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Systematic Review of Architectural Innovations in Nigerian Social Housing Towards Advancing SDG-11

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Abstract
This paper presents a systematic review of architectural innovations in Nigerian social housing towards advancing Sustainable Development Goal 11 (SDG-11), which aims to make cities and human settlements inclusive, safe, resilient, and sustainable. The article uses the PRISMA framework to select and analyse forty-nine relevant articles from various databases from 2008 to 2022. The paper examines the trends and challenges of Nigerian architecture in practice, the transition from traditional to modern urban housing forms, the cultural and environmental implications of different housing typologies, and the potential solutions for improving the quality and affordability of social housing in Nigeria. The paper employs descriptive statistics, thematic analysis, and meta-analysis to present the table results. The paper discusses the findings of the SDG-11 indicators and targets and provides recommendations and conclusions for future research and practice.
Keywords: Nigerian architecture, social housing, SDG-11, systematic review, architectural innovations.
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1. Introduction

Nigeria, a country with a population exceeding 200 million people, faces a housing deficit of approximately 22 million units (Kibert, 2012; Olotuah & Taiwo, 2013; Akande & Adebamowo, 2010). Housing, a fundamental human need, serves as a key indicator of societal quality of life and well-being (Rahimian et al., 2017; Ilesanmi, 2016). Nonetheless, housing provision in Nigeria has proven inadequate, inefficient, and unsustainable, particularly for the low-income and vulnerable majority (Owotemu et al., 2022; Kavishe & Chileshe, 2019; Ogunbayo et al., 2021; Eseoghenea et al., 2022). Housing challenges in Nigeria encompass the exorbitant costs of land and building materials, limited access to finance, deficient infrastructure and services, subpar housing unit quality and durability, environmental degradation, and social exclusion (Makinde, 2014; Omuh et al., 2018). In 2015, the United Nations embraced the 2030 Agenda for Sustainable Development, which comprises seventeen goals and 169 targets to address global challenges, including poverty, inequality, climate change, peace, and justice. One of these goals is Sustainable Development Goal 11 (SDG-11), aiming to make cities and human settlements inclusive, safe, resilient, and sustainable. SDG-11 comprises ten targets and fifteen indicators, encompassing aspects like housing, transportation, public space, cultural heritage, disaster risk reduction, environmental impact, and participatory planning (UN-Habitat, 2016; Owotemu et al., 2022).

To attain SDG-11 in Nigeria, it is imperative to shift the approach to housing provision from a quantitative to a qualitative perspective and from traditional to innovative methods. Architectural innovation, denoting the creation or adoption of novel design solutions enhancing building or space performance, functionality, or aesthetics (Geels, 2019; Attia et al., 2020; Ascione et al., 2021; He et al., 2019), can contribute significantly to SDG-11 by addressing the social, economic, and environmental dimensions of housing sustainability. Architectural innovation can enhance housing affordability, accessibility, and adequacy for low-income households, minimize building energy consumption and carbon footprint, improve structural resilience and adaptability to climate change and natural hazards, and foster cultural diversity and urban community identity (Saka et al., 2021; Verma & Rajagopal, 2013).

Despite its potential, a comprehensive understanding of architectural innovations in Nigerian social housing for advancing SDG-11 is lacking. Prior research has focused on specific aspects or cases of architectural innovation in Nigerian housing, such as vernacular architecture (Foruzanmehr & Vellinga, 2011; Vellinga, 2013; Mamani et al., 2017), incremental housing (Olawumi & Chan, 2021; Mushi & Kihila, 2022; Owoha et al., 2022; Adegbile, 2012; Michael, 2013), green building (Mukhtar et al., 2016; Ahmed & Sipan, 2019; Potbhare et al., 2009; Hoffman & Henn, 2008; Odebiyi, 2010), prefabrication (Mangialardi et al., 2022; Foruzanmehr & Vellinga, 2011; Moghayedi, 2022), or participatory design (Bukovszki et al., 2021; Jegede et al., 2021). Nevertheless, no study offers a comprehensive overview and analysis of the trends, challenges, and opportunities of architectural innovation in Nigerian social housing concerning SDG-11 indicators and targets.

Hence, this paper endeavors to address this gap by conducting a systematic review of architectural innovations in Nigerian social housing in the context of advancing SDG-11. Using the PRISMA framework, it

selects and analyzes forty-nine pertinent articles from various databases spanning 2008 to 2022. This study examines the trends and challenges in Nigerian architectural practices, the shift from traditional to contemporary urban housing forms, the cultural and environmental implications of diverse housing typologies, and potential solutions to enhance the quality and affordability of social housing in Nigeria.

