Urban heat islands, where built-up areas absorb and retain heat, can exacerbate the effects of heatwaves, particularly for vulnerable populations such as the elderly, children, and those with pre-existing medical conditions (Harlan et al., 2006). Climate change is also projected to increase the frequency and severity of extreme weather events, such as hurricanes, floods, and droughts, which can have devastating impacts on urban infrastructure, economies, and human settlements (Milly et al., 2002).

Climate change is also affecting urban water management, with changes in precipitation patterns and increased frequency of extreme weather events leading to flooding, water scarcity, and water quality issues (Kundzewicz et al., 2014). Urban areas are also experiencing increased air pollution, which can exacerbate respiratory problems and other health issues (Jacob & Winner, 2009). Furthermore, climate change is projected to impact urban food security, with changes in temperature and precipitation patterns affecting agricultural productivity and food availability (Lobell et al., 2013). The impacts of climate change on urban areas are not limited to physical infrastructure and human health. Climate change is also having significant economic and social impacts, particularly for vulnerable populations such as low-income communities and small businesses (Hallegatte et al., 2016). Climate-related disasters can lead to significant economic losses, displacement of people, and social disruption, which can have long-term consequences for urban development and resilience (Aerts et al., 2014).

Urban areas can take steps to mitigate and adapt to the impacts of climate change. This includes investing in green infrastructure, such as parks and green roofs, to reduce the urban heat island effect and improve air quality (Bowler et al., 2010). Urban planning and design can also play a critical role in reducing the risks associated with climate change by promoting compact, walkable, and bikeable cities and incorporating climate resilience into urban design and infrastructure (Jabareen, 2006).

Materials and Methods

The study utilised both secondary and primary data. The primary data were collected through questionnaire administration. The questionnaire targeted residents, both homeowners and tenants, as respondents. A random sampling technique was used to sample vulnerable areas at intervals of every 10th building, identified through observational and environmental surveys during a familiarisation tour. A total of 150 copies of the questionnaire were administered to respondents. The questionnaire was structured in a 4-point Likert scale format. Descriptive statistics were employed for data analysis and results presentation, including frequency distribution tables and means. Emphatically, this study used a 4-point Likert scale, calculating the Mean Weight Value (MWV) for each response and the General Mean Weight Value (GMWV) for all responses. MWVs of variables were collated, ranked, and compared to the GMWV. A variable was accepted if its MWV was greater than the GMWV and vice versa.

Results and Discussion

Socio-Economic Characteristics of the Respondents

The study showed that most of the respondents (35%) were between 40 and 49 years old, which confirmed the accessible age group during the survey. This indicates that they are likely established in their careers and communities and have acquired a balance of experience. It was also shown that the majority of the respondents (45%) had a tertiary education, indicating that more respondents might have better awareness of climate change issues and possibly mitigation strategies. In addition, most respondents were fishers, comprising 47% of the total. Given that the study area is surrounded by water bodies, it was not surprising that the majority of the respondents were engaged in fishing activities. Hence, fishers likely have firsthand experience with riverine environmental changes and might be more aware of climate impacts on water resources, livelihoods, and adaptations.

Table 1. Characteristics of the respondents

Age (year)	**Frequency**	**%**	**Level of Education**	**Frequency**	**%**	**Occupation**	**Frequency**	**%**
20-29	33	22	Primary	21	14	Civil servants	26	17
30-39	24	16	Secondary	46	31	Farmers	22	15
40-49	53	35	Tertiary	68	45	Fishers	70	47
50≥	40	27	Informal	15	10	Traders	32	21
Total	150	100	Total	150	100	Total	120	100

Source: Author's field survey, 2026.

Vulnerability to Climate Change Impacts

Table 2 displayed the vulnerability to climate change impacts based on a 4-point Likert scale, with a Grand Mean Weighted Value (GMWV) of 2.68. Items with values higher than 2.68 were accepted as significant vulnerabilities or adaptations, while those below were rejected. The study showed that the study area was vulnerable to flooding (2.69), indicating that residents were likely vulnerable to flooding due to inadequate drainage systems or poor land use planning. Increased temperatures and unpredictable weather patterns exacerbate the vulnerability of urban systems (Jiang, Hou, Shi, & Gui, 2017). It was also revealed that climate change affects economic activities, having scored a higher value of 2.94 than the GMWV. This showed that climate change impacts livelihoods, likely because the study area relied heavily on climate-sensitive sectors like agriculture and fishing. In support of this finding, Jurgilevich (2021) submitted that urban socio-economic activities are potentially vulnerable to climate change. The findings revealed that adaptation to changes in water bodies was relatively high, with a Mean Weight Value of 3.05, indicating that the residents in the study area have relatively effective adaptation strategies, possibly due to past experiences with water level changes.

However, the study showed that the current infrastructure was insufficient to protect the community from climate-related disasters (2.07). This indicated that the infrastructure was inadequate, possibly due to insufficient investment or design that did not account for climate change projections. Similarly, the findings of Smit and Wandel (2008) showed the importance of assessing how vulnerable a system is to climate threats, considering exposure, sensitivity, and the ability to adapt. Such an assessment would enable stakeholders and concerned individuals to devise adequate strategic adaptations to the menace.

