

Relationship between Design for Sustainability and Affordability in Mass Housing Development in Nigeria

Bello Nagogo Usman Ph. D¹, John Agmada Bawa Ph. D²

¹Department of Quantity Surveying, Baze University Abuja

²Department of Architecture, Baze University, Abuja

DOI: <https://dx.doi.org/10.47772/IJRISS.2025.9010010>

Received: 18 December 2024; Revised: 28 December 2024; Accepted: 30 December 2024; Published: 27 January 2025

ABSTRACT

Design for sustainability and affordability in mass housing development in Nigeria is crucial to addressing the country's housing deficit while promoting environmental and economic resilience. This study explores how sustainable design principles can be integrated into mass housing projects without significantly increasing costs, ensuring that homes are both affordable and environmentally friendly. The research adopted a desktop study approach and reviewed literature on sustainable design, affordable housing, policy and regulatory framework for housing development in Nigeria and community/stakeholder engagement. The research identified issues in the Nigerian mass housing space that has slowed adoption of design of sustainable and affordable housing. The study identified strategies for optimizing design elements of housing to reduce the overall environmental footprint while ensuring affordability for low- to middle-income populations.

Keywords: Affordable, Design, Mass Housing, Sustainability, Urbanization

INTRODUCTION

Background of Mass Housing Development in Nigeria

Rapid urbanization and population growth are driving infrastructure and housing demands globally, particularly in Nigeria. With a population exceeding 200 million, over 50% of Nigerians currently reside in cities, a figure projected to rise to 70% by 2050 (Obilor et al., 2024). Nigeria faces a significant housing deficit, requiring more than 28 million housing units to meet current needs (The State House, 2023). Like many Sub-Saharan African nations, over 56% of urban residents in Nigeria live in slums (UNSD, 2021). This situation is exacerbated by an inflation rate exceeding 30%, which, coupled with economic challenges, has significantly increased the cost of housing delivery, further deepening the housing crisis and forcing more people into slum conditions (Ebekozien, 2024).

Significant sustainability building materials such as adobe bricks, thatch, stone, bamboo etc. and financial resources will be needed to meet Nigeria's housing deficit. Therefore, it has become crucial to incorporate sustainability into home design since it solves the need for inexpensive housing as well as environmental issues. Sustainable housing methods can improve living circumstances and quality of life by lowering long-term expenses through resource conservation and energy efficiency, (Aribigbola, 2011; Ezeanah, 2021). Stakeholders may develop housing solutions that suit both short-term demands and long-term community viability by focusing on sustainable design principles.

The objective of this study is to explore the relationship between design for sustainability and affordability in mass housing development in Nigeria, highlighting the challenges and opportunities present in the current landscape. It aims to provide insights into how sustainable practices can be effectively integrated into housing policies to address the pressing housing deficit while ensuring affordability for all Nigerian

LITERATURE REVIEW

Importance of Sustainability and Affordability in Mass Housing

There is a growing recognition of the environmental impact of housing development, with traditional building practices contributing significantly to resource depletion and greenhouse gas emissions, (IEA, 2020). Sustainable housing practices have the potential to alleviate the effects of climate change which leads to raise in sea level causing flooding, erosion and other attendant consequences to housing. Sustainability is actualized by emphasizing the use of environmentally friendly materials, energy-efficient designs, and renewable energy sources, which can also yield economic advantages (UN-Habitat, 2023). For example, there is significant potential for sustainable housing development strategies in Nigeria such as innovative designs and construction methods, creative financing models, and community-driven initiatives, to empower marginalized populations, thereby enhancing economic resilience and promoting inclusivity, (Family Homes Funds Limited, 2024).

Sustainable housing delivery finds its premise in the United Nations Sustainable Development Goals (UNSDG), (2015), Goal 11, targeting accessibility to adequate, safe, and affordable housing and basic services for all, (Ewurum et al 2020). Designing mass housing with sustainability in mind is crucial to tackling environmental issues and guaranteeing affordability for low- and middle-class households. According to recent studies, there are numerous advantages to sustainable housing, including improved living conditions and lower long-term expenditures due to resource conservation and energy efficiency (Moore and Doyon, 2023).

Researchers (Almusaed & Almssad, 2023), have established that it is important to note that healthy living is fostered by appropriate housing, and thus the contribution of housing is very paramount to health, they have also noted that in homes, natural light, proper ventilation, and nontoxic materials contribute to a healthier living condition. These, in addition, create green areas that further facilitate social interactions and give an overall better quality of life, (Intech Open, 2023). This is not a trend that will decline but, rather, a much-needed transition in the course of urban development. By means of embracing the concept of sustainability, communities will have economic, as well as social, prosperity by protecting the environment for future generations, (Sustainable Housing Solutions, 2023).

