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URBAN PLANNING AND DESIGN

Built environment transformation in Nigeria: the effects of a regenerative framework

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ABSTRACT
The promise of a healthier, more comfortable, and more productive way of life has fueled a rapid technological transition, and a regenerative built environment has emerged as the tagline to denote the recent sustainable development. In the built environment, the regenerative paradigm has emerged as a transformative approach that goes beyond mere sustainability, aiming to restore, renew, and enhance the ecosystems affected by human activities. However, the concept of the regenerative paradigm and its potential to foster sustainable development has been understudied in recent time. Therefore, this paper explores how we can transform the built environment in the face of the present impacts of climate change using a new regenerative paradigm concept. The objectives of the study are: (i) to explore the predictors of climate change, (ii) to determine the negative impacts of environmental issues on inhabitants' health, and (iii) to explore adaptive climate change strategies for Nigeria's regenerative built environment. The study sample consisted of 235 stratified respondents' opinions from within the built environment in southwestern Nigeria collected via a self-administered questionnaire. The collected quantitative data was analysed using SPSS (version 22) logistic regression analysis. The major results of the analysis revealed: (i) the ten most important predictors of climate change indicators, (ii) the existence of negative consequences of the impacts of climate change on inhabitants' health in southwestern regions of Nigeria, and (iii) a significant ($p \leq 0.05$) in all regenerative factors: planting native species has the highest β coefficient of 0.499, followed by the biophilic approach (0.494), the establishment of a city's tree canopy (0.467), the creation of a green functional green space (0.436), the use of smart landscaping techniques (0.388), and the development of a healthy watershed (0.314). This indicates that to have a regenerative built environment it is essential to create a functional green space, plant native species, establish a city's tree canopy, create a healthy watershed, and render a biophilic approach. The study's recommendations include urgent action to integrate climate change interventions into the decision-making processes, initiatives, and development plans of the Nigerian government. This integration should prioritize sustainable practices within the built environment, considering the regenerative paradigm's potential to address climate change impact effectively.

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1. Introduction

Climate change remains one of the most pressing and prominent critical issues facing countries worldwide today. Climate change is referred to as an alteration in the environment that can be traced back to human activity, either overtly or covertly, and that modifies the creation of the global atmosphere despite natural changes in the environment that were detected during a comparable time frame (UNEP 2007; UNFCCC 2010; Munang et al., 2013). It also refers to long-term alterations in temperature patterns, precipitation levels, wind patterns, and other aspects of Earth's climate system (World Bank 2010b; Federici et al., 2015; Rossi et al., 2016; Morecroft2016 et al, 2019). The main cause of these alterations can be largely ascribed to human activities, specifically the combustion of fossil fuels, the clearing of forests, industrial procedures, and agricultural methods that emit greenhouse gases (GHGs). Furthermore, climate change exacerbates existing social and economic inequalities, disproportionately affecting vulnerable populations, including low-income communities, indigenous peoples, and developing countries. It poses risks to food security, water resources, public health, and economic stability. It also contributes to the loss of biodiversity and ecosystems, further compromising the planet's ecological balance. Researchers in the built environment are increasingly enhancing their endeavors to mitigate and adapt to

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climate change. Mitigation involves reducing GHG emissions through the transition to renewable energy sources, energy efficiency improvements, and sustainable land management. Adaptation measures focus on minimising the impacts of climate change by enhancing resilience in communities and ecosystems, implementing disaster preparedness plans, and incorporating climate considerations into urban planning and infrastructure development.

International cooperation is crucial in addressing climate change: a global issue that requires collective action. The United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement are key international frameworks aimed at mitigating GHG emissions and promoting adaptation efforts. These agreements foster collaborations among nations, encourage technology transfer, and provide financial support to developing countries for climate action. Furthermore, public awareness and engagement are vital in tackling climate change. Education and advocacy play significant roles in fostering sustainable lifestyles, encouraging sustainable consumption, and driving policy change. Individuals, governments, and corporate organisations all have roles to play in reducing emissions, promoting clean technologies, and advocating for climate-resilient practices.

Addressing climate change requires long-term commitment and comprehensive strategies at local, national, and international levels. By recognizing the urgency and taking proactive measures, countries can work together to mitigate GHG emissions, adapt to the changing climate, and build a sustainable and resilient future for generations to come. Although a complete appraisal of the environmental implications of climate change has been developed, scholars focused on scenario analysis of climate change and climate change damage consequences to mankind (Chou, Dong, and Yan 2016, Tol, 2002; Gattuso et al., 2015; Yilmaz 2021).

There is a strong possibility that climate change in Africa will not abate if the required actions are not taken, as iterated by Isingoma (2009). Climate change across Africa has resulted in unpredictable weather patterns, deteriorating coastlines, and the proliferation of pests and waterborne diseases. Cities, as has been established elsewhere, are major producers of GHGs. Environmental problems in African countries have recently increased due to the production of unusually large amounts of industrial pollutants due to urbanisation, which has harmed national economies. To complicate things further, African nations have among the greatest urbanisation rates in the world, ranging from 2.4% in North Africa to 4.02% in West and Central Africa and 4.05% in East Africa between the years 2005 and 2010 (Yuen and Kumssa 2010). In view of this, African countries lack both the economic and human resources to ameliorate the consequences of climate change (Yuen & Kumssa, 2011; Jagtap 2007; Rajabifard et al. 2019).

Climate change is anticipated to have significant effects on peri-urban inhabitants, who are increasingly vulnerable to climate-induced hazards due to African cities' current vulnerability and their constantly increasing populations (Bele et al., 2014). At the same time, knowledge and skills in Africa are at a low level with regard to the technological capabilities needed to combat the pollution generated by a large population and increased motor vehicles. Consequently, in any international discussions, it is expedient for African countries to express their minds in unity for possible solutions and assistance. However, this is not only for Africa's acute vulnerability, but also for equity and fair play in reducing GHG emissions in the global sphere. Action is required at various stages, as Africa confronts enormous problems in adapting to the impact of climate change as well as managing the rising levels of climate risk, in which additional support is critical.

Studies have increasingly highlighted concerns regarding the impact of climate change on the built environment in Nigeria (Kahan, et al., 2015; Shittu 2020). The built environment encompasses all human-made structures, including buildings, infrastructure, and urban spaces. Nigeria, as a country vulnerable to climate change, faces various challenges and risks that directly affect its built environment. One significant concern is the increased frequency and intensity of extreme weather events, such as floods, storms, and heatwaves. These events can damage or destroy buildings and infrastructure, disrupt transportation systems, and lead to human displacement. Coastal areas are particularly vulnerable to rising sea levels and coastal erosion, which put coastal cities and communities at risk.

Rising temperatures and changing precipitation patterns can also impact the functionality and longevity of buildings and infrastructure. Higher temperatures can lead to increased energy demands for cooling, affecting the energy efficiency of buildings (UNEP 2013; World Health Organization 2021). Changes in rainfall patterns can result in water scarcity or excessive rainfall, which may strain water management systems and affect the availability of clean water in urban areas. Another concern is the potential impact of climate change on public health within the built environment. Heatwaves and higher temperatures can increase the risk of heat-related illnesses, particularly in densely populated urban areas with limited green spaces and inadequate cooling infrastructure. Changes in vector-borne disease patterns, such as those of malaria and dengue fever, may also occur as a result of altered climatic conditions. Furthermore, climate change can exacerbate existing social and economic inequalities within the built environment. Low-income communities often lack adequate infrastructure, housing, and access to basic services, making them more vulnerable to the impacts of climate change. Limited financial resources and poor urban planning can hinder adaptation and resilience efforts, further exposing these communities to risks (Beyioku 2016; Ibitoye and Eludoyin 2010; Odjugo 2010).

In their research, scholars have investigated the adaptive strategies employed to address climate change in Nigeria. These strategies encompass the integration of energy-efficient measures in buildings to mitigate the impact of climate change (Adebamowo & Olusanya, 2012). Additionally, studies have examined various adaptive approaches adopted by individuals to enhance resilience to climate variability (Ebhuoma and Simatele 2017; Yilmaz 2021). Another study focused on evaluating the potential of six common tree species found in residential and industrial areas of Ota, Ogun State, southwest Nigeria, and recommended the planting of bio-indicators and tolerant tree species (Anake et al., 2018). Furthermore, an exploration was conducted to understand the thermodynamic impact on architectural buildings in Lagos State as an urban center (Emetere 2019). However, there is a research gap regarding the need to explore and analyze the comprehensive impacts of a regenerative framework on inhabitants in Nigeria. By filling this research gap, scholars and practitioners can gain a deeper understanding of the potential benefits and challenges associated with implementing a regenerative framework in the Nigerian built environment and develop targeted strategies for achieving sustainable and regenerative outcomes.

Recognizing these concerns, Nigeria must develop strategies and policies to address the impacts of climate change on the built environment. This includes integrating climate resilience and sustainability considerations into urban planning and infrastructure development. Implementing measures towards enhancing the adaptive capacity of the built environment. The gap in this study's background, however, is due to the quantitative approaches utilised to generate facts, conclusions, and suggestions for climate change mitigation strategies in southwestern Nigeria. In recent years, regenerative adaptive notions of the built environment have become more generally recognised (du Plessis and Chrisna du Plessis 2012; Griscom et al. 2017), as these will contribute to improving inhabitants' quality of life under the climate change regime.

As a result, the proposed methodology aids in the documentation of preventative actions in the Nigeria climate change study for prospects, health enhancement, and environmental regeneration of Nigeria's built environment. The purpose of this empirical study is to determine how climate change has affected the built environment in Nigeria's southwestern region. The goals are to investigate climate change predictors and to critically examine adaptive climate change methods for a regenerative built environment in Nigeria's southwestern zone. By embracing systemic thinking, restorative design, biodiversity enhancement, and social and economic resilience, we can create built environments that not only mitigate harm but also actively contribute to the regeneration of ecosystems and the well-being of communities.