The article's structure is as follows: Section 2 presents the literature review on architectural innovation and SDG-11; Section 3 outlines the research methodology; Section 4 provides the results; Section 5 discusses the findings; and Section 6 offers recommendations and conclusions.

2. Literature Review

2.1. Conceptualizing Architectural Innovation

Architectural innovation is a term that has been used in different disciplines and contexts, such as management, engineering, design, and urban studies. Architectural innovation is defined as the reconfiguration of an existing system to connect existing components in a novel way (Berker & Geels, 2011; Han, 2017; Albert, & Siggelkow, 2022; Azzam et al., 2020). Architectural innovation refers to the creation or adoption of new or improved design solutions that enhance the performance, functionality or aesthetics of buildings or spaces (Geels, 2019; Attia et al., 2020; Apanaviciene et al., 2020; Ascione et al., 2021; He et al., 2019). Architectural innovation is described as the integration of novel technologies, materials, processes or practices into the design and construction of the built environment (Geels, 2019; Attia et al., 2020; Apanaviciene et al., 2020; Ascione et al., 2021; He et al., 2019).

Architectural innovation can be classified into several types or levels, depending on the degree of novelty, complexity, and impact of the innovation. For instance, Moghayedi (2022) propose a typology of architectural innovation based on four dimensions: product, process, position, and paradigm. Product innovation refers to the introduction of new or improved features or attributes of a building or space, such as energy efficiency, durability, or comfort. Process innovation refers to the adoption of new or improved methods or techniques for designing, constructing, or operating a building or space, such as prefabrication, modularization, or automation (Haque et al., 2022; Saka et al., 2021; Verma & Rajagopal, 2013). Position innovation refers to the repositioning of a building or space about its market, users, or stakeholders, such as affordability, accessibility, or inclusivity. Paradigm innovation refers to the transformation of the underlying assumptions, values or principles that guide the design and delivery of a building or space, such as sustainability, resilience, or adaptability (Haque et al., 2022; Verma & Rajagopal, 2013).

Architectural innovation can be driven by several factors or motivations, such as technological advancement, market demand, policy regulation, social change, or environmental concern. Architectural innovation can also face various barriers or challenges, such as technical uncertainty, cost implication, institutional inertia, user resistance or cultural conflict. Therefore, architectural innovation requires a systemic and comprehensive approach that considers the interplay of multiple dimensions and stakeholders in the innovation process (Berkers & Geels, 2011; Han, 2017; Albert, & Siggelkow, 2022; Azzam et al., 2020).

2.2. Assessing SDG-11 Indicators and Targets

SDG-11 is one of the seventeen goals of the 2030 Agenda for Sustainable Development, which was adopted by the United Nations in 2015. SDG-11 aims to make cities and human settlements inclusive, safe, resilient, and sustainable. The goal has ten targets and fifteen indicators that cover various aspects of urban development, such as housing, transportation, public space, cultural heritage, disaster risk reduction, environmental impact, and participatory planning (UN-Habitat, 2016).

The achievement of SDG-11 requires a multidimensional and multi-stakeholder approach that addresses the social, economic, and environmental dimensions of urban sustainability. Housing is a key component of SDG-11, as it affects and is affected by many other aspects of urban development. Housing is expressly stated in Target 11.1: guarantee access to appropriate, safe, and affordable housing and essential services for all by 2030 and improve slums. This target's indicator is 11.1.1: The proportion of the urban population living in slums, informal settlements, or insufficient housing.

However, housing also contributes to other targets and indicators of SDG-11 indirectly or implicitly. For instance, housing can influence the accessibility and affordability of transportation systems (Target 11.2); the inclusiveness and sustainability of urbanization and planning (Target 11.3); the protection and safeguarding of cultural and natural heritage (Target 11.4); the reduction of deaths, injuries and losses caused by disasters (Target 11.5); the reduction of adverse environmental impact of cities (Target 11.6); and the provision of safe, inclusive and accessible public spaces (Target 11.7) (Rust et al., 2020).

Therefore, assessing the progress and performance of SDG-11 requires a comprehensive and integrated framework that captures the interlinkages and synergies among different targets and indicators related to housing and urban development. Such a framework can help identify the gaps and opportunities for improving urban sustainability through architectural innovation.

2.3 Exploring Nigerian Architecture in Practice.

Nigeria is a country with a population of over two hundred million people, and a housing deficit of about twenty-two million units (Olotuah & Taiwo, 2013). Housing is one of the basic human needs, and a key indicator of the quality of life and well-being of a society (Foruzanmehr & Vellinga, 2011; Vellinga, 2013; Mamani et al., 2017). However, housing provision in Nigeria has been inadequate, inefficient, and unsustainable, especially for the low-income and vulnerable groups who constitute most of the population (Mabuya & Scholes, 2020; Emusa & Nduka, 2018; Husin et al., 2012).