METHODOLOGY

The paper adopted desktop research. It utilized secondary data from reports, published papers, Libraries and websites. The process of desktop research, also known as secondary study, involves compiling, cross-checking, and analyzing data sources that are readily available, (Nooraini, 2013). Desk research is frequently seen as a low-cost method since it involves gathering data from already-existing resources, (Rahman et al. 2014).

CONCEPTUAL FRAMEWORK

Definition of Design for Sustainability

Design for sustainability involves strategies that reduce environmental impact, enhance resource efficiency, and promote social equity in the development of housing. It encompasses ecological, economic, and social parameters throughout the design process to assure viable housing solutions for both the present and future generations, (Eucolite, 2023; Factory, 2023).

Sustainable design seeks to lower energy usage, harness renewable resources, and decrease waste production, ultimately fostering healthier living spaces, (IBM, 2023). By emphasizing long-term ecological stability, designers play a crucial role in developing a more sustainable built environment that enhances the well-being of communities, (Kaospilot, 2023)

Definition of Affordability in Housing

Affordability refers to the capacity of individuals or families to obtain housing while maintaining their financial

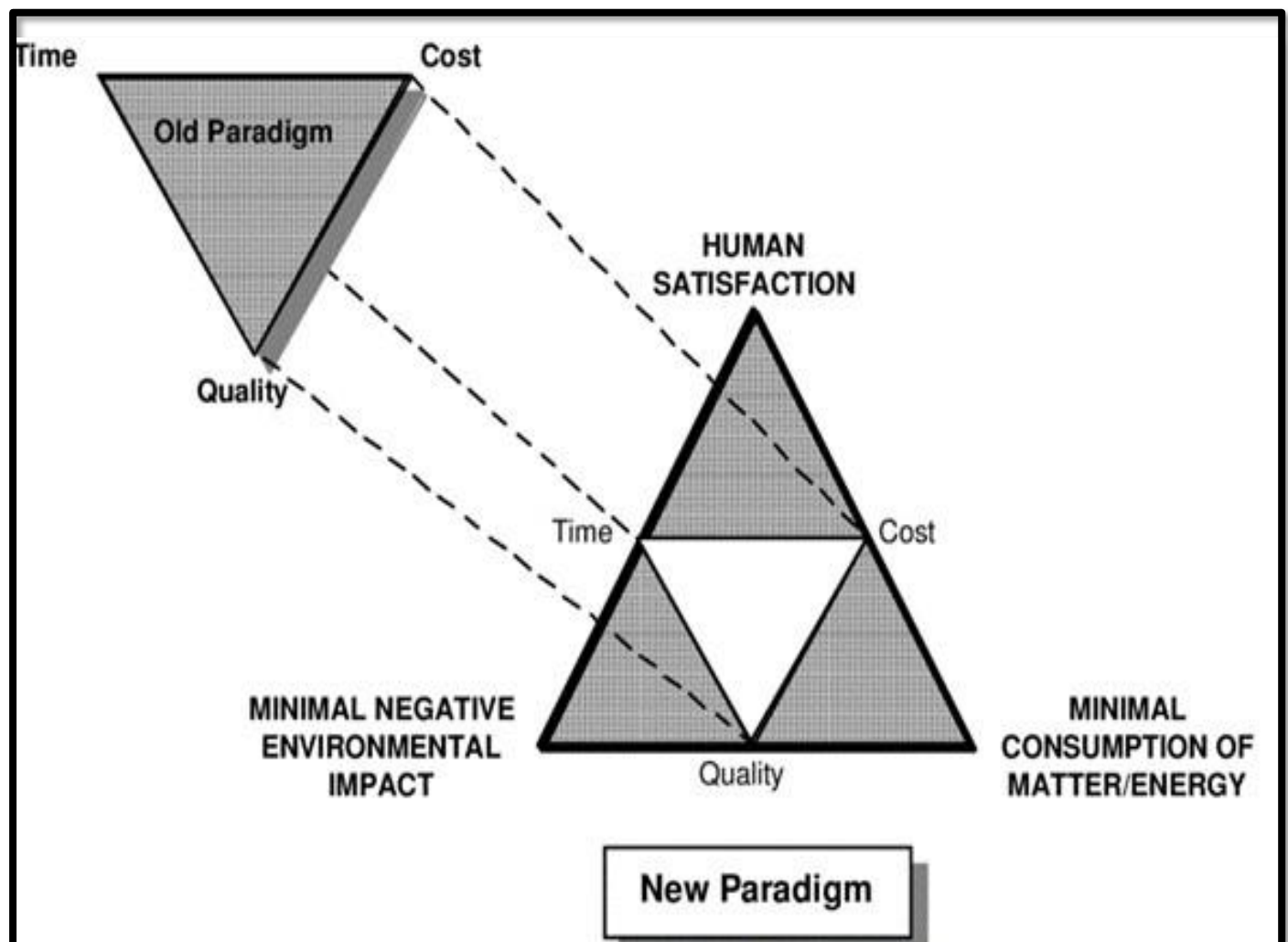
well-being, commonly characterized by housing expenses that do not surpass 30% of a household's income, (UN-Habitat, 2023).