While challenges exist, the potential benefits and transformative impact make the adoption of the regenerative paradigm a worthy pursuit for a sustainable future (Akinola et al. 2020; Oketola & Osibanjo, 2009; Ajayi, 2007). Additionally, raising awareness among policymakers, urban planners, architects, engineers, and communities about the importance of climate-resilient design and sustainable practices is essential. Capacity-building and knowledge-sharing initiatives can empower stakeholders to incorporate climate change considerations into their decision-making processes, resulting in more resilient and sustainable built environments. A collaboration between the government, private sector, academia, and civil society organisations is also critical. By working together, these stakeholders can leverage their expertise, resources, and influence to develop and implement comprehensive strategies that mitigate the impact of climate change on the built environment in Nigeria. Overall, addressing the impact of climate change on the built environment requires a multidisciplinary approach, long-term planning, and proactive measures. By prioritising climate resilience, sustainability, and social equity in urban development, Nigeria can enhance the resilience of its built environment and ensure a more sustainable future for its citizens.

1.1. Climate change as a global challenge affecting advanced and emerging countries

Climate change has become a worldwide issue affecting both developed and developing countries. It transcends geopolitical boundaries, affecting both advanced and emerging countries. While advanced nations face the challenge of adapting their existing infrastructure and policies, emerging countries navigate the complexities of sustainable development and climate resilience. Shared concerns, such as transitioning to clean energy, conserving ecosystems, and adapting urban environments, call for global cooperation and knowledge sharing. Addressing climate change requires a comprehensive, inclusive, and collaborative approach to ensure a sustainable future for all nations.

Part of the recent climate change problems includes the emergence of urban heat islands in some significant regional cities in Nigeria (Akinbode et al., 2008; Ayanlade & Jegede, 2015). In reality, Nigeria ranks as the sixth least prepared country in the world to adapt to climate change, according to the 2021 Notre Dame Global Adaptation Index, which ranks it as the 53rd most vulnerable nation overall (Nwankpa, 2022). Therefore, harm to the environment may have caused negative impacts on mankind, biodiversity, and ecosystems, among other examples (Ifeanyi 2018, Zhang et al., 2015; Roe et al. 2019).

The multifaceted nature of climate change and its implications for countries at different stages of development highlights the shared concerns and unique challenges faced by advanced and emerging nations. These include:

(i) Climate change as a global issue: The scientific consensus on anthropogenic climate change is well established, emphasizing the role of human activities in driving global warming and its associated impacts. The rise in GHG emissions, primarily from burning fossil fuels and deforestation, has led to rising global temperatures and altered weather patterns. This global issue demands international collaboration and comprehensive strategies to mitigate its consequences.

(ii) Impacts on advanced countries: Advanced nations, characterised by high levels of industrialisation and economic development, are not immune to the effects of climate change. These countries experience a range of impacts, including rising sea levels threatening coastal infrastructure, increased frequency and intensity of extreme weather events, disruptions to agricultural productivity, and health risks from heatwaves and air pollution. Advanced countries face the challenge of adapting their established infrastructure and policies to address climate-related risks effectively.

(iii) Challenges for emerging countries: Emerging countries, often characterised by rapid economic growth and industrialisation, face unique challenges in dealing with climate change. These nations are confronted with the need to balance economic development goals with sustainable practices. They often experience vulnerability to climate-related hazards, inadequate infrastructure, limited access to resources and technology, and socioeconomic disparities that amplify the impacts of climate change. Building resilience and implementing adaptive measures are key priorities for emerging countries.

(iv) Shared concerns: Both advanced and emerging countries share common concerns in addressing climate change. These include energy transition from fossil fuels to renewable sources, reducing GHG emissions, preserving ecosystems and biodiversity, ensuring food security, managing water resources, and adapting urban planning to enhance climate resilience. International agreements like the Paris Agreement provide a framework for collaborative efforts to tackle these shared concerns.

(v) Strategies and initiatives: Efforts to mitigate and adapt to climate change have gained momentum globally. Advanced countries often lead in developing and implementing sustainable technologies, renewable energy systems, and climate policies. They invest in research and development to advance climate solutions and support capacity building in emerging countries. Emerging nations, on the other hand, focus on leapfrogging to sustainable technologies, implementing climate-smart agriculture, and adopting resilient urban planning strategies.

(vi) Knowledge sharing and capacity building: Knowledge sharing and capacity building play crucial roles in addressing climate change. A collaboration between advanced and emerging countries facilitates technology transfer, policy learning, and sharing of best practices. Advanced nations can support capacity-building initiatives, provide financial assistance, and share expertise to empower emerging countries in climate action.

The task of mitigating the impacts of environmental hazards, including urban droughts, pollution, and flooding, has become progressively more challenging due to the aggravating effects of climate change. These hazards present substantial barriers for urban stakeholders and policymakers as they strive to attain ecological sustainability and fulfill the objectives of the Sustainable Development Goals (SDGs).

(i) Urban droughts: Climate change influences the frequency and severity of drought events in urban areas. Rising temperatures, altered precipitation patterns, and increased evaporation rates intensify water scarcity in many regions. Urban droughts have severe implications for water resources, affecting drinking water supplies, agricultural production, and industrial activities. The ability to mitigate and adapt to urban droughts is crucial for ensuring water security and sustainable urban development.

(ii) Pollution: Climate change interacts with urban pollution, exacerbating its consequences on human health and the environment (Hutchinson 2017). Rising temperatures and increased heatwaves contribute to the formation of ground-level ozone, a harmful air pollutant. Heat-trapping GHGs can also amplify the effects of air pollution by intensifying the stagnation of pollutants in urban areas. These conditions lead to respiratory diseases, cardiovascular problems, and reduced air quality, posing challenges to urban sustainability and public health.

(iii) Flooding: Climate change intensifies the risk of flooding in urban areas through increased precipitation, sea-level rise, and changes in storm patterns. Urbanisation, with its impermeable surfaces, disrupts natural drainage systems, exacerbating the impacts of heavy rainfall events. Urban flooding damages infrastructure, disrupts transportation networks, and poses risks to public safety. The resilience of cities to flooding is critical for protecting lives and property, maintaining essential services, and ensuring sustainable urban development.

(iv) Obstacles for urban stakeholders and policymakers: The effects of climate change on environmental hazards present significant obstacles for urban stakeholders and policymakers striving for ecological sustainability and the achievement of the SDGs.

Overcoming the obstacles posed by climate change and environmental hazards requires concerted efforts to achieve ecological sustainability and the SDGs (NEST, 2003; Yuen & Kumssa, 2011; Zhang et al., 2015; Mauree et al., 2019). As a result, the imperative for environmental sustainability is confronted by the challenges posed by climate change, which are recognised as the primary hurdles confronting humanity (UNEP 2013; Mauree et al., 2019). Other key strategies include: (i) climate resilience planning, which integrates climate resilience considerations into urban planning processes, incorporating green infrastructure, sustainable water management systems, and climate-responsive design, (ii) mitigation and adaptation that concern implementation measures to reduce GHG emissions and enhance adaptive capacity to mitigate the impacts of climate change. This includes transitioning to renewable energy, promoting energy efficiency, and implementing nature-based solutions for climate resilience.

Table 1 demonstrates that degradation and fossil energy production has increased dramatically, with only 10.8% of the land area wooded. Almost all of the 37 regional centers are highly populated, including the federal capital, Abuja (about 1000 people per square kilometre). Akinbode et al. (2008) investigated a typical Nigerian metropolitan city and discovered that it may generate a considerable heat island (0.5–2.5°C) during the day. Additionally, research indicates that from 1960–1990 and 1991–2013, the southwestern region of Nigeria had a rise in temperature of roughly 1°C (Abuloye et al., 2017). As a result, certain political leaders pushed for municipal greening projects that involved planting plants in previously completely built-up regions in order to reduce the impacts of the urban heat island in Nigeria (Ojo & Kayode, 2006).

There is no doubt that the chain from GHG emissions to atmospheric concentrations is the main determinant of climate change, both natural and anthropogenic (Federici et al., 2015; Rossi et al., 2016). Furthermore, it has long been recognised that carbon dioxide (CO2) makes up the most significant part of GHG emissions, having grown at the fastest rate between 1970 and 2004 (Climate Change in Nigeria 2007). This massive consumption came from energy supply (25.9%), industry (19.4%), transportation (13.1%), and other sources. The application of fossil carbon-based fuels has been a major source of GHG emissions. Additionally, research has revealed that some incidents of heat-related mortality have been observed in Nigeria and its neighboring countries (Greenwood, 2006; Sawa & Buhari, 2011). Health issues are caused by atmospheric pollution, habitat destruction, demands on grasslands, changes in aquatic processes, and the rise of global organic pollutants (Agboola 2011b; Healthy Parks Healthy People 2015). In view of these, the climate change problem calls for a future mitigation strategy process.

1.2. Regenerative built environment

Researchers studying the built environment are increasingly supporting the regenerative idea,

Table 1. Several indicators of Nigeria's urban and population growth.