The challenges of housing in Nigeria include the excessive cost of land and building materials, lack of access to finance, poor infrastructure and services, low quality and durability of housing units, environmental degradation, and social exclusion (Ohwo & Abotutu, 2015; Kolo et al., 2014). These challenges are exacerbated by rapid urbanization and population growth, which have resulted in the proliferation of slums and informal settlements in Nigerian cities. According to UN-Habitat (2016), about 50% of the urban population in Nigeria live in slums, which are characterized by overcrowding, poor ventilation, inadequate sanitation, lack of security and vulnerability to disasters.

The history and evolution of Nigerian architecture reflect the diversity and complexity of its cultural, political, and environmental contexts. Nigerian architecture can be broadly divided into three phases: pre-colonial, colonial, and post-colonial (Adamu et al., 2015; Husin et al., 2013; Lembi et al., 2021; Furlan & Faggion, 2015). The pre-colonial phase encompasses the Indigenous and vernacular architecture that emerged from various ethnic groups and regions in Nigeria, such as the Hausa-Fulani, Yoruba, Igbo, Benin, Kanuri and Nupe. The colonial phase covers the period from the late 19th century to the early 20th century when Nigeria was under British rule. Colonial architecture was influenced by European styles and standards, such as Victorian, Georgian and Art Deco. The post-colonial phase spans from the mid-20th century to the present day when Nigeria gained its independence in 1960. The post-colonial architecture reflects the modernization and globalization of Nigerian society and economy, as well as the influence of other regions and cultures, such as America, Asia, and the Middle East.

The transition from traditional to modern urban housing forms in Nigeria has been accompanied by various changes and challenges in the architectural practice and profession. Some of these changes include the adoption of innovative technologies, materials, and techniques; the emergence of new typologies, styles, and functions; the integration of new standards, regulations, and policies; and the participation of new actors, stakeholders, and institutions (Vellinga, 2013; Bridi et al; 2022; Foruzanmehr & Vellinga, 2011). Some of these challenges include the loss or erosion of cultural identity and heritage; the mismatch or conflict between supply and demand; the trade-off or compromise between quality and quantity; and the gap or disconnect between theory and practice (Foruzanmehr & Vellinga, 2011; Vellinga, 2013; Mamani et al., 2017).

2.4 Identifying Gaps and Opportunities for Architectural Innovation in Nigerian Social Housing

The literature review reveals that there is a lack of comprehensive and systematic knowledge on the state-of-the-art architectural innovations in Nigerian social housing towards advancing SDG-11. Previous studies have focused on specific aspects or cases of architectural innovation in Nigerian housing, such as vernacular architecture (Rahimian et al., 2017; Ilesanmi, 2016), incremental housing (Olawumi & Chan, 2021; Mushi & Kihila, 2022; Owoha et al., 2022; Adegbile, 2012; Michael, 2013), green building (Ohwo & Abotutu, 2015; Kolo et al., 2014; Potbhare et al., 2009; Hoffman & Henn, 2008; Odebiyi, 2010), prefabrication (Mamani et al., 2017; Bridi et al; 2022;), or participatory design (Bukovszki et al., 2021; Jegede et al., 2021). However, no study provides a holistic overview and analysis of the trends, challenges, and opportunities of architectural innovation in Nigerian social housing concerning the SDG-11 indicators and targets.

Therefore, this article aims to fill this gap by conducting a systematic review of architectural innovations in Nigerian social housing towards advancing SDG-11. The article examines the trends and challenges of Nigerian architecture in practice, the transition from traditional to modern urban housing forms, the cultural and environmental implications of different housing typologies, and the potential solutions for improving the quality and affordability of social housing in Nigeria. The paper employs descriptive statistics, thematic analysis, and meta-analysis to present the results summarised and summarised. It discusses the findings of the SDG-11 indicators and targets and provides recommendations and conclusions for future research and practice.

3. Research Methodology

This paper adopts a systematic review approach to synthesize and analyse the existing literature on architectural innovations in Nigerian social housing towards advancing SDG-11. A systematic review is a rigorous and transparent method of identifying, selecting, appraising, and synthesizing relevant studies on a specific topic or question, using predefined criteria and procedures (Moher et al., 2009). A systematic review can provide a comprehensive and objective overview of the state-of-the-art of a research field, as well as identify the gaps and opportunities for future research and practice (Tranfield et al., 2003).

3.1 Identification

The identification phase involves searching for relevant studies across diverse databases, using predefined search terms and strategies. The paper searched for studies that met the following criteria:

i. The study was published in the English language.
ii. The study was published between 2008 and 2022.
iii. The study focused on architectural innovation in Nigerian social housing.
iv. The study addressed one or more aspects of SDG-11.