This criterion is essential for evaluating housing policies and guaranteeing that families with low to moderate incomes can secure safe and stable living conditions, (Sustainable Housing Solutions, 2023). Various elements, such as geographical location, type of housing, and prevailing market conditions, impact affordability, highlighting the need for comprehensive approaches to tackle the housing crisis, (Elsinga *et al.*, 2020)

Theoretical Perspectives on the Relationship between Design for Sustainability and Affordability

Traditional construction is driven by the three pillars of time cost and quality. However, long before now there has been advocacy for a shift, for example, Vanegas, *et al.*, (1996), advocated the integration of human satisfaction, minimal negative environmental impact and minimal consumption of energy. This matters in the way we design and build facilities through lifecycle perspective see fig 1. The interplay between sustainability and affordability suggests that sustainable design can lead to lower operational costs, thereby improving affordability over time. Research indicates that sustainable housing strategies can effectively address both affordability and environmental challenges, (Moore & Doyon, 2023; Tucker *et al.*, 2020). For example, energy-efficient homes reduce utility bills, making them more affordable in the long run, (Almusaed & Almssad, 2023). Additionally, design for sustainability fosters community engagement in sustainable housing projects promotes social equity and enhances residents' quality of life, further aligning sustainability and affordability, (Zhang & Wang, 2023).

Figure 1: New Paradigm for Sustainable Built Facilities



Source: Vanegas *et al.*, 1996

Passive Design Strategies

Homes can drastically cut expenses and energy usage by implementing passive design techniques like optimal sun light orientation and natural ventilation. These strategies reduce the need for mechanical heating and cooling systems, which results in lower energy costs and increased internal comfort, (Fox Blocks, 2023). For example, buildings with large, well-placed windows can capture sunlight for natural heating in the colder months, while overhangs can offer shade during the summer, (Gordian, 2023). Furthermore, using thermal mass materials like concrete or brick can help maintain indoor temperatures by absorbing heat during the day and releasing it at night, (Construction & Civil Engineering, 2023). This approach not only cuts energy costs but also fosters a more sustainable living environment.

Material Selection and Construction Techniques

Choosing local and sustainable materials while using efficient construction methods can help reduce costs and lessen environmental impact. Materials like bamboo, recycled steel, stabilized earth and reclaimed wood not only cut down the carbon footprint of construction but also bolster local economies (DYPVP, 2023; Construction21, 2021). Additionally, construction techniques such as modular building and prefabrication can help minimize waste and streamline the building process, further promoting sustainability (Temp Wall Systems, 2024). Green building practices, including insulated concrete forms (ICFs) and rainwater harvesting systems, are also essential for enhancing energy efficiency and conserving resources (Fox Blocks, 2023). By incorporating these strategies, the construction industry can tackle both sustainability and affordability issues, resulting in homes that are both environmentally friendly and economically sound.

Technological Innovations in Sustainable and Affordable Housing

The technological innovations in sustainable and affordable housing is considered by the study into green building technologies and prefabrication and modular construction.

Green Building Technologies

Solar panels, energy efficient appliances and smart home systems are technologies that foster sustainability while saving the homeowner money over time. The renewable energy produced by solar panels helps to mitigate the use of fossil fuels and cuts down on electricity (Almusaed & Almssad, 2023) With energy star appliances, Low energy consumption with LED lighting, which results in savings over time (Sustainable Housing Solutions, 2023). The advent of internet of Things (IoT) have facilitated the adoption of smart home technologies, Smart home technologies help regulate and monitor use of home appliances resulting in optimized energy use (IBM, 2023).

Prefabrication and Modular Construction

Prefabrication and modular construction methods can streamline the building process, reduce waste, and lower costs, making housing more accessible. These techniques involve Off-site construction of a building at a factory, and then the assembling will take place on the construction site, (Temp Wall Systems, 2024). It allows for flexibility of incorporating certain client needs (Factory, 2023). The controlled nature of production allows for quality control, cost savings and reuse of materials compared to traditional construction system, (Moore & Doyon, 2023).