Variables	Specifics	Rate
Land use	Deforestation	4000 km^2/year
	Reforestation	10 km^2/year
	Forested area (2008)	10.8%
Urban population	Annual growth	3.8%
	Urban population in 2004, 2010	45%, 48.9%
Rural population	Annual growth	1.8%
Total population	Population density in 2004, 2009	137.6, 167.5 persons/km^2
	Annual growth	2.5%
Total fossil fuel emissions	1951	460,000 tonnes
	1980	18,586,000 tonnes
	2008	26,113,000 tonnes

Source: United Nations Statistics Division (2013), Carbon Dioxide Information Analysis Centre (2012).

which helps to eliminate environmental effects through sustainability (Brown et al. 2018) and reconstruct social economic systems (Lee & Li, 2009). A regenerative landscape is the foundation for the built environment's sustainability. Emerging trends emphasize the current paradigms, which are based on a deterministic epistemological and rationalistic thinking, in an effort to lessen the effects of the built environment's deteriorating effects on human health and ecological systems (Prasad 2017). A regenerative sustainability paradigm may have its foundations established by an ecological perspective, according to DuPlessis and Brandon's (2015). To pave the way for regenerative, site-specific solutions in the built environment, the United States Green Building Council devised LENSES and REGEN (Plaut et al., 2012; Svec, Berkebile, and Todd 2012). These frameworks were developed with the aim of providing a clear pathway toward implementing regenerative practices and approaches within the context of sustainable building and design. The frameworks and techniques involved were created to support restoration and regenerative sustainability. The regenerative paradigm represents a shift in mindset from a linear, extractive approach to a circular, holistic approach. Rather than focusing solely on minimizing negative impacts, it seeks to create positive environmental, social, and economic outcomes. It embraces the principles of regeneration, resilience, and interconnectedness to foster thriving ecosystems and the following:

(i) Systemic thinking: The regenerative paradigm acknowledges the interconnectedness of natural and built systems. It emphasizes a holistic understanding of the built environment, considering its interactions with the surrounding ecosystems, communities, and resources.
(ii) Restorative design: Regenerative design aims to restore and enhance the natural environment rather than depleting it. It involves employing sustainable materials, renewable energy sources, and regenerative practices such as water and waste management systems that mimic natural processes.
(iii) Biodiversity enhancement: Recognizing the importance of biodiversity for ecological health, regenerative development prioritizes the protection and restoration of habitats. It encourages the integration of green spaces, native plantings, and wildlife corridors into urban landscapes to support biodiversity.
(iv) Social and economic resilience: The regenerative paradigm recognises the need to create inclusive and resilient communities. It promotes social equity, access to resources, and the development of local economies through sustainable practices and green job opportunities.

Regenerative built environment strategies encourage more green space and plant life while also including smart ecology. Smart ecology refers to the integration of technology, data, and intelligent systems into ecological practices and management to improve environmental sustainability and conservation efforts (Agboola et al. 2022; Biscaya and Elkadi 2021). It involves leveraging advancements in information technology, artificial intelligence, and the internet of things (IoT) to monitor, analyse, and optimise ecological processes and interactions. The key elements of "smart ecology" are:

(i) Monitoring and sensing: Smart ecology relies on the deployment of sensors and monitoring devices to collect real-time data on environmental parameters, such as air quality, water quality, temperature, humidity, and biodiversity. These sensors provide a continuous stream of information, enabling a deeper understanding of ecological systems.
(ii) Data analysis and decision-making: The data collected from sensors and other sources are processed and analysed using advanced analytics and machine-learning algorithms. This analysis helps identify patterns, trends, and anomalies, enabling informed decision-making for ecosystem management and conservation strategies.
(iii) Automation and control: Smart ecology involves the use of automation and control systems to optimise ecological processes. This can include automated irrigation systems, precision agriculture techniques, and smart grids for energy management. These systems enable resource efficiency, reduce waste, and promote sustainable practices.
(iv) Citizen engagement and participation: Smart ecology recognizes the importance of involving citizens and communities in ecological management. It promotes citizen science initiatives where individuals can contribute data, participate in monitoring activities, and engage in collaborative decision-making processes. This engagement fosters environmental awareness and empowers individuals to take an active role in conservation efforts.

In view of the aforementioned, the benefits of smart ecology comprise the following:

(i) Enhanced environmental monitoring: Smart ecology enables real-time and comprehensive monitoring of ecosystems, providing detailed insights into environmental conditions and changes. This information can help identify environmental risks, detect pollution incidents, and support early intervention and mitigation measures.

(ii) Improved resource management: By optimising resource use through automation and data-driven decision-making, smart ecology promotes efficiency and sustainability. It can optimise water and energy consumption, reduce waste generation, and minimise the ecological footprint of human activities.

(iii) Conservation and biodiversity protection: Smart ecology aids in the protection and restoration of ecosystems and biodiversity. By monitoring and analysing species populations, habitat conditions, and ecological interactions, it can contribute to targeted conservation efforts and adaptive management strategies.

(iv) Public awareness and education: Smart ecology initiatives provide opportunities for public engagement and education. Involving citizens in data collection and analysis promotes environmental awareness, encourages behavioural changes, and fosters a sense of stewardship towards the environment.

The following six principles of a regenerative built environment are discussed as itinerated by Panagopoulos, Sbarcea, and Herman (2020) and Klausing Group, (2021) namely:

(i) Create a functional green space: A functional lawn supports the natural ecosystem and lowers the material and financial costs of maintenance. It could be argued that lawns are a ubiquitous feature of urban and suburban landscapes, often associated with aesthetics and recreational purposes. However, a shift towards creating functional lawns that support the natural ecosystem is gaining momentum. By rethinking traditional lawn management practices and embracing ecologically sound approaches, we can transform lawns into vibrant habitats that benefit biodiversity, promote ecosystem services, and enhance overall environmental sustainability. In addition, lawns can serve as effective tools for managing rainwater run-off and reducing the risk of flooding. By adopting permeable lawn surfaces, such as using grass pavers or allowing some areas to remain unmowed, functional lawns facilitate the infiltration of rainwater into the ground, reducing erosion and replenishing groundwater supplies. This helps to mitigate the adverse impacts of storm water run-off and contributes to sustainable water management.

(ii) Plant native species: Native plants require less chemical treatment, since they tend to retain water better, which reduces stormwater run-off, prevents flooding, and reduces the need for irrigation systems. Similarly, native plants cater to wildlife, and planting native plants helps create natural habitats for birds. In addition, studies have revealed that native plant landscapes are less expensive to implement than conventional landscaping.

(iii) Expand the city's tree canopy: By deliberately expanding the urban tree canopy, environmental problems can be addressed efficiently. The layer of leaves, branches, and stems that cover the ground below is known as the urban tree canopy. By absorbing a large portion of the sun's radiation and letting just a small quantity pass through to the ground below, trees reduce the heat island effect. Furthermore, trees release heat into the atmosphere far more quickly than concrete, brick, or pavement. In addition, trees use the heat from evaporating water to chill the air through a process known as transpiration. As a result, trees reduce energy use and improve environmental comfort.

(iv) Healthy watershed: This is essential to the survival of ecosystems and the ability of people, plants, and animals to live in a place. But in addition to affecting temperature and heat stored during the day, large volumes of concrete and pavement also prevent precipitation from penetrating the earth and completing the natural water cycle. Instead, water flows into storm-water infrastructure, sewage systems, and drains. Chemicals and other pollutants may be introduced by this run-off into our waterways and ultimately into our drinking supply. Flooding, erosion, infrastructure damage, and storm/sewer system overflow can all result from this.

(v) Smart landscaping approach: This notion involves implementing smart landscaping through improved decision-making based on information from IoT sensors that monitor growth, soil quality, and meteorological data. Plants suitable for the different types of ecosystem and soil are selected using a smart landscaping strategy.

(vi) Render a biophilic approach holistic in its strategy, somewhat passive in its involvement with life, and ethnocentric in its goals: Biophilia is an approach to innovation that supports healthy, flourishing communities (Mang and Reed 2013; Panagopoulos, Sbarcea, and Herman 2020). The fundamental idea is to investigate why people love living things and how they function, and to use specialized biophilic strategies to improve people's health and well-being. To realize the restorative and regeneration potential of the built environment, it is becoming more and more crucial to incorporate biophilic methods into planning and design (Svec, Berkebile, and Todd 2012). In the natural world, human activities contribute to ecological issues. To promote urban sustainability and resiliency, adopting a biophilic approach is recommended (Maller et al., 2006; Orr, 2007; Panagopoulos, Sbarcea, and Herman 2020).

1.3. The concept and theoretical framework

The concept of a regenerative built environment centres around the idea of creating sustainable and resilient human habitats. It seeks to establish a harmonious relationship between human activities and the natural world with a view to actively restore and replenish natural systems. A regenerative built environment challenges traditional notions of sustainability by shifting the focus from mere preservation to actively improving and regenerating ecosystems. It recognizes that human well-being is interconnected with the health and vitality of the natural environment. By adopting a regenerative approach, we can create built environments that not only sustain human life but also contribute to the restoration and resilience of the planet's ecosystems. A regenerative built environment includes a critical understanding of the sustainability in the built environment through a variety of development strategies from social, cultural, and international viewpoints (du Plessis and Chrisna du Plessis 2012; Svec, Berkebile, and Todd 2012). Overall, the regenerative paradigm establishes the foundation for a sustainable paradigm that is appropriate from an ecological standpoint. It provides the best approach that is specifically created to interact with an ecosystem by stressing an interface with nature using strategies of adaptation, resilience, and regeneration (du Plessis and Chrisna du Plessis 2012; Mang and Reed 2013). Key principles of a regenerative built environment include:

(i) Ecological restoration: A regenerative approach involves restoring and rehabilitating degraded ecosystems within and around built environments. This may include rewilding, reintroducing native species, and conserving biodiversity to create resilient and thriving ecosystems.
(ii) Sustainable resource use: It prioritizes the efficient use of resources, such as energy, water, and materials. This involves implementing renewable energy systems, utilising water-efficient technologies, employing circular economy principles, and reducing waste generation to minimise the overall ecological footprint.
(iii) Climate resilience: A regenerative built environment anticipates and addresses the challenges posed by climate change. It incorporates climate adaptation and mitigation strategies, such as designing for extreme weather events, implementing green infrastructure for flood management, and reducing GHG emissions through sustainable transportation and building practices.
(iv) Social equity: The concept recognises the importance of social equity and inclusivity in the built environment. It aims to create spaces that are accessible, safe, and healthy for all individuals, regardless of their socioeconomic status, age, or abilities. It promotes community engagement, cultural diversity, and the provision of equitable opportunities.
(v) Circular design: A regenerative approach embraces the principles of a circular economy, where waste is minimised, resources are recycled or repurposed, and the lifecycle of materials is maximised. It encourages sustainable building practices, such as using recycled and locally sourced materials, incorporating renewable energy systems, and designing for adaptability and longevity.
(vi) Integrated systems thinking: It emphasizes the interconnectedness of various elements within the built environment and recognises the need for holistic and integrated design approaches. This includes considering the interplay between buildings, infrastructure, landscapes, and the surrounding natural systems to create a cohesive and regenerative ecosystem.