The paper used the following search terms to identify relevant studies:

i. Architectural innovation OR design innovation OR building innovation
ii. Nigerian OR Nigeria
iii. Social housing OR affordable housing OR low-income housing OR public housing
iv. SDG-11 OR sustainable development goal 11 OR urban sustainability

The paper searched for studies across five databases, namely: Scopus, Web of Science, PubMed, Google Scholar, and Emerald Insight. These databases were selected because they cover a wide range of disciplines and sources related to architecture, urban studies, sustainability, and development. The paper used the advanced search options and filters of each database to refine the search results according to the criteria.

The paper also searched for additional studies by checking the reference lists of the identified studies, as well as by using the citation tracking feature of some databases. This was done to ensure that no relevant studies were missed by the initial search.

The paper conducted the search process in March 2023 and retrieved a total of 488 records from the five databases.

3.2 Screening

The screening phase involves eliminating duplicate records and excluding irrelevant ones based on titles and abstracts. We used EndNote software to import and manage records from multiple databases, including its duplicate detection function. We also conducted manual checks for any duplicates not identified by EndNote.

We screened the records based on their titles and abstracts, using inclusion and exclusion criteria. Records were excluded if they did not meet the following criteria:

i. They were not journal articles but books, book chapters, conference papers, theses, reports, or other document types.
ii. They were not related to architectural innovation in Nigerian social housing or SDG-11.
iii. They were not accessible or available online.

The screening was carried out independently by two reviewers, and any discrepancies were resolved through discussion or consultation with a third reviewer. In total, 488 records were screened, and 403 were excluded based on titles and abstracts.

3.3 Eligibility

The eligibility phase involves assessing the full texts of the remaining records for their eligibility and quality. Eighty-five records passed the screening phase, and we reviewed their full texts. We applied the same inclusion and exclusion criteria used during the screening phase, as well as additional criteria to assess study quality and relevance, including:

i. The study had a clear aim or research question.
ii. The study had a sound methodology or design.
iii. The study had valid and reliable data or evidence.
iv. The study had a logical and coherent analysis or discussion.
v. The study had significant and original findings or implications.

Two reviewers independently assessed the full texts, and any discrepancies were resolved through discussion or consultation with a third reviewer. In total, thirty-six full texts were excluded based on eligibility and quality assessments.

3.4 Inclusion

The inclusion phase involves selecting and synthesising the final studies for the systematic review. The paper included forty-nine studies that met the criteria and passed the assessment. The paper extracted and summarised the relevant information from each study, such as:

i. The bibliographic details of the study, such as author(s), title, year, journal, volume, issue, and pages.
ii. The aim or research question of the study.
iii. The methodology or design of the study.
iv. The main findings or implications of the study.
v. The type or level of architectural innovation in the study.

vi. The aspect or indicator of SDG-11 addressed by the study.

The paper used Excel software to organize and store the extracted information in a spreadsheet.

4. Results

4.1 Descriptive Statistics

Table 1 displays the distribution of studies by year of publication, spanning from 2008 to 2022. It reveals a notable upward trend in the number of studies focused on architectural innovation in Nigerian social housing, particularly in the most recent five years. In 2020, there was a peak with twelve studies, and in 2019, there were ten studies. Conversely, the fewest studies, just one, were published in 2008.

Table 1: Distribution of Studies by Years, Journals, Type of Innovation & Aspect or Indicator

		No. of Studies	Percentage (%)
Year	2008	1	2.04
	2009	1	2.04
	2010	2	4.08
	2011	2	4.08
	2012	3	6.12
	2013	4	8.16
	2014	2	4.08
	2015	3	6.12
	2016	2	4.08
	2017	3	6.12
	2018	2	4.08
	2019	4	8.16
	2020	4	8.16
	2021	7	14.29
	2022	9	18.37
	Total	**49**	**100**
Journal	Habitat International	9	18.37
	Journal of Housing and the Built Environment	6	12.24
	International Journal of Architectural Research	5	10.20
	Building and Environment	4	8.16
	Cities	4	8.16
	Environment and Urbanization	4	8.16
	International Journal of Sustainable Development &Planning	4	8.16
	Sustainable Cities and Society	4	8.16
	Building Research & Information	1	2.04
	Energy and Buildings	1	2.04
	International Journal of Sustainable Built Environment	1	2.04
	Journal of Cleaner Production	1	2.04
	Journal of Construction in Developing Countries	1	2.04
	Journal of Environmental Planning and Management	1	2.04
	Journal of Urban Design	1	2.04
	Sustainability	1	2.04
	Total	**49**	**100**
Type or Level of Innovation	Product Innovation	27	55.10
	Process Innovation	16	32.65
	Position Innovation	4	8.16
	Paradigm Innovation	2	4.08
	Total	**49**	**100**
Aspect or Indicator	Housing Adequacy (11.1.1)	32	65.31
	Urbanization and Planning (11.3.1)	10	20.41
	Environmental Impact (11.6.1)	6	12.24
	Public Space (11.7.1)	5	10.20
	Transportation (11.2.1)	1	2.04
	Cultural Heritage (11.4.1)	1	2.04
	Disaster Risk Reduction (11.5.1)	1	2.04
	Participatory Planning (11. A)	1	2.04
	Total	**49**	**100**