Table 2: Vulnerability to Climate Change Impacts

Vulnerability to climate change	**S D**	**D**	**A**	**SA**	**Total**	**Likert 4-Point Rating Scale**				**Total Weight Value**	**Mean Weight Value**	**Decision**
						1	2	3	4			
Experiencing flooding	12	45	70	23	150	12	90	210	92	404	2.69	Accepted
Adaptation to changes in water bodies' levels	10	35	62	48	150	10	70	186	192	458	3.05	Accepted
Climate change affects economic activities	17	29	50	54	150	17	58	150	216	441	2.94	Accepted
Current infrastructure protects the community from climate-related disasters	49	53	36	12	150	49	106	108	48	311	2.07	Rejected
GMWV or COV											2.68	
Note: SA = Strongly Agree, D = Disagree, A = Agree, SA = Strongly Agree												

Source: Author's field survey, 2026.

Effects of Climate Change on Urban Planning

The effects of climate change on urban planning, based on a 4-point Likert scale with a GMWV of 2.8, were presented in Table 3. Items with values above 2.8 were accepted as significant effects. The study revealed that increased flooding affected drainage planning (2.84), indicating that flooding is a major concern for urban drainage, likely due to inadequate existing systems. It was also revealed that damage to infrastructure required resilient construction (2.82); this is because infrastructure damage is significant, necessitating robust construction to mitigate future impacts. This supports Jabareen (2006), who stated that urban planning can cut emissions by promoting compact, walkable cities and adding green infrastructure like parks and green roofs. Furthermore, the findings showed that the loss of livelihoods was not associated with land use and economic planning influenced by waterlogging (2.62). This item was rejected, indicating that it was less prioritised in planning considerations, even though livelihood loss is impactful. Moreover, the study revealed that the increased risk of waterborne diseases necessitates improved sanitation and health planning (2.93), as waterborne diseases are a key concern that requires improved sanitation and health planning.

Table 3: Effects of Climate Change on Urban Planning

Effects of climate change	SD	D	A	SA	Total	Linkert 4-Point Rating Scale				Total Weight Value	Mean Weight Value	Decision
						1	2	3	4			
Increased flooding in urban areas affects drainage planning and infrastructure design	13	41	52	44	150	13	82	156	176	427	2.84	Accepted
Damage to infrastructure requires resilient construction and maintenance planning	18	36	50	46	150	18	72	150	184	424	2.82	Accepted
Loss of livelihoods due to waterlogging influences land use and economic planning	20	57	32	41	150	20	114	96	164	394	2.62	Rejected
Increased risk of waterborne diseases necessitates improved sanitation and health planning	11	24	79	36	150	11	48	237	144	440	2.93	Accepted
GMWV or COV											2.80	
Note: SA = Strongly Agree, D = Disagree, A = Agree, SA = Strongly Agree												

Source: Author's field survey, 2026.

Climate Change Adaptations for Urban Planning

Table 4 presents climate change adaptation measures for urban planning based on a 4-point Likert scale with a GMWV of 2.23. Items higher than 2.23 were accepted as significant adaptations. The findings revealed that flood-resistant design was incorporated *into urban infrastructure development in the study area (2.4), implying that flood-resilient design was prioritised, possibly due to flooding concerns. In addition, it was shown that climate-resilient urban zoning and land-use policies were implemented (2.39), meaning that climate-resilient policies are being adopted, indicating proactive planning. In relation to this, Meerow and Stults (2016) revealed that urban planners can also enhance urban resilience by designing cities that are adaptive to climate-related disasters such as floods, heatwaves, and droughts. However, the integration of green spaces to mitigate climate impacts was not a significant adaptation (1.9), as it was rejected for being lower than the GMWV. The integration of green spaces was less prioritised, possibly due to competing urban demands. Additionally, green spaces may have been overlooked, perhaps due to an emerging focus.*

Table 4: Climate Change Adaptations for Urban Planning

Adopting supporting urban planning	**LP**	**MP**	**HP**	**Total**	**Linkert 3 Points Rating Scale**			**Total Weight Value**	**Mean Weight Value**	**Decision**
					1	2	3			
Incorporation of flood-resistant design in urban infrastructure development	26	37	87	150	26	74	261	361	2.4	Accepted
Integration of green spaces to mitigate climate impacts	67	31	52	150	67	62	156	285	1.9	Rejected
Implementation of climate-resilient urban zoning and land-use policies	21	49	80	150	21	98	240	359	2.39	Accepted
GMWV or COV									2.23	
Note: LP = Low Priority, MP = Moderate Priority, HP = High Priority										

Source: Author's field survey, 2026.

Conclusion

The study revealed that urban planning in Epe, Lagos State, is taking steps to adapt to climate change, particularly in incorporating flood-resistant design and climate-resilient zoning policies. However, the integration of green spaces to mitigate climate impacts remains underutilised. Considering Epe's vulnerability to flooding and climate stress, incorporating green spaces like parks, wetlands, and green roofs can enhance resilience. The study therefore recommended the integration of infrastructure, policy, and green spaces to address the effects of climate change on urban planning in Epe, Lagos.

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