In support of the regenerative built environment, there are calls for the intervention of Steiner's Ecological Planning Model (1991; 2000), which addresses multiple abiotic, biotic, and cultural goals, in the built environment. The model technique comprises methods for examining a landscape's ecological and sociocultural systems. The Ecological Planning Model also emphasises goal-setting, execution, management, and citizen engagement through organised education and ongoing citizen participation (Steiner, 2000). As it engages professionals, specialists, and citizens in the decision-making process, it can be seen as multidisciplinary. It was designed to be interdisciplinary, since it incorporates knowledge from stakeholders, residents, planners, scientists, and others. To address spatial conflict and adaptability patterns, the technique explicitly recognises the strategic environment. This approach is mostly based on the theory and concepts of landscape ecology as they are comprehended and applied through spatial evaluations and notions. This framework, like Steinitz's approach, directs the strategic planning through a variety of prospective futures in order to enlighten, stimulate, and test the decision-making approach and connect planning actions with probable outcomes (Paradis, Treml, and Manone 2013). The scenarios outline an existing circumstance, potential futures, and the processes or acts required to connect the current with the future. The scenarios are assessed with input from the general public, specialists, and stakeholders.

1.4. Built environment, environmental challenges and sustainability

Built environment in this study includes neighbourhoods, streets, and other public urban spaces which offer a habitable human environment. Built environment plays a crucial role in the formation and transformation of urban identity (Agboola and Oluyinka 2019; Anastasiou et al. 2022; Siramkaya 2019; Arefi & Aelbrecht, 2022). Built environments help to promote liveable communities and make higher-density neighbourhoods more enjoyable. At the same time, they are an important component of creating secure, inclusive, resilient, and sustainable cities, and have been designated as a specific target under SDG 11. Creating resilience in the built environment is treading the UN-Habitat path that seeks urban areas as an important component of successful environment that foster a sense of belonging, culture, social capital, and rejuvenation.

There is no denying that man depends on his existing circumstances for survival and nourishment to such an extent that his reality is shaped by his current circumstances, highlighting the need for climate protection because of the associated challenges (Agboola 2011a; Beyioku 2016). Nature researchers have argued vehemently that man cannot exist without the climate, because human activities depend on their immediate environment. Because the environment is subjective, it pertains to both the geographical and psychological circumstances in which it impacts humanity. It comprises interactive water bodies as well as land masses, forests, grasslands, deserts, animals, and humanity (Gana & Toba, 2015).

Similarly, the environmental region is a collection of physical and biological phenomena that enable man's existence in all of its forms (Nwanne, 2013). Sustainability implies a realisation that the environment has a wealth of resources that must be safeguarded. This recognition as part of the current development agenda dates back to the United Nations Brundtland Commission in 1987, which defines sustainability as a growth that satisfies the current requirements without endangering the ability of future generations to satiate urgent needs. One of the pillars of sustainable growth is environmental sustainability, which is followed by social and economic sustainability (Geissdoerfer et al., 2017; Van der Waal and Thijssens 2020). Environmental sustainability is a process that emphasises the use of natural and social resources while also taking into account long-term scenarios. The term sustainable development is commonly understood as the necessity to attain long-term sustainability in the environmental, economic, and social dimensions (Shittu 2020; United Nations 2015). Poverty, pollution, deforestation and desertification, population increase, and urbanisation are just a few of Nigeria's environmental concerns and issues.

Human activities have played a significant role in the emergence of environmental and ecological deterioration in Nigeria (Tyokumbur, 2014). Traditional bush burning and open animal grazing have both played a part in Nigeria's deforestation and desertification problems (Geist & Lambin, 2002). Both have the resultant effect of continuing to degrade the soil and biodiversity of the impacted regions and increase financial losses in the agriculture sector (Leke and Leke 2019). The social-economic development consequences of such high levels of pollution include a loss of biodiversity in the natural environment and a threat to food security consequent upon the outcome of soil contamination (Leke and Leke 2019). The erratic nature of public power has been a cog in the wheel of promoting environmental sustainability, and reliance on fossil fuel-powered power producers contributes to noise and air pollution (Mauree et al., 2019). As a result, the built environment plays a critical role in ameliorating the impacts of the climate change and obtained sustainable energy economy (Agboola 2011a; House of Lords 2016). Landscape ecology, which supports the significance of local variations and interactions between sections of an ecological system, has had a big influence on environmental sustainability notions (Msumba, 2006; Mickaityte et al., 2008; Shittu 2020). These ideas have since been expanded to include resilience in the context of human – environmental relationships as well as the importance of cultural capital in achieving regional sustainability (Warner, 2011; Silva et al., 2020; Van der Waal and Thijssens 2020).

1.5. Mitigation and adaptation strategies

Three key variables are responsible for environmental concerns and climate change: (i) periodic variations in climatic parameters, (ii) human activities responsible for environmental degradation and deterioration, and (iii) environmental issues and climate change in areas and regions around the world that are resulting from regular variations in climatic parameters, such as rainfall, temperature, wind pattern, and humidity. Environmental challenges and climate change have resulted in continuous increases in air temperature, melting glaciers, sea-level rise, flooding, depletion, pandemic outbreaks, and desert emergence, all of which are the result of changes in climatic elements. The impacts of one or a combination of the above elements on the ecosystem's environmental balance are enormous. This assertion was supported by NEST (2003) and Zhang et al. (2019) – that sea-level rise, weather, hurricanes, and increasingly severe droughts are some of the ways that climate change has impacted our cities (Beyioku 2016). Environmental degradation is a function of the concentration of contaminants and radioactive chemicals in the environment. The quantity of pollutants available in a given space determines the environment's equilibrium and climate change. An increase or decrease in harmful pollutants in the ecosystem has negative consequences for a location's environmental issues.

1.6. The study area

The study was conducted in the southwestern region of Nigeria, encompassing the six states of Lagos, Ogun, Oyo, Osun, Ekiti, and Ondo. This region shares borders with Edo and Delta states to the east, Kwara and Kogi states to the north, the Republic of Benin to the west, and the Atlantic Ocean to the south. According to the 2006 demographic census, the region is situated between longitudes 20° 31′and 60° 00′ east and latitudes 60° 21′and 80° 37′ north. It has a landmass of 77,818 km^2 and a population of 27,722,432 (Agboola, 1979; Faleyimu et al., 2010; NBS, 20102010; NPC 2006). The southwestern region of Nigeria falls within the country's tropical rainforest zone, covering a significant portion of the area. The region experiences an annual rainfall ranging from 1400 to 4000 mm, with temperatures varying between 21 and 34 degrees Celsius. The topsoil in the rainforest zone of southwestern Nigeria is predominantly ferruginous tropical, resembling that found in heavily weathered parts of the bedrock complex strata (Onyekwelu et al., 2008).

The sub-equatorial rainforest in the southwest of Nigeria is characterised by warm, humid zones (Agboola 2011a); the zone is the low-wet climate of the tropics, while the warm humid zone covers places such as the coasts, forests, and transitional regions. The climate of Nigeria is warm throughout the year, with just a slight difference between summer and winter periods. The climate of Nigeria is typically separated into two seasons: wet and dry. Wintertime (the dry season) lasts from November to March, while summertime (the rainy season) lasts from April to October. The states of Oyo, Osun, Lagos, Ondo, Ogun, and Ekiti make up the regional zone of southwest Nigeria. The effects of climate change as experienced in the zone are attributed to its urbanisation, geographical location, vegetation, soil condition, population density, energy demands, and environmental challenges, among other factors.

2. Methodology

2.1. Data collection, distribution, and analysis

To gather pertinent and precise evidence regarding the causes, impacts, and strategies for environmental sustainability in the face of climate change, an empirical quantitative approach utilising a questionnaire survey is employed. This method aims to offer reliable and sensitive data that shed light on the factors contributing to climate change, its consequences, and effective measures for mitigation and adaptation. By employing questionnaire surveys, this study aims to provide robust empirical evidence to support the understanding and promotion of environmental sustainability in the context of climate change. It involved one-on-one and online survey distribution conducted among key stakeholders/professionals (aged ≥27 years) who are inhabitants of the case study areas. Participant's involvement in this study includes feedback through survey questionnaires on the study's objectives. The respondents included both registered professionals and other specialists in the built environment, such as environmentalists, educationalists, meteorologists, professional designers, and agriculturists. Their inclusion brings with it a diverse range of perspectives and expertise related to the built environment. Justification for their inclusion and details of their relationship with the built environment are as follows:

(i) Educationalists: Educationalists play a crucial role in shaping and disseminating knowledge related to the built environment. They can provide insights into educational practices, curriculum development, and the integration of sustainable design principles within educational institutions. Their perspective is valuable in understanding how the built environment impacts education and vice versa.

(ii) Meteorologists: Meteorologists are experts in studying and understanding weather patterns, climate conditions, and atmospheric processes. Their knowledge is essential for assessing the impacts of climate change on the built environment, predicting extreme weather events, and developing strategies to adapt and mitigate potential risks. Meteorologists can provide valuable input on climate-related considerations for sustainable design and planning.

(iii) Professional designers: Professional designers, such as architects, urban planners, and landscape architects, are directly involved in shaping the built environment. They possess expertise in creating sustainable and functional spaces, considering factors like aesthetics, spatial organisation, energy efficiency, and materials selection. Their perspective can offer insights into design principles, best practices, and the implementation of sustainable strategies.

(iv) Agriculturists: Agriculturists have expertise in agricultural practices, land use, and food production systems. In the context of the built environment, they can provide insights into urban agriculture, green infrastructure, and the integration of food production within cities. Agriculturists contribute to sustainable urban planning, community gardens, rooftop farming, and other initiatives that promote food security and ecological resilience.