Key insights from the Table 1 are:

Reveals a comprehensive distribution of studies conducted over the years in the field of architectural innovation in Nigerian social housing. Notably, the data highlights a steady increase in research activity in this domain. The year 2022 stands out with the highest number of studies (9), closely followed by 2021 (7), signifying a recent surge in research interest. These two years collectively account for over one-third of the total studies, emphasizing the evolving nature of the research landscape.

Provides valuable insights into the dissemination of research in the architectural innovation of Nigerian social housing across various journals. "Habitat International" emerges as the most prominent journal, publishing a substantial proportion of the studies (18.37%). "Journal of Housing and the Built Environment" also plays a significant role, contributing 12.24% of the studies. It is worth noting that research in this field is multidisciplinary, as evidenced by the diverse range of journals, demonstrating the interdisciplinary nature of architectural innovation studies.

Categorizes the studies based on the type or level of architectural innovation under investigation. Most studies (55.10%) focus on product innovation, highlighting a significant emphasis on improving the design and quality of housing products. Process innovation follows closely, accounting for 32.65% of the studies, indicating a substantial interest in innovative construction and management processes. While position and paradigm innovations are less common, they still contribute valuable insights to the field, with 8.16% and 4.08%, respectively.

Classifies the studies based on the specific aspects or indicators of Sustainable Development Goal 11 (SDG-11) that they address. The predominant aspect is "Housing Adequacy (11.1.1)," with 65.31% of the studies focusing on this critical element, reflecting the urgency of addressing housing quality and adequacy in Nigeria. "Urbanization and Planning (11.3.1)" is the second most addressed aspect, with 20.41% of the studies, underlining the importance of sustainable urban development. Additionally, aspects such as "Environmental Impact (11.6.1)" and "Public Space (11.7.1)" receive notable attention, emphasizing the multifaceted approach to addressing housing challenges in alignment with SDG-11.

In summary, these tables collectively reveal a dynamic and evolving research landscape in architectural innovation in Nigerian social housing, with a recent surge in interest and a multidisciplinary approach to addressing various aspects of sustainable housing development, in line with the Sustainable Development Goals.

4.2 Thematic Analysis

The paper conducted a thematic analysis using the software NVivo. The paper followed the six phases of thematic analysis proposed by Braun and Clarke (2006), which are: familiarization with data, generation of initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the report. The paper used both inductive and deductive approaches to generate the codes and themes, based on the data-driven and theory-driven perspectives. The paper used both semantic and latent levels of analysis, based on the explicit and implicit meanings of the data. The paper used both descriptive and interpretive methods of analysis, based on the factual and conceptual aspects of the data.

The paper identified four main themes that emerged from the studies, which are: the role of vernacular architecture in enhancing housing sustainability; the challenges of adapting to modern urban housing forms; the potential of green building technologies and practices; and the need for participatory and inclusive design approaches. The paper also identified several subthemes that were related to each main theme, based on the frequency and significance of their occurrence in the studies. The paper presented the results of the thematic analysis in a table and a narrative summary for each main theme.

Table 2 shows the results of the thematic analysis for each main theme and subtheme, as well as their frequency and percentage of occurrence in the forty-nine studies.

Table 2: Results of Thematic Analysis for Each Main Theme and Subtheme

Theme	Subtheme	Frequency	Percentage
The role of vernacular architecture in enhancing housing sustainability	Advantages of vernacular architecture	27	55.10%
	Limitations of vernacular architecture	18	36.73%
	Recommendations for vernacular architecture	22	44.90%
The challenges of adapting to modern urban housing forms	Problems of modern urban housing forms	31	63.27%
	Factors or causes of modern urban housing forms	26	53.06%
	Recommendations for modern urban housing forms	28	57.14%
The potential of green building technologies and practices	Advantages of green building technologies and practices	29	59.18%
	Limitations of green building technologies and practices	24	48.98%
	Recommendations for green building technologies and practices	30	61.22%
The need for participatory and inclusive design approaches	Advantages of participatory and inclusive design approaches	25	51.02%
	Limitations of participatory and inclusive design approaches	20	40.82%
	Recommendations for participatory and inclusive design approaches	27	55.10%

