The Built Environment and the Need for Sustainable Architecture due to Climate Change in Asaba

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Abstract

The expansion of the built environment and the attendant impacts of the climate system often lead to climate change. The changes in climate on the other hand, creates serious challenges for the already built architectures. The projections for building span often fail due in part to climate change issues not planned for. As a result, it is contemporary to build sustainably. However, most developers in the developing countries often build with utter disregard for sustainable architecture. In effect, the architecture continues to impact the environment negatively; with consequences for the buildings, man and the environment. This study as a result, aimed at assessing the built environment and the need for sustainable architecture due to climate change in Asaba. The study deployed the literature search method and the archives of databases such as Web of Science, Scopus and Google Scholar were consulted. Findings from literature confirmed that the developers in Asaba paid little or no attention to sustainable architecture. Most of the buildings were built to fulfil aesthetics and space requirements, rather than for sustainability. Conversely, the literature also showed that the developed countries have advanced from basic to sustainable architecture and by extension improving their climate. As advanced in literature of similar climatic belts to that of the study area, deep-roof overhangs and natural ventilation were recommended for Asaba. Similarly, limiting of concreted compounds and population of greens around the compounds were also advised. As a policy, the study advised the use of locally sourced and environmentally friendly materials for building among others.

Keywords: Sustainable-Architecture, Climate Change Adaptation, Built-Environment, Urban-Resilience, Asaba

1.0 Introduction

The challenges imposed by climate change have, of recent, made sustainable architecture an important one, especially in rapidly developing urban areas such as Asaba, being the capital of Delta State, Nigeria (Isiwele et al., 2018; Sijakovic & Peric, 2021). Similarly, like other conurbations of developing nations, the urban landscape of Asaba is faced with severe challenges of growth in population, accompanied by urbanization, as well as the enhanced effects of climate change (Ozabor & Ajukwu, 2023; Ahmed et al., 2025; Ozabor et al., 2025). This tends to indicate that the demands imposed by growth in human population, subsequently accompanied by demands for housing, constitute the urgency of the

need for sustainability principles to be incorporated into architectural practices (Ritchie & Thomas, 2013; McCormick et al., 2013; Mba et al., 2024). This must be achieved given that there is a need to address the problem through mitigating the issue of environmental degradation, coupled with improvement of social and economic sustainability ideals (Adekomaya & Majozi, 2022). Climate change in Asaba, is both through temperature increase (Ozabor et al., 2025), frequent instances of extreme weather conditions such as heavy rainfall or flooding (Ozabor & Ajukwu, 2023), as well as longer instances of dry weather seasons, that fundamentally influence the durability, comfort, or functionality of any architectural design of constructions built. This therefore tends to indicate that sustainable architecture seeks to ensure reduced carbonization effect of constructions, improve energy efficiency rates, effectively manage resources for their maximization, as well as foster occupants' health and wellness states for enhanced sustainable utility ideals of the constructions built (Ozabor et al., 2024; Nwaogu et al., 2025).

Sustainable architecture refers to the designing and erecting of architectural structures that are eco-friendly and resource-saving throughout their life span (Aliamin, 2021). This is achieved through the utilization of renewable energy resources, eco-friendly materials, proper waste management practices, and adequate architectural design adapted to the prevailing climate of that region (Okumagba & Ozabor, 2014; Ahmadizadeh et al., 2024). Therefore, in Asaba, the prevailing tropical climate (with high humidity levels and rainfall seasons) influence architectural building orientations, ventilation systems, and material selection (Ogbogo et al., 2025, Chukwudi et al., 2025), therefore, building sustainably must be applied. An example is the utilization of passive cooling systems such as natural ventilation and shading, which would be imperative for ensuring that the need for energy-intensive air conditioning systems is reduced to a great extent, with its consequent lowering of global gas emission levels (Ali & Akkaş, 2023). There are many sustainability issues that pervade the built environment of the current global climate that make it more susceptible to climate change (Younger et al., 2008); these issues emanate from the widespread utilization of non-renewable materials in the construction industries such as cement and steel, inappropriate waste management systems, poor urban development schemes (Joseph & Tretsiakova-McNally, 2010; Ozabor & Obaro, 2016), as well as poor public knowledge levels of such influences of climate change on the built environment. These issues pervade the Asaba metropolis.