Case Studies for Design for Sustainable and Affordable Housing Project

Many countries have embraced the concept of designing sustainable and affordable housing. Table 1 highlights various projects and strategies implemented to achieve sustainable and affordable housing solutions.

Table 1 Sustainable and Affordable Mass Housing Projects with Design for Sustainability and Affordability Strategies

Use cases	Design for Sustainability and Affordability strategies
The Serenbe Community, Georgia, USA (Serenbe, 2023).	A. Prioritizes environmental preservation and social well-being B. Mixture of affordable apartments to luxury homes C. water conservation, and the use of sustainable materials D. walkability, green spaces, E. Adopted community engagement for design
BedZED, London, UK (Bioregional, 2023)	A. Renewable energy sources, and sustainable transportation options B. Passive solar heating, natural ventilation C. Use of recycled and locally sourced materials,
Elemental – Quinta Monroy, Chile (YAŞAR, and ÖZÇELİK, 2022).	A. Incremental housing B. Design orientation that optimizes natural light and ventilation C. Solar technologies, rain water harvesting systems and waste recycling systems D. Adopted community engagement in design and development
Savonnerie Heymans, Belgium (Tatnell, 2019; Hinderson, 2021)	A. Retrofitted old soap factory into a mixed income residential development B. Provides shared green spaces and amenities in a dense neighborhood C. The building was reconstructed using recycled materials D. The building features green roofs and solar panels and rain water harvesting systems
Indira Awaas Yojana, India (Mabogunje, 2023).	A. Emphasizing the use of locally sourced B. Community participation in design and development C. Adopted eco friendly design principles
The Khayelitsha Eco-Village in South Africa (UN-Habitat, 2023).	A. Passive cooling and water harvesting system B. Community-driven development
The Khuda Ki Basti project in Pakistan (Siddique, 2013).	A. Incremental development model B. Plots are serviced with water and electricity C. Plot owners build gradually based on their financial position D. Cluster of social services like schools and clinics to facilitate the creation of a self-sustaining communities E. Personal payment plan system

Source: Authors’ work, (2024)

CURRENT STATE OF MASS HOUSING IN NIGERIA

Nigeria is currently facing a complex set of challenges in delivering mass housing. These include limited financial resources, bureaucratic bottlenecks, inadequate knowledge of sustainability among stakeholders, poor logistics systems, and insufficient construction expertise. These issues have significantly affected the speed and quality of housing delivery despite efforts by the government and private sector (Center for IS, 2021; Mabogunje, 2023). The country is currently grappling with a housing deficit of over 28 million units (World Bank, 2023). Additionally, with the growing trend in urbanization, there will be a corresponding increase in housing demand (UN-Habitat, 2023). Presently, over 50% of Nigeria’s population resides in urban areas, and this figure is projected to rise to 70% by 2050 (Obilor et al., 2024).

To address these challenges, the Nigerian government has introduced various policies aimed at promoting affordable housing, such as the National Housing Policy and the Family Homes Fund, which provide financing options for low-income families (Family Homes Funds Limited, 2024). However, inconsistencies in implementation persist (Alao, 2023), resulting in inadequate adoption of sustainable housing solutions across the country (Mabogunje, 2023). In contrast, other African nations like South Africa have successfully implemented similar initiatives, leading to significant improvements in housing accessibility and sustainability (UN-Habitat, 2023).

Barriers to Achieving Sustainable and Affordable Mass Housing

A major bottleneck to affordable mass housing delivery in Nigeria is financing in both supply and delivery side, as housing development demands huge funds. Housing can best be described as capital-intensive, yet funding

for the sector has hardly been on the scale of other areas such as defense or even health (Okunbor, 2023). Limited access to affordable financing options remains a significant barrier to developing sustainable housing in Nigeria. High-interest rates and a lack of mortgage products tailored for low-income households hinder investment in sustainable construction, (Teplova *et al.*, 2020). Moreover, the absence of a robust mortgage system restricts access to affordable housing options for many Nigerians, (Agbola, 2023). The absence of a robust financial market further exacerbates these challenges of delivering affordable housing, discouraging private sector participation on the supply side, (Adabre & Chan, 2019).

There is a critical need for education and capacity-building among stakeholders to promote sustainable practices in housing development. Many developers and policymakers lack the necessary knowledge about sustainable construction techniques and their long-term benefits, (Chan & Adabre, 2019). There exists cultural resistance from home users on certain building technologies and materials, (Toriola-Coker *et al.* 2021). Additionally, there is inadequate training programs and workshops that can enhance understanding and facilitate the adoption of sustainable practices which ultimately leading to improved housing outcomes, (Antipin & Trufanova, 2021). Approval processes are cumbersome and time wasting, again the system is averse to innovation in design and adoption of new construction processes. The Bureaucratic delays further exacerbate the housing availability situation by hindering timely project execution, (Ukoje & Kanu, 2023).

