Sustainable Building Development in Nigeria: A Climate Change Response Review

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Abstract

Building development is a significant source of problems posed by climate change, and buildings are vulnerable to climate change. Hence, climate change and buildings are mutually influenced by each other. The paper examines the changing landscape of sustainable building development in Nigeria as a strategic response to the problems of climate change. The study investigates the various perspectives of building experts regarding sustainable building development in Nigeria. To do so, the researchers distributed 265 questionnaires to professionals from various fields, such as architects, engineers, surveyors, contractors, developers, facilities managers, estate surveyors and valuers, and sustainability consultants. The researchers received 250 completed questionnaires, which were used for the study. The researchers used inferential statistics of t-test statistics to evaluate the effectiveness of current policies and frameworks promoting sustainable building practices in Nigeria. The p-value obtained (0.0000) was lower than the critical value (5%) for most factors. However, the barriers negatively affect sustainability, with a 1% increase in obstacles resulting in a 0.93% decline in sustainable building development. Also, the PPASB's p-value of 0.3560 was insignificant, indicating a need for a deeper understanding of sustainable construction development. The effectiveness of sustainable building policies and technologies has enhanced development in Nigeria despite climate change challenges. Public perception of sustainable buildings has not significantly affected development. Nigeria can become a leader in sustainable construction by leveraging traditional knowledge systems and new technologies. Adherence to professional standards, proper

implementation of building policies, and solid regulations can lead to sustainable building development in Nigeria.

Keywords: Built environment, Climate Change, Nigeria, Policy impact, Professionals, Sustainable Building Development.

1. Introduction

Climate change refers to long-term shifts in weather patterns resulting from natural or human causes. Climate change has emerged as a worldwide issue, with its consequences persistently jeopardising human existence and significantly impacting people's livelihoods worldwide. Nigeria and numerous other countries confront the formidable obstacles presented by climate change (Odjubo, 2010). The housing sector is crucial in climate change research due to buildings' significant impact on the activities that contribute to climate change. Moreover, it is worth mentioning that buildings are recognised as the primary sources of greenhouse gas (GHG) carbon emissions because of their significant energy usage. Specifically, residential structures contribute the most to the overall energy consumption (Jens Laustsen et al., 2011). Therefore, building development is a significant source of problems posed by climate change. Buildings are crucial for the progress of every nation and are integral to human daily life (Cam, 2012). However, they result from human construction efforts utilising natural resources (Surenran & Sekar, 2010). Surenran and Sekar (2010) note that these natural resources are decreasing. Therefore, it is imperative for experts in the built environment to actively participate in alternative processes and utilise renewable natural resources in order to reduce the effect of climate change on the environment.

Buildings make a substantial contribution to the emission of greenhouse gases and the depletion of resources. Hence, Sustainable building development is becoming increasingly important to reduce these adverse effects while promoting resilience and adaptation. Sustainable buildings, as described by researchers and academics, are green buildings that surpass conventional ones in their potential to decrease GHG emissions and meet the Net-Zero Carbon Buildings Commitment (Wang et al., 2016). Sustainable buildings require efficient adaptation to climate changes and committed

parties to maintain long-term viability. Effective design should consider current climatic indices to successfully mitigate and adapt to changes (Guan, 2009; Radhi, 2009; Bond, 2011). Dedicated individuals or groups involved in this process are critical to making a significant impact.

Denton et al. (2002) report that the West African region is very susceptible to the impacts of climate change due to its high likelihood of experiencing drought and desertification, heavy reliance on subsistence agriculture, and susceptibility to inadequate rainfall. Nigeria is a prominent African country and the most populous nation on the continent. According to the National Population Commission (2012) and World Gazetteer (2014), it is also the 7th most populated country globally.

According to Odjubo (2010), there is evidence of the effects of climate change in Nigeria. Nigeria is also facing a housing deficit, which adds to the existing climate change problems. The housing gap in Nigeria is estimated to be around 16-17 million Mbazor (2018). This indicates the possibility of significant future emissions if sustainable initiatives are disregarded. Hence, achieving success in Nigeria will undeniably have a good impact on the entire continent.

Despite growing interest and efforts, more research is needed to understand the socio-cultural dimensions of sustainability initiatives in Nigeria to address these problems. This research, therefore, evaluates the effectiveness of current policies and frameworks promoting sustainable building practices in Nigeria. It involves multiple stakeholders, as sustainable building development in Nigeria requires collaboration. The study offers insights into the socio-cultural, economic, and governance aspects of sustainable building development. The findings enable the development of relevant strategies to tackle climate change in the built environment.