In Asaba, this is often true with regards to urbanization, since it is either unplanned or occurs too quickly (Momodu et al., 2012; Weli et al., 2017). This type of development pattern has, to some extent, badly aggravated environmental concerns with regards to unplanned development (Barasa, 2018). The current practice of using impervious surfaces in the urban area of Asaba tends to increase the amount of surface runoff that occurs with rainfall, ultimately resulting in floods (Ozabor & Wodu, 2016), erosion (Eyetan & Ozabor, 2021), or damage to current infrastructure (Okumagba & Ozabor, 2016). Flooding is only tantamount to affecting daily life but is also causing damage to current infrastructural integrity aside from raising the amount of maintenance costs of the building-apartment complex (Leisure, 2021). Similarly, the current practice of using energy that is driven by fossil fuel, like other urban areas in developing nations, tends to contribute in one degree or another to air or carbon emissions in Asaba (Ozabor et al., 2024). This is apart from limited strict enforcement of current building regulations that could tend to support energy conservation or environmental

preservation (Iwaro & Mwasha, 2010; Ozabor et al., 2018). Furthermore, like other developing nations, current economic limitations often tend to hamper the ability of both real estate builders or private property owners in Asaba to implement sustainable building practices that tend to quickly increase initial costs despite factors that relate to their long-term efficiency.

Traditional architectural knowledge that is disconnected from sustainable, modern architectural ideals is another important consideration in Asaba architectural landscape. Traditional architectural practices that were dependent on locally sourced materials and adapted to climate were undermined by more modern architectural practices that are likely inappropriate for the climate of the region. This disconnection in architectural practice speaks to the development of buildings that are more fragile to weather conditions and energy-hungry. Traditional architectural practices that were dependent on locally sourced materials, as proposed by Dabaieh (2022), reinstated with applications of sustainable technological approaches would be more beneficial in improving architectural performance.

Climate change also creates socio-economic issues for the people of Asaba (Eyetan & Dibosa, 2025). These are the poor who reside in houses with inadequate housing conditions and deteriorating environments. Therefore, slums and poor areas lack adequate infrastructure that exposes inhabitants to heat stress syndrome, floods, and associated health issues (Hambrecht et al., 2022; Nwagbara et al., 2017). Sustainable architecture is therefore relevant in dealing with both environmental issues as well as those related to social equity, including the promotion of sustainable alternatives for healthy housing for the poor. This is in support of the sustainable development objectives of the global community on inclusivity and elimination of inequalities in urban areas (Smets & van-Lindert, 2016).

Despite the recognized significance of sustainable architecture in literature, research that focuses on its application within the built environment of Asaba is very limited. This, by implication, makes it impossible for effective policy formulation and implementation (Onyemenam et al., 2025). Available research is more directed at issues related to sustainable urban development or other Nigerian urban centres with unique climatic and socio-economic factors distinct from that of Asaba (Ogbo, 2011; Ozabor, 2014; Dissanayake et al., 2018). This further necessitates research that considers the unique factors of Asaba environmental setting, their culture, and economic situation in the development of a relevant sustainable architectural concepts (Ogbo, 2011). More importantly, there appears to be a very low awareness and acceptance of sustainable architectural techniques among architects and developers in Asaba. And this seems to be a major hindrance to the implementation of sustainable architecture in the study area.

On the other hand, climate is already changing, and it is expected to get worse in the coming decades, if all things remain equal (Akinola et al., 2020; Famous & Adekunle, 2020). Therefore, there isn't a better time to implement sustainable architecture than now; since sustainable architecture is documented (Ushurhe et al., 2024; Abubakar et al., 2025) to affect climate characteristics in a positive way. Green city components and infrastructure that includes green-roof rainwater harvesting (Famous, 2024) and urban vegetation designs can be incorporated into the urban development and designs to ameliorate the micro-climate situation and be extension improve urban aesthetics (Ozabor & Obisesan, 2015; Almeida et al., 2022, Godspower et al., 2023).