The inclusion of these diverse categories of respondents expands the scope of the study beyond traditional built environment professions. It acknowledges the interconnectedness of different disciplines and recognises the need for a multidisciplinary approach to address sustainability challenges in the built environment. By involving educationalists, meteorologists, professional designers, and agriculturists, the study gains a more holistic understanding of the complex dynamics between human activities, the natural environment, and the built form. Their perspectives can contribute valuable insights, innovative ideas, and cross-sector collaboration to enhance the sustainability and resilience of the built environment. By engaging a diverse range of stakeholders, the study aims to foster a comprehensive and inclusive approach to addressing the challenges and opportunities in built environment professions.

Data collected through the questionnaire were analysed using the Statistical Package for the Social Sciences (SPSS) software package, specifically Version 22. The utilisation of SPSS Version 22 facilitated the statistical analysis of the collected data, enabling comprehensive and rigorous examination of the research variables and generating valuable insights for the study. A total of 300 survey questionnaires were distributed to respondents in the targeted states of Ekiti (50 questionnaires), Lagos (50), Ogun (50), Ondo (50), Osun (50), and Oyo (50). However, earlier, in September 2019, a pilot survey was conducted in order to pretest the survey instrument in the study areas. Meanwhile, all the feedback was noted and revised in the final questionnaire distributed during the main survey period. The main survey distributions were done between November and December 2019 in the study areas and were based on the convenience sampling methods as supported by Akinola et al. (2020) and considered appropriate due to lack of detailed lists of professionals in the built environment in the regions.

For satisfactory data gathering and removal of bias, stratified random sampling was adopted. Stratified sampling involves dividing the population into homogeneous subgroups (strata) based on certain characteristics. In this case, the strata have been determined by specific factors related to the built environment or location within southwestern Nigeria. By sampling within each stratum, we ensure that different segments of the population are represented. This sampling technique allows for a more representative and accurate analysis of the different predictors, impacts of climate change, and regenerative factors within the built environment in southwestern Nigeria. According to Creswell (2012), using stratified sampling in conjunction with probability sampling is the most effective technique for minimising bias. A total of 314 survey questionnaires were distributed, and 235 were retrieved and deemed suitable for analysis. To calculate the response rate, we divided the number of retrieved questionnaires by the number of distributed questionnaires and then multiplied by 100 to get the percentage. Therefore, the response rate stood at approximately 74.84%, which was a justifiable percentage (Moser and Kalton 1971). According to the literature, when employing the questionnaire method, a response rate exceeding 30% is commonly regarded as a satisfactory and acceptable level (Crimp and Wright 1995).

The internal consistency was assessed using Cronbach's alpha coefficient (α). Internal consistency, or reliability, refers to how closely all items on a given (sub)scale measure the same model. Cronbach's α and composite reliability are two commonly used methods for estimating an instrument's internal consistency dependability. The data reliability measure for all the variables exceeded Cronbach's α of 0.6, which demonstrated a reliable value. Cronbach and Shavelson (2004) and George and Mallery (2003) affirmed that scores within the range of 0.6–0.7 are acceptable. The test assisted in the clarity and level of the application of the questionnaire instrument.

The Kaiser-Meyer-Olkin (KMO) measure, indicating the adequacy of the sample, was 0.706, confirming the suitability of the questionnaire (Field, 2000). The Bartlett's sphericity test was significant at 0.001, meeting the threshold of 0.7 for a latent construct to be considered reliable. Additionally, descriptive analysis was performed on the demographic data of all 235 respondents. The survey covered various demographic and socio-economic variables, such as age, education, income, gender, areas of residency, and area of expertise. These variables underwent descriptive statistical analysis to provide a comprehensive understanding of the survey participants' characteristics. The descriptive analysis offered valuable insights into the demographic profile and socio-economic background of the respondents. Alongside demographic data, the survey included responses to a set of 25 measurement variables related to climate change indicators (Omar et al., 2000; Adger, et al, 2005; DeWeerdt 2007), negative impacts of environmental issues on health (Thomas, 2009; Daramola and Eziyi 2010; Munang et al., 2013); climate change mitigations and adaptations, and more (Moser & Boykoff, 2013; Agbebaku, 2015; Morecroft, et al, 2019; Berrang-Ford et al. 2019), among others. Participant responses were scored on a 5-point Likert scale, ranging from "Strongly agree" (5) to "Strongly disagree" (1), with "Agree" (4), "Neutral" (3), and "Disagree" (2) as intermediate options.

3. Results

3.1. Demographic characteristics

The descriptive analysis of respondent demographics (refer to Figure 1) yielded a host of findings. In terms of age distribution, respondents aged 27–34 years accounted for 24 (10.21%) individuals, ages 35–44 years comprised 44 (18.72%), ages 45–54 years represented 78 (33.19%), ages 55–65 years constituted 61 (25.95%), and ages above 65 years consisted of 28 (11.91%). Regarding professional affiliations, the respondents included environmentalists (47 or 20%), agriculturists (36 or 15.31%), meteorologists (24 or 10.21%), professional designers (70 or 29.78%), and educationalists (58 or 24.70%). In terms of marital status, 60 respondents (25.5%) were single, 169 (71.91%) were married, and 6 (2.5%) were divorced/separated/widowed.

Considering diverse social dynamics, including marital status, can contribute to the creation of built environments that foster community engagement and support social interaction. Geographically, out of the total respondents, 40 (17.11%) were from Oyo State, 38 (16.7%) were from Osun State, and both Ondo and Ekiti states had an equal number of respondents, with 25 each (10.6%). Notably, the highest number of respondents, 62 (26.38%), were from Lagos State, while the remaining 45 (19.14%) were from Ogun State. These percentages reflect the geographic representation of respondents across different states in the study area. Educational qualifications varied, with 20 (8.53%) having a Diploma certificate, 27 (11.48%) possessing an HND certificate, 51 (21.70%) holding a BSc degree, 62 (26.38%) having a Master's degree, and 75 (31.91%) respondents having a Ph.D.

3.2. Quantitative results

Multivariate Regression Analysis is an analytical test that examines the relationship between multiple independent variables and a dependent variable through a linear equation. Principal Component Analysis was used to identify the dominant factors by combining

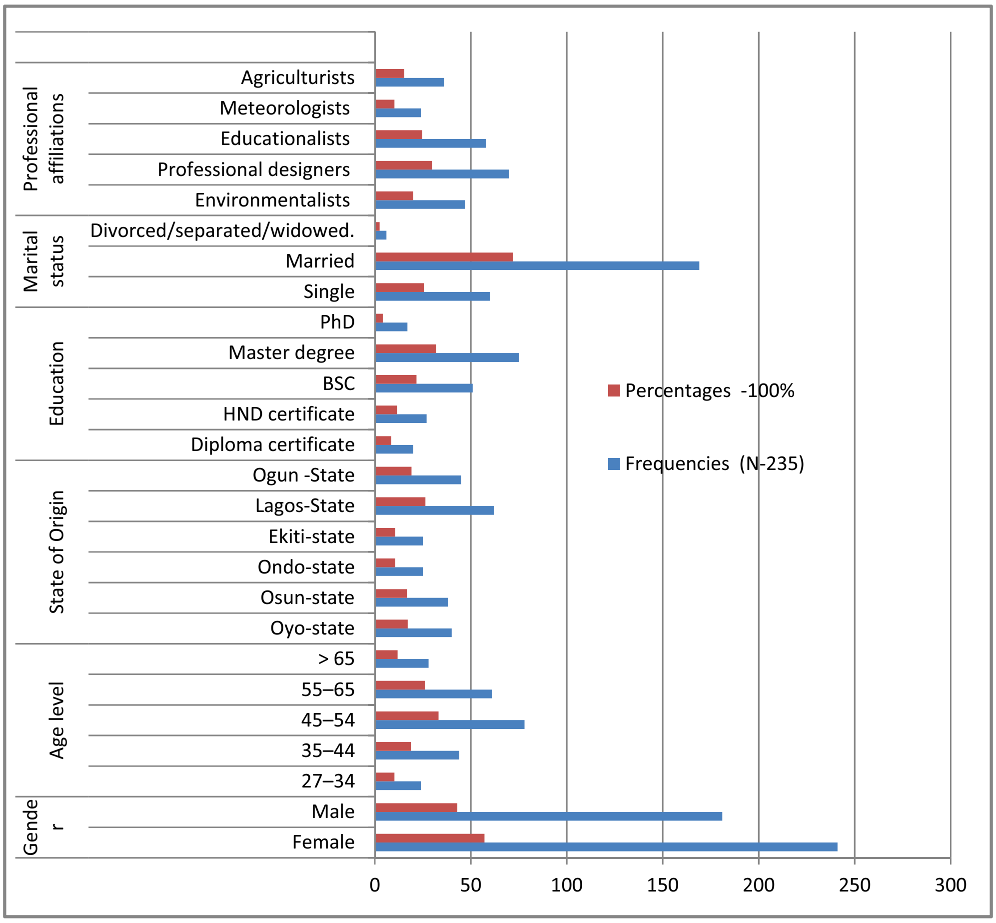

Figure 1. Respondents' demographics. Source: Authors' compilation.

different variables into a single designated variable based on content. This method extracted multiple independent variables for further analysis. To determine the relationships between the research variables, Pearson Bivariate Correlation Analysis was employed. The primary objective was to develop a model that demonstrates how the predictor variables influence the outcome variable. The results of the descriptive statistical analysis, presented in Table 2, illustrate the manifestation of climate change across various indicators. The analysis reveals that indicators such as Land-degradation (Mean = 4.25, Std. = 0.52), biodiversity loss (Mean = 4.23, Std. = 0.26), Pollution (Mean = 4.07, Std. = 0.59), Drought (Mean = 4.04, Std. = 0.52), Deforestation/Desertification (Mean = 4.08, Std. = 0.46), Urbanization (Mean = 4.10, Std. = 0.63), and Population growth (Mean = 4.09, Std. = 0.74) exhibit relatively high mean scores. The identified factors, namely Land-degradation, biodiversity loss, Pollution, Drought, Deforestation/Desertification, Urbanization, and Population growth, have been determined as noteworthy contributors to climate change based on their above-average scores. The results indicate that these factors hold significant implications and exert a substantial influence on climate change. Their relatively high mean scores underscore their significant role in environmental degradation and climate-related challenges. These findings emphasize the importance of addressing these factors within climate change mitigation and adaptation strategies.