COMMUNITY ENGAGEMENT AND STAKEHOLDER INVOLVEMENT

Stakeholders are persons that can affect or be affected by the outcome of an activity or project (Duong, *et al.*, 2024). Community/ stakeholder engagement has been defined as a process of working collaboratively with groups of people connected by geographic proximity, similar interest or circumstance with respect to issues affecting their well-being. Overall, engagement or participation denotes an act of being involved in a process or decision, (Nunes *et al.*, 2021).

Engaging communities/ stakeholders in the planning and design process ensures that housing meets local needs and fosters ownership, which is vital for sustainability. Community participation enhances transparency and accountability, leading to better project outcomes, (Chen *et al.*, 2022). By involving residents in decision-making, developers can create housing solutions that resonate with the community's cultural and social contexts, ensuring long-term sustainability, (UN-Habitat, 2023). Engagement offers all stakeholders an opportunity to articulate their views, concerns, and opinions to create an open discussion around the advantages and disadvantages of an issue or project.

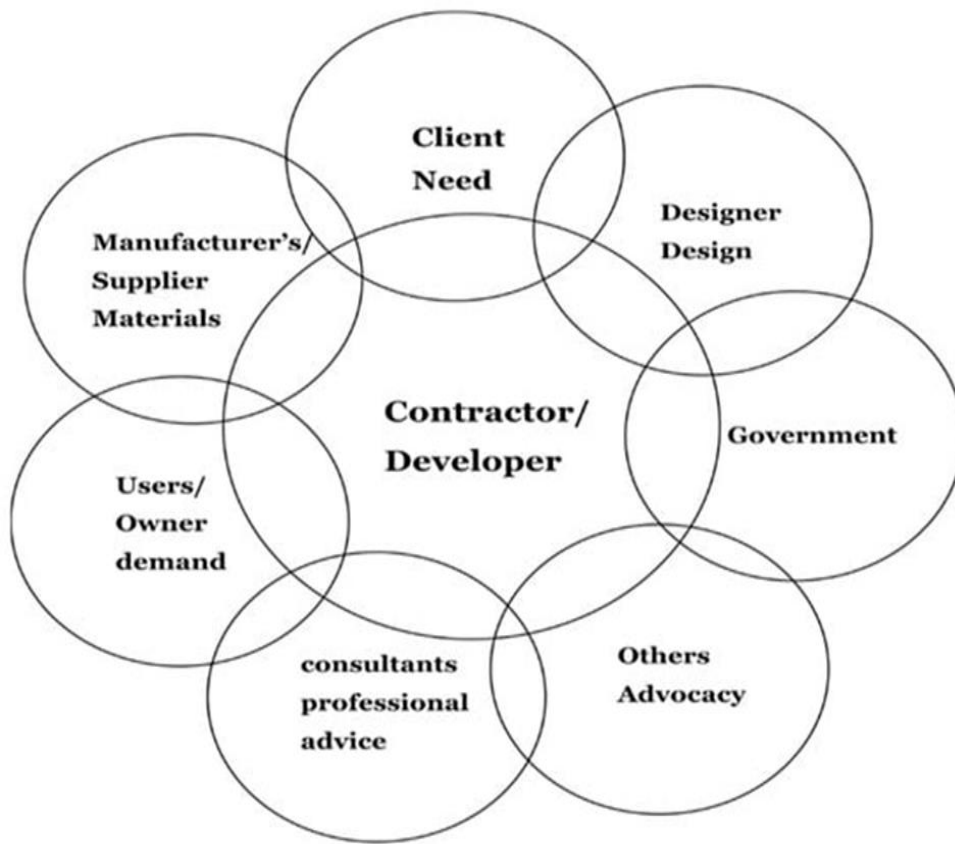
Responses and contribution given if considered can help bridge the gap between the high-level government officials and the community, which can translate into partnerships with the people at the lower level, (Fredericks *et al.*, 2020; Ståhlbröst *et al.*, 2015). Correspondingly, municipalities are advocated to create inclusive urban communities that fosters community-driven urban innovation and development (Anthony, 2024). However, the present tactic employed by housing providers in Nigeria is not enough to drive a sound community/ stakeholder engagement strategy, (Ewurum, *et al.*, 2020). Ezennia, (2022), adds that the lack of adequate stakeholder engagement is a key barrier to attainment of sustainable and affordable housing in Nigeria.