Generally, the application of sustainable architecture in the built settings of Asaba could represent an important policy milestone in the fight against urbanisation related climate change in the area and adjoining locations. While there are serious challenges that exist (that, of course, include but are not limited to, economic constrains, lacunae of regulations, challenges of technical capacities), the implementation of sustainable architecture principles, nevertheless, would establish the possibility of developing sustainable, efficient, and liveable spaces within the built environment of Asaba. This is, of course, without discounting the challenges that would necessitate the continued efforts of policy actors, practitioners, researchers, and communities at large. This would ensure the supervision of the emergence of innovative formulations that would address the proper climatic and socioeconomic needs of Asaba. Going forth, it is, of course, important to foster further developments that would establish the initiations of widespread acceptability for the implementation of sustainable architecture for climate change challenges in Asaba. It is on this point that the need for the implementation of the various objectives of this research became initiated. This study, therefore, attempted to evaluate sustainable architecture trends in the challenges of climate change in the built environment of Asaba, Delta State, Nigeria.

2.1 Conceptual Issues

This study is hinged on the concepts of Climate-Responsive Design and Sustainable Urban Resilience. The main elements of these concept are discussed hereafter.

2.1.1 Climate-Responsive Design

This concept focuses on architectural and urban design strategies that responds directly to the local climatic conditions (such as temperature, humidity, solar radiation, and rainfall) to minimize environmental impact and improve occupant comfort without heavy reliance on mechanical cooling systems (Yang et al., 2011). The concept emphasizes passive cooling, natural ventilation, appropriate building orientation, and the use of local materials adapted to the tropical climate of Asaba.

2.1.2 Sustainable Urban Resilience

This concept refers to the ability of the urban environment, including the built infrastructure, communities, and ecosystems, to anticipate, absorb, and adapt to the shocks and stresses that are caused by climate change (Howarth & Brooks, 2017; Zhang & Li, 2018; Zeng et al., 2022). The concept involves integrating sustainable architecture with urban planning approaches; and therefore, create resilient buildings and neighbourhoods that reduce vulnerability to flooding, heatwaves, and other climate-related hazards that area common in Asaba and environs.

3.0 Materials and methods

3.1 study area

Asaba is the capital of Delta State, which is situated on the western bank of Niger River. Geographically, it is situated west of Onitsha in Anambra State. Asaba is physically situated between latitudes 6°10'N & 6°15'N and longitudes 6°40'E & 6°45'E. It is also

estimated that it is about 43.5KM^2 in area. The study area is a nodal town that connects some of the major Nigerian towns in southern Nigeria. This area is where the administrative, business, and social life of the people takes place Figure 1.