To effectively mitigate the adverse impacts of climate change, it is crucial to focus efforts on sustainable land management, biodiversity conservation, pollution control, water resource management, forest preservation, urban planning, and population control. Recognizing these significant contributors enables policymakers, researchers, and stakeholders to prioritize interventions and allocate resources appropriately to address the identified environmental issues. By doing so, meaningful steps can be taken toward combating climate change and promoting a more sustainable future.

In contrast, factors such as Transport disruption (Mean = 3.67, Std = 0.64), Health challenges (Mean = 3.84, Std = 0.59), and Stratospheric ozone depletion (Mean = 3.08, Std. = 0.57) exhibit lower mean scores. However, despite their relatively lower averages, these factors remain important predictors of climate change. The findings highlight that land degradation, biodiversity loss, pollution, drought, deforestation/desertification, urbanization, and population growth play significant roles in driving climate change. At the same time, factors like transport disruption, health challenges, and stratospheric ozone depletion, although scoring lower on average, still contribute to climate change and are considered influential factors. These results underscore the significance of these indicators in comprehending and addressing climate change. They provide valuable insights for policymakers and researchers in the field, emphasizing the need to consider and tackle both the higher-scoring and lower-scoring factors to effectively mitigate and adapt to the challenges posed by climate change.

The detrimental effects of environmental issues on human health are manifested in both mental health and the occurrence of nutritional infectious diseases. Human mental health encompasses emotional, psychological, and social well-being, influencing thoughts, feelings, behaviors, stress management, relationships, and decision-making. Mental health disorders, such as depression, anxiety disorders, bipolar disorder, schizophrenia, and eating disorders, significantly impact cognitive processes, mood, and behavior. They can hinder daily functioning and diminish the overall quality of life. Nutritional infectious diseases, on the other hand, are a subset of infectious diseases influenced or aggravated by nutritional factors. These diseases arise from pathogens like bacteria, viruses, parasites, or fungi, and their severity can be affected by nutritional deficiencies or imbalances. Inadequate nutrition weakens the immune system, rendering individuals more vulnerable to infections. Conversely, certain infections can contribute to malnutrition or nutrient deficiencies due to heightened nutrient requirements or impaired nutrient absorption. Understanding the interconnectedness of environmental issues, mental health, and nutritional infectious diseases is crucial in addressing the comprehensive well-being of individuals. Efforts should focus on promoting environmental sustainability, improving mental health support systems, and ensuring adequate nutrition to mitigate the negative impacts on human health.

Table 2. Respondents' Rating of the Predictors of Climate Change in the Built Environment.

Variables	N	Minimum	Maximum	Mean	Std. Deviation
1) Climate change manifests through Land-degradation (flood erosion)	235	1.00	5.00	4.2576	.52347
2) Climate change manifests through Biodiversity loss	235	1.00	5.00	4.2300	.26048
3) Climate change manifests through pollution (land, air & water)	235	1.00	5.00	4.0775	.59466
4) Climate change manifests through Drought (water shortage)	235	1.00	5.00	4.0425	.52812
5) Climate change manifests through Deforestation/Desertification	235	1.00	5.00	4.0875	.46955
6) Climate change manifest through Urbanization	235	1.00	5.00	4.1075	.63481
7) Climate change manifests through Stratospheric ozone depletion	235	1.00	5.00	3.0800	.57380
8) Climate change manifests through Health challenges	235	1.00	5.00	3.8450	.59477
9) Climate change manifests through Population growth	235	1.00	5.00	4.0925	.74201
10) Climate change manifests through Transport disruption	235	1.00	5.00	3.6750	.64001

The descriptive analysis results in Table 3 revealed highest mean scores of negative impacts of environmental issues on inhabitants' health in air pollution related health effects (Mean = 4.81, Std. = 0.55), temperature-related health effects (Mean = 4.85, Std. = 0.52), mental-related infectious diseases (Mean = 4.94, Std. = 0.23), nutritional infectious diseases (Mean = 4.83, Std. = 0.41), and increase in water and foot borne related diseases (Mean = 4.75, Std. = 0.70). However, lower means scores were recorded increase in shortage of food production (Mean = 3.82, Std. = 0.60); an increase in the Poverty/low level of economic activities (Mean = 3.85, Std. = 0.51); Displacement and Forced Migration (Mean = 3.87, Std. = 0.42).

The results of the Multiple Linear Regression Analysis in Table 4 indicate that predictors of negative impacts of climate change are vested solely on (i) increase in air pollution-related health effects, (ii) increase in temperature-related health effects, (iii) increase in mental-related health effect, (iv) increase in nutritional infectious health-related effects, (v) increase in water and food-borne related health effects, (vi) increase in shortage of food production, (vii) increase in poverty/low level of economic activities, (viii) increase in deaths. Therefore, the emerged equation is that Predictors of Negative Impacts of climate change on inhabitants conditions = 0.035 + 0.688 (Increase in Air pollution-related health effects) + 0.686 (Increase in Temperature-related health effects) + 0.601 (Increase in Mental-related health effects) + 0.427 (Increase in Nutritional infectious-health related effects) + 0.431 (Increase in Water and foot Borne related health effects)+ 0.428 (Increase in shortage of food production)+ 0.410 (Increase in Poverty/low level of economic activities) + 0.698 (Displacement and Forced Migration).

In Table 5, the results of Principal Component Analysis (PCA) are presented, which categorizes and emphasizes the most significant factors in the dataset. It also provides information on the percentage of variance explained by each component. The identified categorized factors from the analysis serve as crucial components for subsequent analyses. By evaluating 49 variables, it was discovered that after four iterations of rotation, four components converged, collectively explaining 86.99 percent of the overall variation. These components individually accounted for specific percentages of variance: the first component explained 26.45%, the second component explained 21.22%, the third component explained 18.63%, and the fourth component explained 20.69% of the total variation. These findings underscore the notable contribution of these components in capturing and elucidating the underlying patterns and variability within the dataset.

The first factor, labeled as "Respondents" Demographics," encompasses a range of variables, including education level, gender, age, educational background, respondents' professional background, and years of residency. It provides insight into the demographic characteristics of the respondents. The second factor, known as "Climate Indicators 2 (CLI2)," consists of variables such as Land degradation, Biodiversity loss, and Pollution. These variables are indicative of climate-related factors associated with environmental degradation. The third factor, termed "Climate Indicators 3 (CLI3)," includes variables like Drought, Deforestation/Desertification, and Urbanization. These variables shed light on climate indicators related to specific environmental changes and human activities. Lastly, the fourth significant factor is referred to as "Climate Indicators 4 (CLI4)." It

Table 3. Respondents' Rating of Negative Impacts of Environmental Issues on effects on Inhabitants' Health.

Variables	N	Minimum	Maximum	Mean	Std. Deviation
1) Increase in Air pollution-related health effects	265	1.00	5.00	4.8130	.55317
2) Increase in Temperature-related health effects	235	1.00	5.00	4.8550	.52690
3) Increase in Mental-related infected infectious diseases	235	1.00	5.00	4.9404	.23726
4) Increase in Nutritional infectious diseases	235	1.00	5.00	4.8347	.41503
5) Increase in Water and foot Borne related diseases	235	1.00	5.00	4.7586	.70005
6) Increase in shortage of food production	235	1.00	5.00	3.8218	.60409
7) Increase in the Poverty/low level of economic activities	235	1.00	5.00	3.8519	.51919
8) Displacement and Forced Migration		1.00	5.00	3.8727	.42299

Table 4. Regression Analysis of features of Negative Impacts of Climate change on Inhabitants' Health.

Model		Unstandardized coefficients		Standardized coefficients		
		B	Std. error	Beta	t-value	Sig. value
1	(constant)	.035	.076		0.214	.312
	Increase in Air pollution-related health effects	.688	.057	.683	8.652	.004
	An increase in Temperature-related health effects	.686	.048	.607	7.581	.000
	Increase in Mental-related health effects	.601	.051	.406	9.522	.000
	Increase in Nutritional infectious-health-related effects	.427	.066	.481	9.833	.000
	Increase in Water and foot Borne related health effects	.431	.059	.434	12.572	.000
	Increase in shortage of food production	.428	.053	.367	12.876	.000
	Increase in Poverty/low level of economic activities	.410	.062	.389	11.768	.000
	Displacement and Forced Migration	.698	.056	.387	12.536	.000

Note: a.Dependent Variable: Opinions of the Public space Inhabitants.

Table 5. The Principal Components analysis for the Respondents' Demographic data and Climate change Indicators.

	Components			
Variables	1	2	3	4
Education level	0.765			
Gender	0.743			
Age	0.702			
Career backgrounds	0.789			
Environmentalists	0.754			
Educationalists	0.756			
Meteorologists	0.659			
Designers	0.786			
Agriculturists	0.739			
Years of residency	0.799			
Land-degradation (floor/erosion)		0.786		
Biodiversity loss		0.729		
Pollution (land, air & water)		0.779		
Drought			0.761	
Deforestation/Desertification			0.793	
Urbanization			0.726	
Stratospheric ozone depletion				0.704
Health challenges				0.733
Population growth				0.761
% the variance explained	26.45	21.22	18.63	20.69

represents variables such as stratospheric ozone depletion, Health challenges, and Population growth. These variables offer insights into climate-related factors with implications for health and population dynamics. By organizing the variables into these distinct factors, researchers can establish a structured framework for analyzing the respondents' demographics and various climate indicators. This categorization facilitates a deeper understanding of the underlying patterns and relationships within the dataset, enabling more focused and insightful analyses.