Stakeholders in Affordable housing

Sustainable mass housing is not possible in a vacuum since multiple parties define the outcome of such an undertaking, the realization of such a complex phenomenon as illustrated in Figure 2. Multiple stakeholders partake in construction projects such as mass housing include: government, developers, clients, buyers/end users, contractors, consultants (architects, other designers, engineers, quantity surveyors), and manufacturers/suppliers. Recently a number of non-governmental stakeholders in sustainable mass housing development have been making concerted efforts to push the agenda for sustainability and affordability in Nigeria. For example, Excellence in Design for Greater Efficiencies (EDGE) has been making a lot of advocacies for sustainable designs and developments in Nigeria. EDGE is an innovation of the International Finance Corporation (IFC). It helps property developers design resource-efficient buildings quickly, easily and affordably. It also certifies buildings that meet suitability standards hence creating a bench mark for sustainable designs and buildings in developing countries (EDGE, 2021). The UN Habitat has been supporting deferent tiers of government in Nigeria

through grants and building capacity for sustainable urban developments since 2003, (UN Habitat, 2023).

Figure 2: Stakeholders in Sustainable Mass Housing



Source: (Bal. et al. 2013)

FINDINGS AND CONCLUSION

This paper reviewed literature relevant to design for sustainability and affordability in mass housing development in Nigeria. The study identified that high population growth and increased urbanization has increased the need for affordable housing. Meeting Nigeria's housing need will require a lot of material and financial resources. Designing sustainable housing that will produce affordable homes is challenging due to different stakeholder views and values of stakeholders in the sector. Shortage of finance to developers and mortgage to people that desire to own homes is an issue. Again, there is bureaucracy in securing building approvals by developers who are involved housing development in Nigeria. Additionally obsolete building codes, lack of technical knowhow of government personals and practitioners in the space are issue affecting design of sustainable and affordable housing in Nigeria.

This study proffers sustainable policy guidelines that can improve design of sustainable and affordable mass housing in Nigeria as follows:

1. The policy perspective: There is need for improvement in government policies relevant to affordable housing. Firstly, building codes need to shift from traditional approach to new building codes that foster sustainable designs and construction methods. Secondly, ecofriendly designs and building techniques need to be adopted as standards to make our cities more inclusive, livable and sustainable. Thirdly, mortgage and real estate financing needs to be strengthened. Financial incentives should be put in place by government from the housing supply and demand side for mass housing project that meet sustainability criteria, doing so will give developers that adopt sustainable housing designs and construction access to cheaper funds than conventional building deigns and construction option. This will make the products affordable to the end user, again with incentives for mortgage on sustainable housing there will be increased demand for such housing.

2. The practical perspective, firstly, designs should be able to harness the adoption of home-grown solutions or adapted solutions that save construction time, cost and ensure quality development of mass housing projects. Secondly solutions adopted should facilitate local manpower use and sourcing of materials at proximity to project sites. Thirdly, solutions should meet the value set of home users, use minimal energy and construction resources. Fourthly, such strategies should spur diffusion of economic growth across deferent strata of the citizens.

Conclusively, sustainable and affordable housing developments are usually tough to design and implement, since it's a long and tangled process that involves the participation of many people as well as various interconnected operations. Stakeholders in the housing space in Nigeria need to be educated on the benefits and strategies to achieve sustainability in mass housing development. Skill sets must also be diffused to practitioners in the sector. This calls for improved advocacy and technical workshops by non-governmental agencies such as UN Habitat and agencies like EDGE for the stakeholders in mass housing space in Nigeria. There is need for convergence of efforts by stakeholders for sustainable and affordable housing to be realized in Nigeria. The development of a framework that can guide stakeholder collaboration in the affordable mass housing space is essential for improved design and delivery of housing in Nigeria.