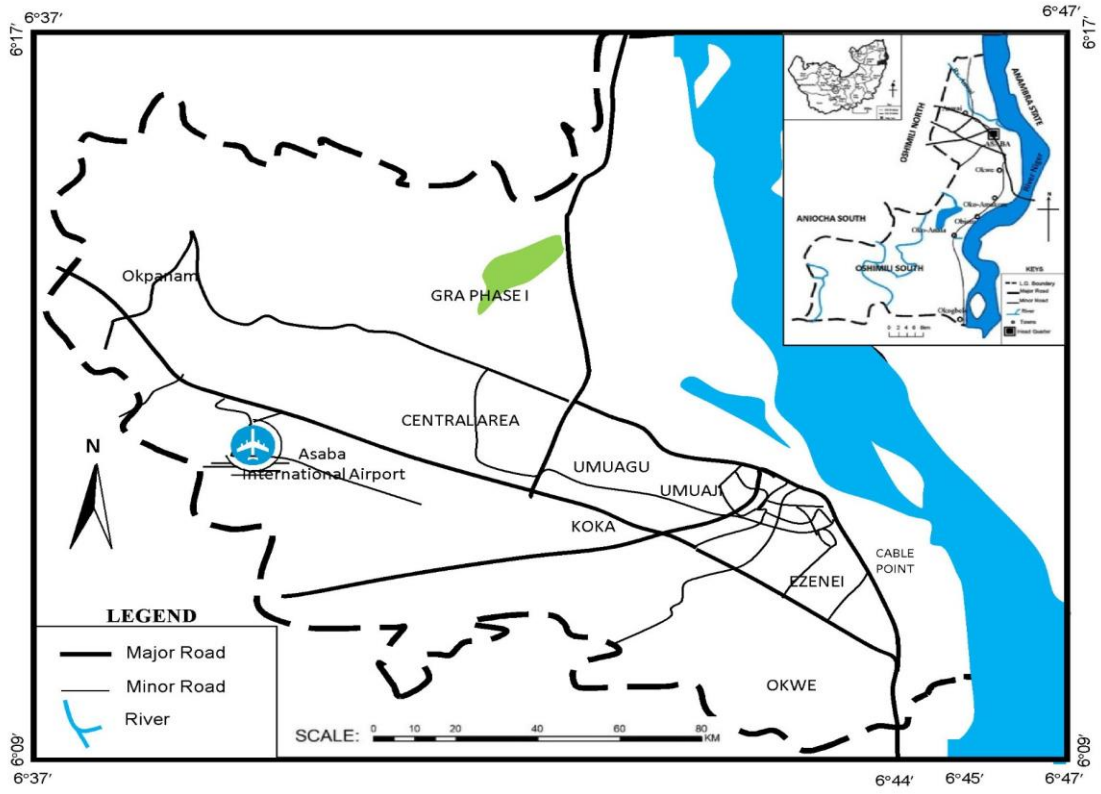

Figure 1. Asaba Area Showing Major Communities
Source: Modified After Ministry of Lands and Surveys, Asaba (2008)

Asaba is an urban area with humid tropical climate characteristics, such as high temperatures ranging between 27°C to 30°C, with relative humidity levels higher than 70% (Ozabor & Ajukwu, 2023). Equally, there is an appreciable level of rainfall, with more than 2,000mm experienced annually, with a wet season from March to October, accompanied by a dry season from November to February. The socio-economic life of Asaba is dominated by governance, business, banking, tourism, education, and small-, medium-scale industries, with conventional markets (Okafor et al., 2024). The increased population of Asaba, with an escalated level of urbanization, is responsible for an intensified process of residential, commercial, and public building constructions. Such constructions tend to avoid climate as much as possible.

The drainage in the Asaba region is affected by the topography and the nearness to the Niger River. The natural drainage courses, which made the region less prone to floods in the past, are now threatened by the lack of proper planning in urbanization and the lack of stormwater infrastructure (Ozabor & Ajukwu, 2023). The natural vegetation in the region includes tropical rain forests, in addition to regrowth and agricultural land (Agbogidi, 2011). However, urbanisation has affected and continues to affect the vegetation in the area negatively. This is exacerbated by the current architecture type developed in the area. All

these create an urban heat island characteristics that further affect the micro climate of the area (Mohammad & Adam, 2010; Ozabor & Ajukwu, 2023).

3.2. Methods

The literature search method was deployed in this study. Academic data bases were consulted and themes such as related to the objectives of this study were used for the searches. Therefore, the themes on sustainable architecture in Asaba and related tropical environments were consulted as well (Donovan, 2020; Mba et al., 2024)

The main databases consulted in the searches included Google Scholar, Scopus, Web of Science, ScienceDirect, among others, tailored to tap into the relevant databases like the African Journals Online (AJOL). This helped to ensure a good collection of the relevant peer-reviewed journals, conferences, theses, government publications, among others (Penev et al., 2017). The searches mainly concentrated on the relevant publications from the past fifteen-year period. This helped to ensure the latest trends concerning research outcomes and advancements (Mba, 2023). Nonetheless, research preceding the above period, though few, still came into consideration whenever they were relevant in the research, although they were limited.

Aside from the utilization of electronic databases, the search also included manual searches on related university repositories, institutional websites, and technical reports of Nigerian environmental departments and urban planning offices for the purpose of embracing grey literature, wherein researches on the subject field, commonly not included in extensive international databases, were emphasized (Messiha et al., 2025). To improve the comprehensiveness of the search results, backward and forward citation searches were made, wherein the reference lists of the key search articles were scrutinized, then followed by the identification of articles containing the cited works (Haddaway et al., 2025). These searches allowed the retrieval of key studies on the subject matter. The search criteria included only researches on sustainable design principles applicable for tropical environments, climate change mitigation or adaptation for the urban context, and case studies found in related countries within the same context as Asaba (Ayeni et al., 2025). Those unrelated to the field of architecture and the environment or was geographically not on point were omitted.