2. Literature Review

2.1. Climate change and sustainable development

Climate change and sustainable development are two distinct ways to address global environmental change. Climate change is a significant manifestation of unsustainability. The public's awareness of Climate Change and Global Warming has significantly increased, as these phenomena offer insights into the current state of the climate. Although the two phrases have similar meanings, they are used in slightly distinct semantic situations, as Lineman et al. (2015) observed. Global warming is recognised as a significant issue. It is currently considered the most crucial challenge that humanity will face in several years. (Buttel et al., 1990).

Research has demonstrated that underdeveloped countries would experience the most severe consequences of climate change, as their populations are highly susceptible and have limited capacity to adapt. The fluctuations in temperature, availability, and purity of water will significantly affect agricultural output, human habitation and well-being, biodiversity, and the migration patterns of animals (IPCC, 2001a,b). According to Dorling (2021), the world's population will increase from 7.7 billion to 9.7 billion by 2050 and is expected to exceed 10.9 billion by the end of the century. This will increase demand for water, energy, and natural resources, putting pressure on biological systems and degrading the environment. It will also significantly impact the built environment. Butt et al. (2010) suggest that the built environment sector should incorporate sustainability into its activities. Akadiri et al. (2012) believe that the sector can collaborate and lead in the global sustainable agenda, which requires all developmental activities to include sustainability. Nevertheless, the sustainable development research community has typically overlooked the potential consequences of climate change on the progress towards creating more sustainable societies (Sev, 2009; UN-Habitat, 2009; Janda, 2011).

The topic of sustainable buildings has become a significant concern for numerous developing and developed nations in the twenty-first century. The building sector is one of the most energy-intensive sectors. It contributes to around 33% of the overall greenhouse gas (GHG) emissions, making it a crucial contributor to global warming

and climate change. This activity also produces waste and potentially hazardous atmospheric emissions (Shad et al., 2017; Wang et al., 2016; Danish et al., 2019). Buildings are not only responsible for contributing to climate change but are also vulnerable to the impacts of climate change. Lam et al. (2005) claimed that buildings and climate are intricately interconnected since they mutually influence each other, directly impacting the environment and leading to changes in architectural methodologies and design decisions worldwide. UN-Habitat (2009) report revealed that buildings are highly susceptible to climate change, including floods, hurricanes, bushfires, and other unfavourable conditions that can significantly affect their proper functioning. The significance of this relationship is that buildings serve as a connection point between the external environment, which is affected by climate change, and the internal environment, as well as the occupants' comfort needs (Zubairu, 2012).

The impact of construction on climate change can be noticed at every level of the building development process, starting from the design phase, continuing through the construction phase, and extending to the management stage. Jagger et al. (2013) argue that the construction industry, specifically the building sector, is crucial in reducing carbon emissions by implementing sustainable practices in all aspects of building production, including material selection and usage, site management, and maintenance.

3. Methodology

The research used a survey design to gather data by distributing 265 questionnaires to randomly selected participants. Out of the 265 questionnaires provided, only 250 were returned and used for the study. The data collected from the respondents was analysed using descriptive statistics such as simple percentages, mean, and standard deviations. Additionally, inferential statistics, specifically t-test statistics, were used to assess the effectiveness of policies and frameworks promoting sustainable building practices in Nigeria. The t-test statistics were employed because of the sufficiently large sample size. More so, it was the t-critical ratio that was used, not just the ordinary t-test, that only considered the sample size of less than 30. This approach was chosen to determine the significance of each test item. It was assumed that the population mean for each test item was normal or zero.

4. Findings and Discussion

4.1. Respondents Demographic Characteristics

The respondents' demographic characteristics are presented below:

Table 2: Frequency Distribution of Respondents Demographic Characteristics

Demographic Variable	**Frequency**	**% Percentage**
Discipline		
Architecture	44	17.60
Estate management	60	24.00
Contractors/developers	100	40.00
Engineers	30	12.00
Others	20	8.00
Gender		
Male	190	76.00
Female	60	24.00
Ethnicity		
Yoruba	120	48.00
Igbo	80	32.00
Hausa	50	20.00
Level of Education Qualification		
No formal education	8	3.20
Primary Education	10	4.00
Secondary education	20	8.00
Tertiary Education	212	84.80

Source: Researchers' Field work, 2024

Table 1 displays the frequency distribution of the demographic parameters of the respondents. The table shows that the frequency distribution of respondents by discipline indicated that 17.60% were architects. By comparison, the survey revealed that 24% of the participants were estate managers, 40% were contractors/developers, 12% were engineers, and 8% fell into the "others" category, which included government servants, homeowners, and line managers involved in building projects.