REFERENCES

1. Abdulrahman, I. R. (2016). Trends and drivers of affordable housing delivery in Nigeria. *International Journal of Scientific & Engineering Research*, 7(9).
2. Adabre, M. A., & Chan, A. P. (2019). Critical success factors (CSFs) for sustainable affordable housing. *Building and Environment*, 156, 203–214. <https://doi.org/10.1016/j.buildenv.2019.04.030>
3. Agbola, S. B. (2023). The housing crisis in Nigeria: A critical analysis. *Journal of Housing and the Built Environment*.
4. Aigbavboa, C., & Thwala, W. (2018). Housing development in Nigeria. In *Residential satisfaction and housing policy evolution* (pp. 86–108). Routledge.
5. Alao, J. (2023). A review of mass housing in Abuja, Nigeria: Problems and possible solutions towards sustainable housing. *Economic Development Journal*.
6. Almusaed, A., & Almssad, A. (2023). Sustainable housing design: System control strategy. *IntechOpen*.
7. Anthony, B. (2024). The role of community engagement in urban innovation towards the co-creation of smart sustainable cities. *Journal of Knowledge Economics*, 15, 1592–1624. <https://doi.org/10.1007/s13132-023-01176-1>
8. Antipin, D., & Trufanova, S. (2021). Project financing as a tool to enhance the role of commercial banks in the construction industry. *IOP Conference Series: Earth and Environmental Science*, 751, Article 012130. <https://doi.org/10.1088/1755-1315/751/1/012130>
9. Aribigbola, A. (2011). Housing affordability as a factor in the creation of a sustainable environment in the developing world: The example of Akure, Nigeria. *Journal of Human Ecology*, 35(2), 121–131.
10. Bal, M., Bryde, D., Fearon, D., & Ochieng, E. (2013). Stakeholder engagement: Achieving sustainability in the construction sector. *Sustainability*, 5, 695–710.
11. Bioregional. (2023). BedZED. Retrieved from <https://www.bioregional.com/projects-and-services/case-studies/bedzed-the-uks-first-large-scale-eco-village>
12. Center for IS. (2021). Mass housing in Nigeria 2021: A brief market analysis. Retrieved from <https://www.centerforis.com/post/mass-housing-in-nigeria-2021-a-brief-market-analysis>
13. Chen, J., Siddik, A. B., Zheng, G.-W., Masukujjaman, M., & Bekhzod, S. (2022). The effect of green banking practices on banks' environmental performance and green financing: An empirical study. *Energies*, 15(4), Article 1292. <https://doi.org/10.3390/en15041292>
14. Construction & Civil Engineering. (2023). 10 sustainable building materials. Retrieved from <https://www.ccemagazine.com/news/10-sustainable-building-materials/>
15. Construction21. (2021). The methods and benefits of sustainable construction. Retrieved from <https://www.construction21.org/articles/h/the-methods-and-benefits-of-sustainable-construction.html>
16. Duong, L., Phillips, W., Roehrich, J. K., & Cook, C. (2024). Realizing NetZero in social housing: Strategic public procurement and internal stakeholder engagement. *Public Management Review*, 1–25.
17. DYPVP. (2023). Sustainable construction: Methods, benefits and challenges. Retrieved from

<https://engg.dypvp.edu.in/blogs/sustainable-construction-methods-benefits-and-challenges>

18. Ebekozen, A., Aigbavboa, C. O., Thwala, W. D., Hafez, M. A., & Samsurijan, M. S. (2024). Sustainable development goals under threat: The impact of inflation on construction projects. *Engineering, Construction and Architectural Management*, 31(13), 323–341.
19. Ecolife. (2023). Sustainable design: What is it really? Retrieved from <https://ecolife.com/dictionary/sustainable-design/>
20. EDGE. (2021). *Green buildings for a smarter world*. <https://edgebuildings.com/wp-content/uploads/2022/03/ifc0060-edge-brochure-ghana-nigeria-en-2021-11-03.pdf>
21. Elsinga, M., Hoekstra, J., Sedighi, M., & Taebi, B. (2020). Toward sustainable and inclusive housing: Underpinning housing policy as design for values. *Sustainability*, 12(5), 1920.
22. Ewurum, N. I., Aniagolu, C. O., & Igwe, C. P. (2020). Sustainable public housing delivery in Nigeria: A conceptual stakeholder management model. *Journal of Economics and Sustainable Development*, 11(10), 36–48.
23. Ezeanah, U. (2021). Housing challenges in Nigeria. In *Sustainable housing* [Working title]. IntechOpen.
24. Ezennia, I. S. (2022). Insights of housing providers on the critical barriers to sustainable affordable housing uptake in Nigeria. *World Development Sustainability*, 1, 100023.
25. Family Homes Funds Limited. (2024). *Going green: A handbook of sustainable housing practices in developing countries*. IntechOpen.
26. Federal Government of Nigeria. (2006). *National population census of Nigeria*. Federal Republic of Nigeria.
27. Fox Blocks. (2023). 10 green building construction methods and techniques. Retrieved from <https://www.foxblocks.com/blog/green-building-techniques>
28. Fractory. (2023). Design for sustainability: Examples included. Retrieved from <https://fractory.com/design-for-sustainability/>
29. Gordian. (2023). 8 sustainable construction techniques: How you build is as important as what you build. Retrieved from <https://www.gordian.com/resources/sustainable-construction-techniques/>
30. Ibem, E. O., & Amole, O. O. (2010). Evaluation of public housing programmes in Nigeria: A theoretical and conceptual approach. *The Built Environment Review*, 3, 88–116.
31. IBM. (2023). IBM design for sustainability. Retrieved from <https://www.ibm.com/design/practices/design-for-sustainability/>
32. IntechOpen. (2023). *Sustainable housing*.
33. Kaospilot. (2023). What is sustainable design? Retrieved from <https://www.kaospilot.dk/what-is-sustainable-design/>
34. Mabogunje, A. (2023). Challenges and opportunities in Nigeria's housing sector. *Nigerian Journal of Real Estate Studies*.
35. Moore, T., & Doyon, A. (2023). The sustainable housing challenge. In *A transition to sustainable housing*. Palgrave Macmillan.
36. Nooraini, R. (2013). Algorithm analysis of definite integration by using desk check method. *J. Inform. Bisnis*, 1, 50–55.
37. Nunes, N., Björner, E., & Hilding-Hamann, K. E. (2021). Guidelines for citizen engagement and the co-creation of nature-based solutions: Living knowledge in the URBiNAT project. *Sustainability*, 13(23), 13378.
38. Obilor, E., Okeke, M., & Nwosu, P. (2024). Urbanization and Housing Demand in Nigeria: Projections for 2050. *Journal of Urban Studies*, 12(4), 45–62.
39. O'Brien, D., & Carrasco, S. (2021). Contested incrementalism: Elemental's Quinta Monroy settlement fifteen years on. *Frontiers of Architectural Research*, 10(2), 263–273.
40. Okunbor, O. (2023). Nigeria's housing sector: Challenges and opportunities. LinkedIn. Retrieved from <https://www.linkedin.com/pulse/nigerias-housing-sector-challenges-opportunities-osagie-okunbor>
41. Olotuah, A. O. (2023). Housing development and environmental degeneration in Nigeria. *The Built & Human Environment Review*.
42. Olotuah, A. O., & Aiyetan, A. O. (2023). Sustainable low-cost housing provision in Nigeria: A bottom-up, participatory approach. In *Proceedings of the 22nd Annual ARCOM Conference*.
43. Rahman, R., Alarifi, A. H. E., Eden, R., & Sedera, D. (2014). Archival analysis of service desk research: New perspectives on design and delivery. In W. Wang & D. Pauleen (Eds.), *Proceedings of the 25th*