The literature search results were systematically arranged using EndNote. Such a tool was used to enable efficient source categorization and retrieval during the literature search and review process (Lam et al., 1999). The literature was critically evaluated based on relevance, research quality, rigor, and contribution towards comprehending sustainable architecture in a climate-responsive urbane setting. The methodology used in this research therefore considered a literature evaluation in terms of interdisciplinary views, which considered climatology, urban planning, environment, and architecture studies in a bid to create a complete platform for conducting this research in an encompassing manner (Glanz et al., 2016). Through conforming to this systematic literature search methodology, this research established a strong literature search capability with the capability to underpin theoretical and practical offerings towards making sustainable architecture in Asaba in a climate change setting a reality (Ahmed et al., 2025).

4.0. Findings

4.1. The built environment and impacts on climate change

The nexus of connections between the built environment and climate change has been pointed out in the consulted literature. For instance, Kaldeh et al. (2025) analysed 1,745 publications and the author consulted repositories such as web of science and used VOS viewer. The main issues interrogated were energy efficiency, sustainable building materials, and climate-resilient urban planning systems. Their study also pointed out that there existed a shift towards an interdisciplinary approach that combined urban studies, architecture development and environmental sciences (Kaldeh et al., 2025).

All over the world, outputs of studies on this topic has significantly increased, with countries like the United States (USA), United Kingdom (UK), and Germany leading in publication volume and citation impact. The UK has produced a notable proportion of high-impact papers in this regard, thus indicating the international recognition of the role of the built environment in climate mitigation and adaptation (Wang et al., 2023).

Researches emerging out of bibliometric studies (Einecker & Kirby, 2020; Baraj et al., 2024) include climate resilience and adaptation. Hulathdoowage et al. (2024) identified that resilient retrofitting of existing residential buildings has gained prominence as a strategy to address climate impacts in existing buildings. Their scientometric analysis showed that adaptive strategies are important if the goal is improving the climate resilience of the buildings and the built environment. Again, a major theme identified in the literature, is the move towards net-zero energy in buildings. Yoon & Arshid (2025) conducted a comprehensive review that focused on the net-zero energy and greenhouse gas emissions (GHGs) within the built environment, and they pointed out the advancements in technology and policy frameworks that were aimed at reducing carbon footprints of extant buildings. Sustainable building materials have also been identified in the literature. The studies by (Peñaloza et al., 2016) and (Raja et al., 2023) revealed that the use of bio-based materials has been shown to lower embodied energy and lifecycle emissions in construction. Studies (Fenner et al., 2018; Wang et al., 2024) indicate that integrating these materials in the building of residential homes contributes to reduce the overall carbon impact of buildings. As in other areas and identified in literature, it is proposed that these methods could be applied in Asaba.

Despite progress in the area of sustainable buildings and architecture, several gaps remain unexplored. There is a need for better integration of remote sensing technologies and artificial intelligence. Which should target a more accurate assess to climate adaptation measures in urban areas (Rezvani et al., 2023). Additionally, research findings often struggle to translate into actionable policies for urban planners and decision-makers to use. Therefore, there exist a gap between science and policy implementation in the area of sustainable buildings. Furthermore, tailoring climate adaptation strategies to local contexts is usually a struggle, as some data for key decision making might be lacking, also regional climate variations and cultural factors, remains underexplored, even though they are essential for effective mitigation and adaptation to the built environmental and sustainable architecture (Poulsen et al., 2020).

Generally, bibliometric reviews showed that the field exploring the built environment and its impacts on climate change is still evolving. The interdisciplinary approaches have formed a bulk of the researches. Therefore, continued research is essential to address existing gaps that are yet to be explored, particularly in areas of data integration, policy translation, and localized solutions, to build more resilient and sustainable urban environments especially with the rates at which climate is changing globally, and in Asaba.