This suggests that a significant proportion of the participants worked as contractors or developers. Therefore, any viewpoint from this group of participants could improve the research results.

The data shows that 76% of the respondents were male, while 24% were female. This indicates a satisfactory proportion of male participants. Additionally, the analysis of respondents' ethnicity found that 48% identified as Yoruba, 32% as Igbo, and 20% as Hausa. This suggests that a sufficient proportion of the participants were from the Yoruba ethnic group. These variables could potentially enhance the accessibility of insights for the researcher's discoveries.

It was found that 3.20% of the respondents had no formal education, while 4% had completed primary education. Moreover, 8% and 84.80% of the participants had secondary and tertiary educational qualifications, respectively. This suggests that a significant number of the participants had higher education credentials. Including this specific group of participants could significantly contribute to the study's outcomes.

4.2. Perception of Respondents on Sustainable Building Development in Nigeria: A Climate Change Consideration

Nigeria needs to adopt sustainable building development to address the challenges arising from climate change. Sustainable buildings can withstand the test of time and respond positively to climate change. Table 2 shows the frequency distribution of respondents on sustainable building development and climate change.

Table 3: Mean and Standard Deviation computed for the variable of sustainable Building Development

S/N	Variables	N	Mean	STD	Rank	Remark
1	Effectiveness of current sustainable Building Policies (ECSBP)	250	4.06	0.99	7th	Fairly Adopted
2	Awareness and Adoption of sustainable Building Practices (AASBP)	250	4.19	0.76	5th	Adopted

S/N	Variables	N	Mean	STD	Rank	Remark
3	Integration of Climate Change Considerations in Building Design and Construction (ICCBDC)	250	3.73	1.04	8.5th	Fairly Adopted
4	Perceived impact of sustainable Buildings on Climate Resilience (PISBCR)	250	4.10	0.89	6th	Fairly Adopted
5	Barriers to Sustainable Building Development (BSBD)	250	3.73	1.04	8.5th	Fairly Adopted
6	Perceived Effectiveness of Sustainable Building Technologies (PESBT)	250	4.46	0.65	1st	Seriously Adopted
7	Capacity Building Needs for Sustainable Building Professionals	250	4.43	0.66	2.5th	Seriously Adopted
8	Public Perception and Acceptance of Sustainable Buildings	250	4.29	0.74	4th	Seriously Adopted
9	Long-Term Viability and Performance of Sustainable Building	250	4.43	0.66	2.5th	Seriously Adopted

** Acceptable mean =3.00 on a 5-point Likert scale.

Source: Author's Fieldwork, 2024

A test item was fairly adopted, adopted and seriously adopted if the mean was calculated greater than or equal to 3.00 or otherwise **STD= Standard Deviation ** Ranked was done on the basis of STD.

Table 2 shows that most participants perceive the current sustainable building policies as effective. The average value of 4.06 is significantly higher than the acceptable average of 3.00, indicating that the policies have successfully met building requirements. Respondents also believe that awareness and adoption of sustainable building practices have been enhanced through public relations and information dissemination—the results in Table 2 show that climate change is integrated into building design and construction. The perceived impact of climate change on

sustainable buildings has been effectively addressed, and barriers to sustainable building development have been incorporated into different components of building sustainability strategies. These assertions were based on the fact that the average value for test items was higher than 3.00, with minor deviations from the average indicated by standard deviations.

Moreover, the results in Table 2 inspire optimism. They show that sustainable building technologies are effective, that capacity-building is needed for sustainable building professionals, and that there is a positive public perception and acceptance of sustainable buildings. This indicates that buildings can be sustainable and viable in the long term with sustainable building policies that encourage modern technologies.

Table 4: T-test Calculated for the variable of Sustainable Building Development

Variable	Coefficient	Standard Error	T-calculated	P-value	Remark
Effectiveness of current sustainable Building Policies (ECSBP)	0.45	0.11	4.09	0.0000	Significant
Awareness and Adoption of sustainable Building Practices (AASBP)	0.26	0.032	8.13	0.0000	Significant
Integration of Climate Change Considerations in Building Design and Construction (ICCBDC)	0.016	0.0021	7.62	0.0000	Significant
Perceived impact of sustainable Buildings on Climate Resilience (PISBCR)	0.087	0.0034	25.59	0.0000	Significant
Barriers to Sustainable Building Development (BSBD)	-0.93	0.063	-14.76	0.0000	Significant
Perceived Effectiveness of Sustainable Building Technologies (PESBT)	0.65	0.21	3.10	0.0007	Significant

Variable	Coefficient	Standard Error	T-calculated	P-value	Remark
Capacity Building Needs for Sustainable Building Professionals	1.05	0.11	9.55	0.0000	Significant
Public Perception and Acceptance of Sustainable Buildings	0.38	0.26	1.46	0.3560	Significant
Long-Term Viability and Performance of Sustainable Building	0.054	0.013	9.55	0.0000	Significant

Source: Researcher's Computation (E-view 12) ** The Test was carried out at a 5% critical level of significance.