From Table 2:

Theme 1: Vernacular Architecture for Housing Sustainability: This theme encompasses studies exploring the advantages, limitations, and recommendations regarding vernacular architecture's role in Nigerian housing sustainability. Vernacular architecture, characterized using local materials and techniques, was found to offer benefits such as low environmental impact, high thermal comfort, and cultural significance. Challenges include the erosion of cultural identity and lack of recognition. Recommendations include documentation, criteria development, and integration into modern housing (Whelan, 2010; Makinde, 2014; Adamu et al., 2015; Lembi et al., 2021; Furlan & Faggion, 2015).

Theme 2: Challenges of Modern Urban Housing Forms: This theme addresses issues, factors, and recommendations concerning modern urban housing forms in Nigeria. Such forms are associated with high environmental impact and low cultural significance. Factors contributing to their adoption include globalization, urbanization pressures, inadequate regulations, and foreign actors' dominance. Recommendations include sustainability evaluation, principal integration, policy development, and local engagement (Husin et al., 2013; Emusa & Nduka, 2018; Mabuya & Scholes, 2020; Omuh et al., 2018; Husin et al., 2012).

Theme 3: Green Building Technologies and Practices: This theme explores the benefits, challenges, and recommendations regarding green building technologies and practices in Nigerian housing sustainability. Green building offers advantages like energy efficiency and resource conservation but faces initial cost and awareness challenges. Recommendations include cost-benefit analysis, capacity building, standards development, and collaboration mechanisms (Kibert, 2012; Akande & Adebamowo, 2010; Mukhtar et al., 2016; Ahmed & Sipan, 2019).

Theme 4: Participatory and Inclusive Design Approaches: Studies in this theme examine participatory and inclusive design approaches in the context of housing sustainability. These approaches enhance housing outcomes by involving stakeholders but require more time and resources. Recommendations include feasibility studies, capacity building, policy development, and trust-building mechanisms (Owotemu et al., 2022; Kavishe & Chileshe, 2019; Ogunbayo et al., 2021; Eseoghenea et al., 2022).

4.3 Meta-analysis

Table 3 demonstrates the meta-analysis results for housing adequacy (11.1.1), covered by thirty-two studies. Architectural innovation significantly improved housing adequacy, yielding an overall standardized mean difference (SMD) of 0.67 (95% confidence interval (CI): 0.54, 0.80), indicating a 0.67 standard deviation increase compared to conventional housing. Moderate heterogeneity existed among studies (I2 = 56.34%). Subgroup analysis revealed that product innovation had the largest effect (SMD = 0.75, 95% CI: 0.60, 0.90), followed by process innovation (SMD = 0.63, 95% CI: 0.48, 0.78), while position and paradigm innovations had smaller effects (SMD = 0.53, 95% CI: 0.38, 0.68, and SMD = 0.49, 95% CI: 0.34, 0.64, respectively).

Table 3: Results of Meta-Analysis for Housing Adequacy (11.1.1)

Aspect or Indicator	Type or Level of Innovation	No. of Studies	SMD	95% CI		I2	Q	p
				Min.	Max.			
Housing adequacy (11.1.1)	Overall	32	0.66	0.53	0.79	55.67%	69.31	<0.001
Housing adequacy (11.1.1)	Product innovation	27	0.74	0.59	0.89	56.23%	59.97	<0.001
Housing adequacy (11.1.1)	Process innovation	16	0.62	0.47	0.77	49.34%	29.76	<0.001
Housing adequacy (11.1.1)	Position innovation	4	0.54	0.39	0.69	43.21%	5.28	0.152
Housing adequacy (11.1.1)	Paradigm innovation	2	0.48	0.33	0.63	N/A*	N/A*	N/A*

*Note: I2, Q and p values are not applicable for subgroups with less than three studies.

5. Discussion

5.1 Summary of Main Findings

Descriptive statistics illuminate the temporal evolution of studies in architectural innovation within Nigerian social housing. Research activities surged notably over the last five years, with peak periods in 2021 and 2022. These studies span various journals, reflecting a multidisciplinary approach encompassing architecture, urban studies, sustainability, and development. Additionally, product innovation emerges as the most prevalent type, followed by process innovation. Housing adequacy takes the forefront among SDG-11 indicators, closely followed by urbanization and planning.

The thematic analysis identifies four prominent themes: the role of vernacular architecture in enhancing housing sustainability, the challenges of adapting to modern urban housing, the potential of green building technologies and practices, and the necessity for participatory and inclusive design approaches. Each theme presents its advantages, disadvantages, contributing factors, and recommended actions for improving housing sustainability.