4.2 Sustainable design strategies adaptable to tropical climates.

Research on sustainable design strategies for tropical climates has grown steadily. This shows the urgent need to develop building solutions that can address the unique challenges that posed by hot and humid environments (Omer, 2008). Bibliometric studies (Shi & Liu, 2019; Li et al., 2021) assessed have shown that the volume of publications on this topic of sustainable architectural strategies has increased over the past decade or so. A major focus has been on passive cooling techniques, natural ventilation, and use of locally sourced materials (Al-Shamkhee et al., 2022). A bibliometric mapping study using VOSviewer by Tushar et al. (2023) assessed over 900 articles from major databases, and identified clusters of researches on green building technologies, climate-responsive architectural designs, and renewable energy integration in tropical settings.

Geographically, the production of research is dominated by tropical nations such as Brazil, India, Malaysia, and Nigeria. These places do not only produce the greatest number of publications in the research field but also influence climate-adaptive, sustainable architectural designs concerning their own local demands (Stephen & Aigbavboa, 2025). Global collaboration has also risen. This reflects a multidisciplinary approach by architects, engineers, environmental researchers, and urban planners (Butt & Dimitrijević, 2022). Some of the major topics that have arisen through bibliometric studies include passive design techniques such as shading devices, cross-ventilation systems, building orientation, and green roofs that are widely explored for their efficiency in heat stress alleviation without much emphasis on air-conditioning (De-Cristo et al., 2025). Chandel et al. (2016) noted that various research works (Lehmann, 2013) emphasized the need for the application of ancient architectural elements (such as verandas, courtyards, and light materials) with more recent sustainable technology, denoted by hybrid architectural design that suits tropical climate settings. As in other areas, the Asaba construction industry would also be able to accommodate room for sustainable architecture.

Another major area of focus is the use of sustainable materials that reduce embodied energy and improve indoor thermal comfort (Latha et al., 2015). Researchers emphasized the value of using bio-based materials and recycled components tailored for humid conditions to enhance building durability and environmental performance (Bourbia et al., 2023) and Asaba can benefit from such strategies. Additionally, recent bibliometric studies pointed to the increasing attention on renewable energy solutions in buildings, such as solar-powered ventilation systems and rainwater harvesting. All of these complement sustainable designs in tropical regions (Obaideen et al., 2023), and Asaba being a tropical environment can benefit from such strategies.

However, bibliometric reviews also identify gaps that included limited research on the long-term performance and cost-effectiveness of sustainable design strategies in tropical

climates, as well as insufficient data on occupant behaviour and comfort (Li et al., 2025). Furthermore, there is a need for more location-specific studies. This is because microclimatic variations and cultural practices to optimize design recommendations are always central to the discuss of sustainable architecture (Sanagustín-Fons et al., 2025).

In all, bibliometric analyses demonstrate growing scholarly interest and diverse approaches to sustainable design in tropical climates, with scant of it coming from Nigeria and Asaba. Emphasis on passive design, sustainable materials, and renewable energy integration have shown dominance in the current research (Weli & Famous, 2018). Therefore, addressing identified gaps through interdisciplinary and region-specific studies can enhance the practical application and effectiveness of sustainable design strategies adaptable to tropical environments such as Asaba.

4.3. Climate change and sustainable architecture: Global to Local (Asaba) Perspectives

Researches (Sheweka & Mohamed, 2012; Anh et al., 2021) on the relationship between climate change and sustainable architecture has greatly expanded recently, this shows the global urgency to mitigate environmental impacts and adapt buildings to changing climatic conditions (Javadinejad et al., 2019; Ushurhe et al., 2024). The bibliometric analyses revealed a robust growth in publications that keenly focused on sustainable building practices that reduce greenhouse gas emissions, improve energy efficiency, and enhance climate resilience (Streimikiene et al., 2024). Globally, research clusters emphasized passive design, renewable energy integration, and the use of low-impact materials as key pillars of sustainable architecture (Ozabor et al., 2025; Jain & Babu, 2024).

At the international level, the United States, China, and the European Union dominate in the publication landscape, driving innovations in green building technologies and climate-responsive urban planning (Miletić et al., 2025). Increasingly, however, local and regional contexts are receiving attention, particularly in the most vulnerable tropical cities-as is the case of Asaba, Nigeria-facing challenges driven by climate change in rising temperatures, increased rainfall variability, and flooding risks (Awolesi, 2025).