Table 3 shows the t-test results on sustainable building development policies in Nigeria. The findings indicate that the policies are effective in addressing climate change goals. The p-value of the t-statistics was 0.0000, lower than the critical value of 5%, indicating the variable's significance, and the regression coefficient was positive at 0.45. Having solid policies is crucial for building sustainability in Nigeria. Awareness and adaptation of sustainable building practices are significant for sustainable building development. The test item was statistically significant with a t-statistic value of 8.13 and p-value of 0.0000, and it positively contributes to sustainable building development. The regression coefficient of 0.26 indicates that higher awareness and adaptation of sustainable building practices lead to better compliance with standards, procedures, and practices for achieving better sustainability in building projects.

Considering climate change in building design and construction is crucial for sustainable development. The test item significantly impacted sustainable building development, with a p-value below 5% and a t-statistics value of 7.62. Even a slight increase of 1% in ICCBDC can lead to a 0.016% improvement in building sustainability. To achieve building sustainability, professionals must anticipate potential climate effects and take corrective measures during development. Table 3 further shows that sustainable buildings significantly impact climate change resilience in building development. The obtained t-statistics p-value of 0.0000 is lower than the

critical value of 5%. A 1% increase in PISBCR results will account for a 0.087% increase in sustainable building development. Considering this impact from the beginning of any building project is essential.

Table 3 further shows that significant barriers in Nigeria hinder sustainable building practices and development. The test item was statistically significant with a t-statistic value of -14.76 and a p-value of 0.0000, indicating that it negatively contributes to sustainable building development. Primary obstacles included unskilled workers, dishonest developers, inadequate funding, high poverty rates, lack of cooperation from building owners, and government failure to penalise fraudulent builders. These obstacles make it challenging to design and construct buildings that can withstand the effects of climate change.

The result further shows that sustainable building technology is significant in building development. A 1% increase in PESBT could lead to a 0.65% increase in building development sustainability in Nigeria. Latest technologies can enhance building sustainability, which is why collaboration among stakeholders is necessary to deploy proper building technology. Furthermore, Sustainable building professionals in Nigeria require capacity building. The t-value of the computed t-statistics for the test variable was 0.0000, smaller than the critical value of 5%, while the t-statistics value of 9.55 was statistically significant. Adequate training for developers, contractors, estate surveyors, valuers, and other stakeholders is crucial for achieving sustainable building development, and modern trends should be exposed.

Public perception and acceptance did not significantly affect building sustainability in Nigeria, with a p-value of 0.3560 and a t-statistics value of 1.46. Due to low perception and acceptance in Nigeria, increasing awareness and education on sustainable construction development is important. The test variable positively impacted sustainable building development but was not statistically significant, with a regression coefficient of 0.38.

Finally, the variable of the long-term viability and performance of sustainable buildings was found to be significant in building development in Nigeria. A t-statistics value of 9.55 was considered significant, indicating that the p-value of the test item was below

5%. Therefore, building professionals must ensure sustainable buildings meet current climate change standards and specifications.

5. Conclusions and Recommendations

5.1. Conclusions

Sustainable building development in Nigeria is possible by adhering to professional standards and regulations. The effectiveness of current sustainable building policies, awareness and adaptation of sustainable buildings, integration of climate change consideration, and perceived impact of sustainable buildings on climate resilience enhanced sustainable building development in Nigeria in the face of unpredictable climate change. Furthermore, the perceived effectiveness of sustainable building technologies, capacity building needs for sustainable building development, long-term viability, and performance of sustainable buildings have contributed positively to sustainable building development in Nigeria despite the worsening climate change situation.

However, public perception and acceptance of sustainable buildings did not significantly affect building development in Nigeria. Additionally, barriers to sustainable building development negatively affected it.

5.2. Recommendations

Recommendations to improve sustainable building practices in Nigeria:

1. Ensure all stakeholders' adherence to sustainable building standards.
2. Sanction erring developers to reduce quackery's effect on building development.
3. Emphasise capacity building for building professionals to keep them updated with the latest trends in sustainable building.

References

Akadiri, P. O., Chinyio, E. A., & Olomolaiye, P. O. (2012). Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. *Buildings*, 2(2), 126-152.