Meta-analysis scrutinizes quantitative data from the studies, revealing that architectural innovation significantly enhances housing adequacy, urbanization and planning, environmental impact, and public space when compared to conventional housing. While the studies exhibit moderate heterogeneity, due to methodological, design, sample, measurement, or contextual differences, it becomes evident that product innovation yields the most substantial effect on these SDG-11 aspects.

5.2 Comparison with Existing Literature

The systematic review aligns with existing literature on architectural innovation in Nigerian social housing and SDG-11, as well as established theories and concepts on innovation and sustainability. However, it also offers novel insights and contributions to the field and identifies gaps and opportunities for future research.

5.2.1 The role of vernacular architecture in enhancing housing sustainability.

The findings corroborate previous studies recognizing the advantages of vernacular architecture in promoting housing sustainability across social, economic, and environmental dimensions. These studies emphasize how vernacular architecture embodies cultural identities, adapts to climatic conditions, supports social cohesion, and offers affordable housing solutions.

Nonetheless, the research offers fresh insights by concentrating specifically on Nigerian social housing, an area unexplored concerning vernacular architecture and SDG-11. It also unveils challenges, such as cultural identity loss, adaptation difficulties, and insufficient recognition, providing recommendations to preserve and integrate vernacular architecture into Nigerian social housing.

5.2.2 The challenges of adapting to modern urban housing forms.

The findings align with prior studies critiquing the suitability and sustainability of modern urban housing forms in developing countries like Nigeria. These studies highlight the disregard for cultural identities, failure to address climatic conditions, and adverse effects on social cohesion and affordability associated with modern urban housing.

Still, the research makes a unique contribution by focusing on Nigerian social housing, offering insights into the factors contributing to the preference for modern urban housing and suggesting reforms. These findings bridge the literature gap and create research opportunities addressing the challenges of modern urban housing in advancing SDG-11.

5.2.3 The potential of green building technologies and practices

The findings echo previous studies advocating for the adoption of green building technologies and practices for sustainable development. These studies emphasize the energy efficiency, climate resilience, health benefits, and

resource conservation offered by green building technologies.

However, the research uniquely examines the potential of green building in Nigerian social housing, an underexplored area concerning SDG-11. It acknowledges challenges such as higher costs and limited awareness, suggesting strategies to promote the adoption and integration of green building technologies. This finding addresses a literature gap and opens doors for future research on green building's role in advancing SDG-11.

5.2.4 The need for participatory and inclusive design approaches

The findings align with previous studies emphasizing the advantages of participatory and inclusive design approaches in enhancing housing sustainability. These studies underscore how involving stakeholders in planning, design, and delivery aligns housing with user needs, enhances quality, fosters ownership, and encourages collaboration.

However, the research focuses specifically on Nigerian social housing, an area where participatory design approaches have been underexplored in the context of SDG-11. It identifies challenges such as time and resource requirements, lack of awareness, and trust issues while providing recommendations to foster their adoption. This finding fills a literature gap and prompts future research on the necessity of participatory design in advancing SDG-11.

5.3 Limitations and Challenges

The systematic review is not without limitations and challenges that warrant acknowledgement and mitigation.

5.3.1 Scope and Coverage

The review's scope is limited to architectural innovation in Nigerian social housing and SDG-11. Consequently, it may have missed studies exploring other types of innovation, housing, or sustainable development indicators. To address this limitation, future research could expand its scope or supplement findings with other sources of evidence.

5.3.2 Quality and reliability

The review's quality and reliability are contingent on the studies included. Thus, it may inherit methodological flaws and biases. To mitigate this, researchers should apply rigorous criteria, acknowledge limitations, and report results cautiously.

5.3.3 Generalizability and applicability

The review's applicability may be restricted to Nigeria and may not extend universally. To enhance generalizability, future research should compare findings with diverse contexts and adapt them to specific needs.

5.4 Implications and Recommendations

The systematic review offers implications and recommendations for research, practice, and policy in architectural innovation within Nigerian social housing and SDG-11.

5.4.1 Implications and recommendations for research

The review identifies avenues for future research:

i. Exploring other types of innovation, housing, or sustainable development indicators.
ii. Investigating the sources of heterogeneity among architectural innovation studies.
iii. Evaluating the impact of architectural innovation rigorously.

To implement these recommendations, research should adopt a holistic perspective, and diverse methods, and consider multiple sources and levels of data.

5.4.2 Implications and recommendations for practice

The findings suggest best practices for architectural innovation in Nigerian social housing:

i. Preservation and integration of vernacular architecture.
ii. Challenge and reform of modern urban housing.
iii. Promotion of green building technologies.
iv. Adoption of participatory and inclusive design.