- Australasian Conference on Information Systems* (pp. 1–10). Auckland University of Technology.
44. Sustainable Housing Solutions. (2023). *The expert's guide to achieving sustainable housing development*.
 45. Retrieved from <https://senangin.com/blogs/news/the-experts-guide-to-achieving-sustainable-housing-development>
 46. Temp Wall Systems. (2024). Sustainable construction materials and techniques in 2024. Retrieved from <https://tempwallsystems.com/blog/construction-materials-methods-and-techniques-building-for-a-sustainable-future>
 47. Teplova, T., Sokolova, T., Gubareva, M., Galenskaya, K., & Teplov, A. (2020). Perception and drivers of financial constraints for sustainable development. *Sustainability*, 12(17), 7217. <https://doi.org/10.3390/su12177217>
 48. The State House. (2023). Nigeria needs N21tr to address housing deficit, says VP Shettima. Retrieved from <https://statehouse.gov.ng/news/nigeria-needs-n21tr-toaddress-housing-deficit-says-vp-shettima/>
 49. The UN Statistics Division (UNSD). (2021). *The Sustainable Development Goals report 2021*. [https://unstats.un.org/sdgs/report/2021/extended-report/Goal%20\(11\)_final.pdf](https://unstats.un.org/sdgs/report/2021/extended-report/Goal%20(11)_final.pdf)
 50. Tucker, S., Gamage, A., & Wijeyesekera, C. (2020). Some design aspects of sustainable post-disaster housing. *International Journal of Disaster Resilience in the Built Environment*, 5(2), 163–181.
 51. Ukoje, J. E., & Kanu, K. U. (2023). Implementation and challenges of the mass housing scheme in Abuja, Nigeria. *American International Journal of Contemporary Research*.
 52. UN Habitat. (2023). *Country brief Nigeria; achieving sustainable urbanization*. https://unhabitat.org/sites/default/files/2023/07/nigeria_country_brief_final_en.pdf
 53. UN-Habitat. (2023). *Going green: A handbook of sustainable housing practices in developing countries*.
 54. Vanegas, J. A., DuBose, J. R., & Pearce, A. R. (1996, November). Sustainable technologies for the building construction industry. In *Proceedings, Symposium on Design for the Global Environment*, Atlanta, GA.
 55. World Bank. (2023). *Nigeria Housing Sector Report: Addressing the Deficit*. Washington D.C.: World Bank Publications.
 56. Zhang, Y., & Wang, J. (2023). Healthy-sustainable housing index: A pilot study to link architecture and public health. *Journal of Environm*