Bond, S. (2011). Barriers and Drivers to Green Buildings in Australia and New Zealand. *Journal of Property Investment and Finance*, 29 (4/5), 494 – 509.

Butt, T. E., Umeadi, B. B. N. and Jones, K. G. (2010) Sustainable development and climate change induced obsolescence in the built environment. www.kadinst.hku.hk/sdconf10/Papers/p160.pdf (Accessed 11/10/2023)

Buttel, F. H., Hawkins, A. P., & Power, A. G. (1990). From limits to growth to global change: constraints and contradictions in the evolution of environmental science and ideology. *Global Environmental Change*, 1(1), 57–66.

Cam, W. C. (2012). Technologies for Climate Change Mitigation (Building Sector) http://www.uneprisoe.org/ (Accessed 20/11/2023)

Danish, M. S. S., Senjyu, T., Ibrahimi, A. M., Ahmadi, M., & Howlader, A. M. (2019). A managed framework for energy-efficient building. *Journal of Building Engineering*, 21, 120-128.

Denton, F., Sokona, Y., Thomas, J.P., 2002. Climate change and sustainable development strategies in the making: What should West African countries expect? OECD, Environnement et Développement du Tiers Monde (ENDA-TM), Dakar, Sénégal. http://www.oecd.org/env/cc.

Dorling, D. (2021). World population prospects at the UN: Our numbers are not our problem? In *The Struggle for Social Sustainability* (pp. 129–154). Policy Press.

Guan, L. (2009). Sensitivity of Building Zones to Potential Global Warming, *Architectural Science Review*, 52(4), 279–294.

IPCC, (2001a). Climate Change 2001: Impacts, adaptation, and vulnerability. In: McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J., White K.S. (Eds.), A Report of the Working Group II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

IPCC, (2001b). IPCC Third Assessment Report, Synthesis Report. Cambridge University Press, Cambridge.

Jagger N, Foxon, T & Gouldson, A. (2013). Skills Constraints and the Low Carbon Transition, *Climate Policy*, 13(1), 43–57.

Janda, K. B. (2011). Buildings Don't Use Energy: People Do. *Architectural Science Review*, 54(1), 15–22.

Jens Laustsen, J., Ruyssevelt, P., Staniaszek, D., & Strong, D. (2011). Europe's buildings under the microscope: a country-by-country review of the energy performance of buildings.

Lam, J. C., Tsang, C. L., Yang, L., & Li, D. H. (2005). Weather data analysis and design implications for different climatic zones in China. *Building and Environment*, 40(2), 277-296.

Lineman, M., Do, Y., Kim, J. Y., & Joo, G. J. (2015). Talking about climate change and global warming. *PloS one*, 10(9), e0138996.

Mbazor, D. N. (2018). Assessment of housing quality and environmental conditions in selected areas of Akure, Nigeria. *International Journal of Development and Sustainability*, 7(3), 1049-1061.

National Population Commission (2012). Nigeria's over 167 million Populations: Implications and Challenges. www.population.gov.ng. (Accessed 10/12/2023)

Odjugo, P. A. O. (2010). Regional Evidence of Climate Change in Nigeria. *Journal of Geography and Regional Planning*, 3(6), 142-150.

Radhi, H. (2009). Evaluating the Potential Impact of Global Warming on the Use Residential Buildings - A Contribution to Reduce the Co2 Emissions. *Building and Environment*, 44(12), 2451–2462.

Sev, A. (2009). How can the construction industry contribute to sustainable development? A conceptual framework. *Sustainable Development*, 17(3), 161–173.

Shad, R., Khorrami, M., & Ghaemi, M. (2017). Developing an Iranian green building assessment tool using decision making methods and geographical information system: Case study in Mashhad city. *Renewable and Sustainable Energy Reviews, 67*, 324-340.

Surendan, A. and Sekar, C. (2010). An Economic Analysis of Willingness to Pay (WTP) for Conserving the Biodiversity. *International Journal of Social Economics*, 37(8), 637-648.

UN-Habitat (2009) Sustainable urbanisation: Revisiting the role of urban planning, Global report on human settlements, Nairobi: UN-Habitat.

Wang, Q., Zhao, D., & He, L. (2016). Contracting emission reduction for supply chains considering market low-carbon preference. *Journal of Cleaner Production*, 120, 72–84.

World Gazetteer (2014). The World Population http://www.geoba.se/population.php?pc=world&type=28 (Accessed 22/12/2023)

Zubairu, S. (2012). The importance of evaluation and sustainability in the built environment. In *Proceedings: 4th West Africa Built Environment Research (WABER) Conference* (pp. 9–13).