Local studies (Momodu et al., 2012) related to the practice of sustainable architecture in Asaba are limited but increasingly there are a few that focus on the need for adaptation of global principles to local environmental conditions. Alegbe et al., 2025, through a bibliometric mapping of literature on sustainable architecture in tropical West African cities, observe that studies from Nigeria relate mainly to climate-responsive building designs. Also, they found that the use of indigenous materials, and community-based adaptation strategies were receiving some attention in the literature. Such approaches address the unique climatic stresses and prevailing socio-economic realities such as in Asaba. Therefore, these studies align with the broader sustainable development goals.

A thematic area that seems consistently relevant both internationally and locally involves bringing traditional building knowledge together with current practice in sustainability. Researchers indicate that vernacular architecture has a positive impact on indoor comfort and mechanical cooling demand due to natural ventilation, thick-wall thermal mass, and shaded courtyards (Mirrahimi et al., 2016). Simultaneously, solar panels, rainwater catchment, and smart energy management systems are increasingly part of local designs that balance innovation with tradition (Partzsch, 2009). Additionally, bibliometric evidence

(Ece-Kaya & Erbaş, 2024) indicates that, while research on climate change and sustainable architecture has matured through out the world to become diverse, local perspectives such as those from Asaba are still emerging and near non extant. A bridge between the global and the local through context-specific studies and integrated approaches will, therefore, be crucial for the development of sustainable, climate-adaptive built environments in vulnerable regions of the tropics (Asaba inclusive).

4.4. Sustainable architectural design strategies for climate adaptation and mitigation in urban settings: case studies from Nigerian

Research into sustainable architectural design strategies for climate adaptation and mitigation in Nigerian urban areas has gradually gained momentum in the literature. This is due to the exposure of the country to climate change. This manifest in flooding, heat stress, and resource depletion. Bibliometric analyses points to a growing body of literature that centres on practical design interventions that improves the resilience of urban areas while reducing carbon footprints (Marvuglia et al., 2020). Passive cooling techniques, energy-efficient building technologies, and integrating green infrastructure into high-density urban areas remain common study areas.

The research output on urban issues in Nigeria is concentrated mainly in major cities such as Lagos, Abuja, and Port Harcourt – Lagos is now a hotspot for research into eco-friendly city design because it's growing so fast and has some big environmental problems.

A cursory look at the literature clearly shows that experts are trying to develop new designs that are booth eco-friendly and culturally accepted in Nigeria. Therefore, ancient building techs such as shaded porches and thick walls can be implemented (Toroxel & Silva, 2024), these techniques not only improve the indoor conditions of buildings, but also they improve the outdoor micro climate conditions (Cosentino et al., 2024; Barbhuiya et al., 2025).

Evidence from articles in Nigeria evidently shows greening and water smart designs not only improve the outdoor weather conditions in the vicinity of the buildings, but also they boost plant population and increase the number of carbon sinks in the environment (Abubakar, 2024). Therefore, in this study the authors advance that these evidences that abound in studies carried out in other tropical regions be implemented in the Asaba region. And these sustainable architectural strategies have been proven to ameliorate weather and control flooding issues in urban areas. A case in point is the Eko Atlantic in Lagos (Unegbu et al., 2024).

In Portharcourt literature show that simple design, plus new insulation and shading, have cit down electricity usage (Dawaye & Enwin, 2021). However, it remains to be seen whether, this new design will sustain the improvements in climate or whether Nigerians would sustain the implementations of these designs (Unegbu et al., 2025). This is where policy direction and implementation become key (Circo, 2007; Ajirotutu et al., 2024). In this regard such policy makes it compulsory to construct buildings that are eco-friendly and by implication help the climate (Roseland, 2000; Sheppard et al., 2024).

5.0. Discussion

The combination of buildings and climate change in Asaba is fast becoming paramount to ponder on (Ogbogo et al., 2025). The area is fast-developing and hot in nature and makes it particularly susceptible to problems such as heat (Ozabor & Ajukwu, 2023), flood (Ozabor & Wodu, 2016) and weird weather (Ojeh & Ozabor, 2013). There are some Nigeria studies which provide us a way belter idea on how to twist designs in the tropic which could also be used for Asaba weather situation. For example, climate-smart buildings in Nigeria have to be built with old-school thinking like thick walls, shady porches and open-air flow as by advanced by Ndem et al. (2025). Applications of climate smart ideas to building keeps houses cool without using tons of power for cooling (Ozabor et al., 2024). Studies (Yusuf, 2021; Ogbonda, 2017) done around the Niger Delta, (where Asaba is located), show that using earth-friendly materials and chill design tricks is a good plan to keep buildings from hurting the world around them.