Table 6 presents the results of a regression study examining the predictors of adaptive climate change strategies and their influence on regenerative built environments. The *p* values in the sixth column of the table indicate the significance of various factors tested. Out of the twenty factors evaluated, sixteen were found to be highly significant predictors of the survey's regenerative built environment indices. The following variables were found to be significant predictors: respondents' gender ($p = 0.017$), respondents' age ($p = 0.002$), respondents' years of residency ($p = 0.001$), respondents' employment status ($p = 0.007$), respondents' highest educational qualification ($p = 0.002$), professionals in the fields of environmental science, education, and meteorology, as well as designers ($p = 0.002$) and meteorologists ($p = 0.009$). Agriculturists ($p = 0.004$), participants' awareness of climate change ($p = 0.012$), participants' ideas about creating a functional green space ($p = 0.003$), their opinions on planting native species ($p = 0.001$), establishing the city's tree canopy ($p = 0.000$), creating a healthy watershed ($p = 0.000$); adoption of Smart

Table 6. Regression of Respondents' Rating of Climate Change Adaptation Strategies on Regenerative Built Environment.

	Standardized Coefficients				
Independent predictors	Beta coefficients	Estimate of Standard error	*df*	Frequency *(f)*	Sig. *p*
Religious affiliation	0.041	0.014	1	1.743	0.175
Gender	0.016	0.019	2	1.713	0.210
Age	0.327	0.015	2	3.177	0.002*
Marital status	0.013	0.017	2	1.899	0.282
Years of residency	0.003	0.016	2	4.039	0.001*
Employment status	0.128	0.015	2	3.279	0.008*
Ethnic background	0.022	0.016	1	1.899	0.189
Highest educational qualification	0.120	0.025	3	3.743	0.002*
Environmentalists	0.136	0.019	3	5.040	0.007*
Educationalists	0.230	0.015	2	4.533	0.009*
Meteorologists	0.247	0.019	2	4.437	0.002*
Designers	0.128	0.036	4	4.345	0.006*
Agriculturists	0.232	0.023	2	5.001	0.004*
Awareness of Climate Change	0.204	0.009	1	3.230	0.012*
Creating a green functional green space	0.436	0.016	1	5.207	0.003*
Planting Native species	0.499	0.025	5	4.899	0.001*
Establishing City's tree canopy	0.467	0.203	4	5.492	0.000*
Creating a healthy watershed	0.314	0.030	3	6.954	0.000*
Smart landscaping approach	0.388	0.211	3	4.254	0.000*
Rendering Biophilic approach	0.494	0.014	1	5.743	0.006*

Note: *Significant predictors ($p \leq 0.05$).

landscaping approach ($p = 0.000$); and the significance of implementing biophilic approach ($p = 0.006$) were also significant.

The impact of various climate change adaptation strategies on the regenerative built environment indices can be analyzed based on their β coefficients. Among the top predictors, planting native species has the highest β coefficient of 0.499, followed by the biophilic approach (0.494), the establishment of a city's tree canopy (0.467), the creation of a functional green space (0.436), the use of smart landscaping techniques (0.388), and the development of a healthy watershed (0.314). These coefficients indicate the strength of association between each predictor and the regenerative built environment indices. For example, for every one-unit increase in the standard deviation of planting native species, there is a 0.499 times increase in the expected outcome of climate change adaptation strategies in the built environment. Similarly, the biophilic approach is associated with a 0.494 times increase, the establishment of a city's tree canopy with a 0.467 times increase, the creation of a functional green space with a 0.436 times increase, the use of smart landscaping techniques with a 0.388 times increase, and the development of a healthy watershed with a 0.314 times increase in the expected outcome.

These coefficients highlight the significant variables that influence the regenerative built environment indices in the context of climate change adaptation strategies. The values represent the impact observed for each strategy when there is a one-unit increase in the standard deviation of the respective predictor. Similarly, the subsequent numbers represent the corresponding results achieved for each one-unit increase in the standard deviation. Below are the interpretations of the results:

(i) Awareness of Climate Change (0.204): Increasing the standard deviation of awareness of climate change by one unit corresponds to an impact or effectiveness of the adaptation strategy that is 0.204 times the original value. This implies that raising awareness may have a relatively moderate positive impact on the overall adaptation strategy compared to other variables.
(ii) Creating a Green Functional Green Space (0.436): With each one-unit increase in the standard deviation of creating a green functional green space, the adaptation strategy achieves a result that is 0.436 times the original value. This indicates that increasing the variability or diversity in creating such spaces may have a moderate positive impact on the overall strategy.
(iii) Planting Native Species (0.499): Each one-unit increase in the standard deviation of planting native species leads to an adaptation strategy result that is 0.499 times the original value. This suggests that increasing the variability or diversity in planting native species has a relatively high positive impact on the overall strategy.
(iv) Establishing City's Tree Canopy (0.467): Increasing the standard deviation of establishing the city's tree canopy by one unit corresponds to an adaptation strategy result that is 0.467 times the original value. This indicates that increasing the variability or diversity in establishing the tree canopy has a moderate positive impact on the overall strategy.
(v) Creating a Healthy Watershed (0.314): With each one-unit increase in the standard deviation of creating a healthy watershed, the adaptation strategy achieves a result that is 0.314 times the original value. This suggests that increasing the variability or diversity in creating a healthy watershed has a relatively moderate positive impact on the overall strategy.
(vi) Smart Landscaping Approach (0.388): Each one-unit increase in the standard deviation of the smart landscaping approach results in an adaptation strategy outcome that is 0.388 times the original value. This indicates that increasing the variability or diversity in adopting a smart landscaping approach has a moderate positive impact on the overall strategy.
(vii) Rendering Biophilic Approach (0.494): Increasing the standard deviation of rendering a biophilic approach by one unit corresponds to an adaptation strategy result that is 0.494 times the original value. This suggests that increasing the variability or diversity in adopting a biophilic approach has a relatively high positive impact on the overall strategy.

4. Discussion

4.1. Climate change adaptation strategies

The research findings presented in this study have identified ten prominent predictors of climate change indicators. These findings align with previous studies conducted by Thomas (2009), Kadir (2006), and Agbebaku (2015), which have highlighted certain variables contributing to environmental imbalances in ecosystems, leading to climate change and associated environmental challenges. The study further confirms that desertification, deforestation, floods, erosion, urbanization, and overpopulation are examples of environmental difficulties that serve as indicators of climate change and ecosystem degradation. The principles of environmental sustainability, economic growth, human development, and nature conservation are intricately linked to urbanization. Notably, the industrial sector and improper sewage management have contributed significantly to environmental pollution, including issues such as excessive noise, poor air quality, oil spills, soil pollution, and urban sprawl. Previous research by Smith (1994) and Hales (2000) has supported these findings, highlighting the impact of rapid modernization and technological advancements in the automotive and construction sectors. To address these challenges, it is considered crucial to focus on transportation systems, create pedestrian-friendly environments with fewer automobiles, and strengthen urban-rural links, as these approaches can effectively reduce cities' carbon footprints (Agboola 2019).

In Nigeria, rapid urbanization, similar to many other developing countries, has resulted in a lack of green spaces in urban areas. This has led to issues such as pollution, heat islands, flooding, and degradation, which need to be addressed (Agboola 2011b; Daramola and Eziyi 2010; Omar et al., 2000). While these environmental challenges are primarily driven by developmental processes, their implications extend to local, regional, and global levels. Consequently, climate change has emerged as a significant environmental health risk faced by humanity. Considering the aforementioned findings, the adverse effects of climate change have a profound impact on the living conditions of inhabitants. Increased CO2 emissions, air pollution-related health impacts, temperature-related health effects, and mental health effects are among the most significant concerns, as indicated by Msumba (2006), DeWeerdt (2007), and Federici et al. (2015). Additionally, there are heightened health risks associated with infectious diseases related to diet, waterborne and vector-borne diseases, food production shortages, and poverty/low economic activity, as supported by Thomas (2009), Nwafor (2007), and Agbebaku (2015) Agboola et. al. (2015).

4.2. The influence of climate change adaptation strategies on the regenerative built environment in Nigeria

This study highlights the significant climatic risks faced by both inhabitants and ecosystems. As a result, fifteen crucial climate change adaptation strategies have been identified. Therefore, it is essential to implement measures for climate change mitigation and adaptation, such as environmental greening, pedestrian-friendly environments, and improved urban-rural connectivity. These measures emphasize the integration of green spaces into communities, reducing carbon emissions by promoting non-motorized transportation, and establishing stronger links between urban and rural areas as key determinants of effective climate change adaptation strategies (Ezeabasili and Okonkwo 2013; Gana & Toba, 2015).

Furthermore, an important finding of this study focuses on the realization of a regenerative built environment. In this regard, creating a functional green space, planting native species, establishing the city's tree canopy, creating a healthy watershed, and adopting the biophilic approach are key considerations. The biophilic approach, rooted in the concept of biophilia, recognizes the inherent human connection with nature and the profound need to engage with natural elements within the built environment. It goes beyond superficial additions of plants or natural materials, aiming to design environments that evoke positive emotional responses, support well-being, and enhance human-nature interactions. Here are some distinguishing aspects of the biophilic approach compared to related factors or variables:

(i) Nature Integration: The biophilic approach emphasizes the integration of nature into the built environment at various levels. This involves incorporating elements such as natural light, views of nature, water features, green spaces, and materials that reflect the patterns and textures found in nature. The goal is to create a seamless connection with nature, blurring the boundaries between indoor and outdoor spaces.

(ii) Health and Well-being: The biophilic approach acknowledges the positive impact of nature on human health and well-being. It takes into account factors like stress reduction, improved cognitive function, enhanced mood, and increased productivity. Design features such as access to natural light, views of greenery, and the use of biophilic patterns and colors can contribute to these positive effects.