To apply these recommendations, practitioners should embrace innovative and sustainable approaches and involve stakeholders.

5.4.3 Implications and recommendations for policy

i. The research indicates policy interventions:
ii. Development of a national policy for architectural innovation.
iii. Establishment of a legal framework.
iv. Implementation of a financial mechanism.
v. Promotion of a social and cultural mechanism.

To enact these policies, governments should foster a supportive environment, encouraging innovation, sustainability, and inclusivity in Nigerian social housing and SDG-11 advancement.

6. Recommendations and Conclusion

6.1 Recommendations

Drawing from the findings and implications of the systematic review, the paper offers several recommendations for research, practice, and policy concerning architectural innovation in Nigerian social housing and its role in advancing SDG-11:

i. In the realm of research, consider expanding the scope and coverage of the systematic review by incorporating other forms of innovation, housing, or sustainable development related to architectural innovation in Nigerian social housing and SDG-11. Alternatively, supplement the findings with additional sources of evidence such as grey literature, case studies, expert insights, or stakeholder input. Prioritize enhancing the quality and dependability of the systematic review by applying rigorous and transparent criteria and procedures when identifying, selecting, evaluating, and synthesizing studies. Acknowledge and address any limitations and challenges encountered during the studies, and report results cautiously while including confidence intervals. Foster greater generalizability and applicability by comparing and contrasting findings and implications with other contexts or cases sharing similar or contrasting characteristics or conditions. Adapt findings and implications to suit the specific requirements or preferences of diverse contexts or cases. Additionally, explore opportunities for future research as identified in the discussion section, which includes investigating various types of innovation, examining different housing types, addressing various aspects or indicators of sustainable development, analysing factors contributing to heterogeneity or variation among studies, and evaluating the effectiveness or impact of architectural innovation in Nigerian social housing as it pertains to advancing SDG-11.

ii. In the domain of practice, consider adopting a more innovative and sustainable perspective on architectural design and delivery in Nigerian social housing. Utilize a more participatory and inclusive approach that involves a wide range of stakeholders in the process. Incorporate best practices and lessons derived from studies on architectural innovation in Nigerian social housing, such as preserving and integrating vernacular architecture into Nigerian social housing, challenging and reforming modern urban housing forms in Nigeria, promoting and implementing green building technologies and practices in Nigerian social housing, and facilitating the adoption and diffusion of participatory and inclusive design approaches in Nigerian social housing.

iii. Concerning policy, encourage the adoption of a more supportive and enabling environment for architectural innovation in Nigerian social housing to advance SDG-11. Employ an integrated and coordinated approach to address multiple dimensions or aspects of sustainability. Implement policy interventions or actions proposed in the discussion section, which includes developing and implementing a national policy or strategy for architectural innovation in Nigerian social housing, establishing a legal or regulatory framework for architectural innovation in Nigerian social housing, devising a financial or economic mechanism for architectural innovation in Nigerian social housing, and creating a social or cultural mechanism for architectural innovation in Nigerian social housing.

6.2 Conclusion

This paper has conducted a systematic review of architectural innovations in Nigerian social housing to advance SDG-11. It has identified, selected, appraised, and synthesized forty-nine studies focusing on architectural innovation in Nigerian social housing, addressing one or more aspects or indicators of SDG-11. The paper utilized descriptive statistics, thematic analysis, and meta-analysis to present and analyse the data.

The findings reveal that architectural innovation exerts a positive and considerable influence on housing sustainability and SDG-11 in Nigeria, particularly regarding housing adequacy, urbanization and planning, environmental impact, and public space. Four main themes emerged from the studies: the role of vernacular architecture in enhancing housing sustainability, the challenges associated with adapting to modern urban housing forms, the potential of green building technologies and practices, and the necessity of participatory and inclusive design approaches.

The paper has discussed the primary findings and implications of the systematic review, comparing them with existing literature. It has also acknowledged certain limitations and challenges of the systematic review, such as its limited scope, variable quality and reliability, and constrained generalizability and applicability. Furthermore, the paper has provided recommendations for research, practice, and policy concerning architectural innovation in Nigerian social housing to advance SDG-11.

In conclusion, architectural innovation is a pivotal and relevant subject within Nigerian social housing and SDG-11, offering substantial opportunities and advantages for enhancing housing sustainability, cultural identity, diversity, social cohesion, well-being, environmental quality, performance, and health and comfort. The paper underscores the complexity and diversity of architectural innovation, highlighting the need for more comprehensive, diverse, and participatory research, practice, and policy approaches to understand, support, and enable it within Nigerian social housing as it relates to advancing SDG-11.

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