Locally sourced materials like clay bricks and bamboo are gaining popularity due to the fact that they require less energy for production. Mixing these with intelligent designs and shading, one can maintain a comfort zone indoors as well as sort out the problem of weather outside (Kulkarni et al., 2024). Other major cities in Nigeria, Portharcourt, Onitsha, face the same problem as Asaba. Due to their rapid growth, they face unplanned areas, lack of proper infrastructure, making the problem of floods and heatwaves more severe. A study revealed that trees and surfaces that can absorb water could help in reducing the effects of heat in the major areas of Asaba as well as sort out the problem of rainwater. This aligns with planning an eco-friendly city in the context of Nigeria (Ogunde et al., 2018). Moreover, this indicates that, in order to cope with the problem of climate change in Asaba, one should look beyond buildings. Real-life instances from Asaba support the point that mixing traditional architectural designs with modern technology designs an ambiance. One study (Passe & Battaglia, 2015) reported that designing buildings with the inclusion of elements such as courtyards and proper ventilation reduces the need for air-conditioning units. Solar energy, still in its infancy, looks quite appealing as well (Hayat et al., 2019). Tests are being conducted in Asaba on implementing solar water heaters and lights, although no research work has been conducted in this context. All this indicates that implementing the usage of green energy sources can make a lot of difference in coping with the energy problems in Asaba. However, there isn't much information on the efficacy of these designs in the local climate of Asaba. Moreover, there are limited studies on human behavior in these buildings (Janda, 2011). Delta State sources sometimes overlook the point that they should command the usage of green architectural practices as the city expands. Therefore, the collaboration of local bodies, designers, and inhabitants in overcoming the hurdles can be considered.

Generally, sustainable architecture in Asaba should be steeped in local climatic conditions and socio-economic realities. Judging from the body of research available locally on Nigeria-specific research, the way forward will be to integrate indigenous design wisdom into contextually appropriate renewable energy technologies and urban greening (Ullah et al., 2024). The applications of researches in the area of sustainable architecture, by the enforcement of policies will allow the built environment of Asaba to adapt to and mitigate climate change related impacts. This can effectively be a model for similar tropical cities (Asaba inclusive) in Nigeria and beyond.

6.0. conclusion and policy options

Sustainable architectural design in Asaba must adopt locally relevant climate adaptation and mitigation strategies. These strategies must flow from an understanding of the local climate conditions of the place. That is putting in mind that the environment of Asaba is a tropical one. Also, such strategies must put into consideration rapid urban expansion and socio-economic realities of Asaba and environs. This is because, while global frameworks provide useful information and data on passive cooling, energy-efficient building envelopes and green infrastructure, direct application without localising the applications of it, could result in failure to address the specific environmental and cultural conditions of Asaba.

Local studies underlined the value of vernacular approaches. These approaches included wide overhangs, use of shaded courtyards, and well-planned cross-ventilation. Also, affordable innovations such as reflective roofing sheets and permeable pavements (that reduce heat gain and manage stormwater) have been enumerated in the literature. These strategies, when integrated with contemporary sustainable design principles, have been shown in literature to improve thermal comfort, reduce energy demand and limit greenhouse gases (GHGs) emissions, particularly in low- and medium-income housing in cities of developing countries (Asaba inclusive).

Policy responses should therefore focus on revising the planning codes applicable in Asaba. This should include as prerequisites to building and construction passive design elements and enforce material performance standards which are suitable in humid climates. Additionally, incentives for developers who integrate energy-efficient and water-sensitive features in new housing estates should be initiated. There is also a need to promote showcase cost-effective building prototypes. These buildings should be climate-responsive designs that adapted locally sourced materials. This will foster public acceptance and initiate replication. Furthermore, embedding sustainable design training in the Delta State Ministry of Housing programs for developers will help ensure that climate adaptation principles are mainstreamed into practice. This will create an urban environment in Asaba that is both resilient and environmentally sustainable.

7.0. References

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