(iii) Environmental Sustainability: The biophilic approach aligns with the principles of environmental sustainability. It emphasizes the use of sustainable materials, energy-efficient systems, and strategies that minimize the ecological footprint of the built environment. Promoting a harmonious relationship with nature, it encourages responsible design and the stewardship of the natural world.

(iv) Psychological and Emotional Connection: The biophilic approach aims to evoke positive emotions and foster psychological well-being through design. It considers elements such as the presence of natural elements, patterns, and materials that evoke a sense of awe, tranquility, and connection to nature. This emotional connection is a fundamental aspect of the biophilic experience.

While factors such as green design, sustainable design, and eco-friendly practices are related to the biophilic approach, they do not encompass the same scope. The biophilic approach specifically emphasizes the human-nature connection and focuses on creating environments that support human well-being by intentionally incorporating nature. By adopting the biophilic approach, designers and architects can create spaces that foster the human-nature relationship, strengthen our connection to the natural world, and enhance the well-being of individuals and communities within the built environment.

The findings of this study highlight the importance of implementing a range of measures for climate change mitigation and adaptation, which play crucial roles in advancing the Sustainable Development Goals (SDGs) and improving the built environment. The results underscore that sustainable communities can be created through environmental greening and reducing global carbon emissions by promoting non-motorized transportation. Additionally, the study emphasizes the responsibility of providing clean energy sources to mitigate the impacts of climate change and contribute to the achievement of the SDGs. Effective government policies and procedures are essential for harnessing the potential of the built environment as a catalyst for SDG attainment.

Furthermore, the study emphasizes the significant role of plants and trees in mitigating environmental pollution. They act as natural filters, capturing pollutants through their foliage and collecting dust particles, thereby reducing their presence in the air we breathe. Additionally, plants contribute to reducing ground-level pollutant concentrations by lowering temperatures through transpiration, which also helps decrease ozone concentrations. Moreover, the release of oxygen by plants improves air quality, benefiting human health (McPherson, 2005).

The street layout has a substantial impact on both climate change mitigation and public health by influencing people's ability to engage in active transportation modes such as walking and cycling. It is crucial to recognize that the road transportation sector plays a significant role in global carbon dioxide (CO_2) emissions, making it a major contributor to climate change. Transport emissions are projected to be 80 percent higher than current levels by 2030 compared to emissions from other sectors. Reducing the use of motorized transportation is an important strategy for lowering CO_2 emissions. Transformations to address the healthcare threat posed by anthropogenic climate change can occur at communal and personal levels, both actively and passively.

The transportation of food has varying environmental impacts depending on the type of vehicle used. Food sold in local public markets often comes from rural areas near cities and therefore travels shorter distances compared to imported food from other countries. However, food transportation still contributes to emissions and global air pollution, affecting climate change (Eichhorst, 2009; Opoku, 2016). The adoption of alternative or renewable energy sources holds great potential for reducing greenhouse gas (GHG) emissions and mitigating the human impact on the ecosystem. Developing and growing economies need to embrace these sustainable practices to prevent catastrophic consequences. Technological advancements are expected to play a significant role in providing practical solutions that promote the use of clean and renewable energy, minimize greenhouse gas emissions, and enhance the value of the ecosystem, as supported by studies conducted by Roaf et al. (2005), Ruddiman (2003), Smith (2007), and Altomonte (2009).

5. Conclusion, implications, and recommendation

Climate change has become a pressing global issue, affecting nations across the world and transcending boundaries. It presents significant challenges for both advanced and emerging countries, impacting various sectors and necessitating collective global action. In the context of Nigeria, this research has made substantial contributions to adaptive climate change strategies. It highlights the importance of a paradigm shift towards regenerative approaches in transforming the built environment, aiming to alleviate the consequences of climate change and modify the nature and functionality of urban frameworks.

The study emphasizes the emergence of the regenerative paradigm as a transformative approach within the built environment, surpassing mere sustainability objectives. By seeking to restore, renew, and enhance ecosystems affected by human activities, the regenerative paradigm offers promising opportunities for creating healthier, more comfortable, and more productive ways of life. However, the concept of the regenerative paradigm and its potential to foster sustainable development have been understudied in recent times. Embracing the regenerative paradigm in built environment research provides numerous benefits. It can reduce ecological footprints, enhance energy efficiency, improve air and water quality, and create healthier and more vibrant spaces for communities. Additionally, regenerative practices have the potential to foster a smart economy and promote economic growth. Smart ecology, combining technological innovations with ecological principles, holds significant promise for advancing ecological sustainability and conservation efforts. It offers valuable tools and insights to support informed decision-making, foster citizen participation, and contribute to the long-term health and resilience of our ecosystems.

The findings of this study provide crucial insights. Firstly, ten important predictors of climate change indicators were identified, offering valuable information for understanding and addressing climate-related challenges. Secondly, the study emphasizes the adverse consequences of climate change on the health of inhabitants in Southwestern Nigeria, highlighting the need for proactive measures. Lastly, several significant regenerative factors were highlighted, with the planting of native species, adoption of a biophilic approach, and establishment of a city's tree canopy emerging as prominent contributors to a regenerative built environment. To achieve a regenerative built environment, it is crucial to prioritize the creation of functional green spaces, implementation of native species planting, establishment of citywide tree canopies, development of healthy watersheds, and adoption of a biophilic approach. The study's findings offer valuable insights for researchers, policymakers, and practitioners, emphasizing the significance of adopting regenerative approaches within the built environment to address climate change and promote sustainable development.

Sustainable development is crucial for addressing the challenges posed by climate change and environmental degradation, requiring collaborative support from all stakeholders. When planning public spaces in cities, it is important to preserve diverse green and open spaces that support a range of species and landscapes. This biodiversity plays a vital role in climate change mitigation and can help mitigate the adverse effects of climate change on cities. Based on the study, the following recommendations can be derived:

(i) Integration of Climate Change Interventions: Urgent actions are needed to integrate climate change interventions into decision-making processes, initiatives, and development plans of the Nigerian government. Prioritizing sustainable practices within the built environment, considering the potential of the regenerative paradigm, is crucial for effectively addressing climate change impacts.

(ii) Policy Frameworks and Regulations: Assess and enhance existing policy frameworks and regulations related to the built environment in Nigeria. Develop or revise policies to incentivize and enforce regenerative practices, including the creation of functional green spaces, planting native species, establishing citywide tree canopies, and developing healthy watersheds. This will ensure the adoption of sustainable and regenerative approaches on a broader scale.

(iii) Awareness and Education: Promote awareness and education among stakeholders, including residents, policymakers, architects, builders, and professionals in the built environment sector. By raising awareness about the benefits of the regenerative paradigm and providing knowledge on sustainable practices, stakeholders can actively contribute to creating a regenerative built environment.

(iv) Collaboration and Knowledge Sharing: Encourage collaboration and knowledge sharing among researchers, practitioners, and policymakers working in the field of sustainable development and the built environment. This will facilitate the exchange of best practices, lessons learned, and innovative ideas to advance regenerative approaches and their implementation in Nigeria.

(v) Long-Term Monitoring and Evaluation: Conduct long-term monitoring and evaluation of regenerative projects and initiatives in the built environment. This will help assess their effectiveness, measure the impact on climate change mitigation and adaptation, and identify areas for improvement. Longitudinal studies can provide valuable insights into the long-term benefits and challenges associated with the adoption of regenerative practices.

(vi) Economic Considerations: Conduct economic assessments to determine the costs and benefits associated with implementing regenerative strategies in the built environment. Understanding the economic implications will assist policymakers and developers in making informed decisions and prioritizing investments in sustainable infrastructure and practices.

(vii) Capacity Building: Invest in capacity-building programs and training for professionals and stakeholders involved in the built environment sector. This will enhance their knowledge and skills in implementing regenerative practices, integrating climate change considerations, and ensuring the long-term sustainability of the built environment.

Regarding the limitations of the study, it is important to acknowledge that implementing the regenerative paradigm comes with challenges. It requires a shift in mindsets and practices, overcoming resistance to change, and integrating various disciplines and stakeholders. Additionally, there may be higher initial costs and complexities associated with adopting regenerative design and construction techniques. Despite these challenges, several potential future studies can contribute to further understanding of the regenerative paradigm and its implications for sustainable development. These studies can provide practical recommendations for policymakers, practitioners, and researchers in the field of the built environment and climate change. Here are some suggested future studies:

(i) Comparative Study: Conduct a comparative study between different regions in Nigeria or other countries to examine the effectiveness of regenerative approaches in addressing climate change impacts and achieving sustainable development within the built environment. This would provide insights into contextual variations and best practices across different locations.
(ii) Longitudinal Study: Conduct a longitudinal study to assess the long-term effects of implementing regenerative strategies in the built environment. This would involve monitoring and evaluating changes and improvements over an extended period, providing valuable data on the effectiveness and sustainability of regenerative practices.
(iii) Qualitative Research: Conduct qualitative research to explore in-depth perspectives, experiences, and perceptions of stakeholders (e.g., residents, policymakers, architects, and builders) regarding the regenerative paradigm and its implementation in the built environment. This would provide a deeper understanding of the challenges, opportunities, and potential barriers to achieving a regenerative built environment.
(iv) Case Studies: Conduct case studies on specific regenerative projects or initiatives within the built environment in Southwestern Nigeria or other regions. This would involve examining real-world examples and their outcomes, identifying key success factors, and drawing lessons that can be applied to future projects.
(v) Policy Analysis: Conduct a policy analysis to assess existing policy frameworks and regulations related to the built environment in Nigeria. This would help identify gaps and opportunities for integrating climate change interventions and regenerative approaches into government decisions and initiatives.
(vi) Economic Assessment: Conduct an economic assessment of the costs and benefits associated with implementing regenerative strategies in the built environment. This would provide insights into the financial feasibility, return on investment, and potential economic impacts of adopting regenerative practices.

These suggested future studies can contribute to expanding knowledge and understanding of the regenerative paradigm, and its implications for sustainable development, and provide valuable insights for decision-makers and practitioners in the built environment and climate change field.

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