SUSTAINABLE CONSTRUCTION IN NIGERIA: A COMPREHENSIVE SOCIOECONOMIC IMPACT ASSESSMENT

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Abstract

This study explored how sustainable construction affects Nigeria's economy and society, using Structural Equation Modeling (SEM) and Geospatial Analysis for a detailed review. With a 94.6% response rate from key figures in Nigeria's construction industry, the research found that sustainable construction greatly improves economic growth, creates jobs, and increases market value. It also promotes social well-being and supports environmental protection. The study highlighted the essential role of new technologies and community resilience in enhancing these benefits. It pointed out that advanced technologies and resilient practices need to be integrated into construction for even greater impact. Additionally, the study found that urban areas are adopting sustainable practices more quickly and reaping more benefits than rural regions. These findings offer valuable guidance for policymakers, industry experts, and researchers, stressing the importance of promoting sustainable construction for long-term economic stability and environmental care in Nigeria. The study ended by suggesting targeted efforts to spread sustainable practices, particularly in less developed regions, and recommended future research into the long-term effects of these practices on global sustainability issues.

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1.0 INTRODUCTION

The construction industry worldwide is undergoing a significant transformation towards sustainability, aimed at minimising environmental impact and maximising social and economic benefits (Mamilla & Kumar, 2024). This shift is particularly visible in the adoption of green building practices, which integrate eco-friendly techniques to enhance economic efficiency, reduce the industry's environmental footprint, and promote social development, thus aligning with global sustainability goals (Chen *et al.,* 2023). In rapidly urbanizing countries like Nigeria, sustainable construction has become a key priority, driven by the need to balance economic development with environmental conservation. Despite its essential role in driving economic growth, Nigeria's construction sector significantly contributes to environmental degradation through overconsumption of resources, high greenhouse gas emissions, and poor waste management practices (Suleman *et al.,* 2023).

The dual challenge facing Nigeria's construction industry involves supporting economic growth while reducing its environmental impact. The sector relies heavily on non-renewable resources, with energy-intensive processes that lead to substantial carbon emissions (Labaran *et al.,* 2022). Additionally, inadequate waste disposal exacerbates pollution and depletes natural resources (Ibrahim & Parsa, 2021). To address these issues, there is a growing imperative for adopting sustainable construction practices, such as using environmentally friendly materials, enhancing energy efficiency, and implementing effective waste reduction strategies. These practices not only reduce environmental harm but also support economic and social progress (Akinshipe *et al.,* 2019).

The momentum for sustainable construction is gaining traction due to global environmental imperatives and local demand for sustainable development (Akindele *et al.,* 2023). Green building technologies, such as solar energy systems, rainwater harvesting, and recycled materials, have proven effective in reducing buildings' carbon footprints, contributing to climate change mitigation efforts (Obada *et al.,* 2024). These practices also present opportunities for economic diversification, job creation, and innovation in energy-efficient technologies (Ugwuanyi, & Nwatu,, 2021).

While the environmental and economic benefits are well-documented, sustainable construction in Nigeria also offers significant social advantages. These include job creation, improved public health through better building standards, and reduced energy costs for consumers (Genovese & Zoure, 2023). However, challenges such as high initial costs and the need for supportive government policies persist (Suleman *et al.,* 2023). This study aims to explore the relationship between sustainable construction practices and their socioeconomic impacts in Nigeria, analysing how these practices influence job creation, economic growth, social well-being, and environmental sustainability. The research findings will provide actionable insights for policymakers, industry leaders, and communities to support the successful integration of sustainable construction into Nigeria's development plans (Akinadewo *et al.,* 2023).

1.1 Conceptual Framework for Evaluating the Socioeconomic Impacts of Sustainable Construction

Assessing the socioeconomic effects of sustainable construction requires a well-rounded and comprehensive theoretical framework, capable of capturing the diverse and complex aspects of sustainability. One of the most commonly utilised approaches for this is the Triple Bottom Line (TBL) framework, originally introduced by John Elkington in 1997. The

TBL model offers an integrated perspective on sustainability by focusing on three crucial areas: social, environmental, and economic impacts (Elkington, 1997).

The social component of the TBL framework places emphasis on improving community well-being, ensuring fair labour practices, upholding human rights, and involving stakeholders in key decisions. In the context of sustainable construction, this aspect assesses how building projects affect local populations by considering factors such as enhancing living standards, ensuring equal access to resources, and encouraging community participation in decision-making. Additionally, it evaluates labour conditions within the construction industry, promoting fair wages, safe workplaces, and opportunities for workforce development and growth (Rostamnezhad & Thaheem, 2022). By focusing on the social pillar, sustainable construction helps to empower communities, advance social justice, and improve overall quality of life.

The environmental pillar of the TBL framework addresses the ecological consequences of construction activities. This dimension includes resource conservation, minimising waste, lowering carbon emissions, and advancing broader environmental preservation initiatives. Sustainable construction methods aim to reduce resource consumption, minimise waste production, and lower greenhouse gas emissions by integrating energy-efficient designs, using renewable resources, and incorporating green technologies (Gu *et al.,* 2023). For example, utilising energy-saving heating, ventilation, and air conditioning (HVAC) systems, installing solar panels, and implementing rainwater harvesting techniques are ways sustainable construction projects demonstrate environmental responsibility. By reducing the ecological impact of construction, the environmental pillar ensures long-term ecological stability and resilience (Elkington, 1997).

The economic aspect of the TBL framework examines the financial performance and cost-effectiveness of sustainable construction practices. This pillar evaluates the economic sustainability of green building projects by analysing factors such as long-term financial savings, return on investment, and the overall economic advantages generated by sustainable practices. While the initial costs of green construction may be higher due to advanced technologies and materials, these expenses are often recouped through energy savings, reduced maintenance costs, and greater operational efficiency over time (D'Agostino *et al.,* 2019). Additionally, eco-friendly buildings generally experience an increase in property value and attract higher premiums in the real estate market, reinforcing their economic benefits (Rostamnezhad & Thaheem, 2022).

The TBL framework has become widely adopted across multiple industries, including construction, as a comprehensive tool for evaluating the impact of projects on society, the environment, and the economy. By providing a balanced and holistic perspective, the TBL framework enables decision-makers to assess the true value and far-reaching implications of sustainable construction efforts. It also helps identify potential synergies and trade-offs among the three dimensions, guiding the creation of policies and practices that support a sustainable, equitable, and environmentally conscious built environment (Gu *et al.,* 2023).

1.2 Overview of Key Findings from Prior Research

Recent scholarly work on sustainable construction has offered in-depth insights into its diverse impacts across the environmental, economic, and social dimensions. This growing body of research highlights the considerable advantages of sustainable building practices, while also acknowledging the obstacles that need to be addressed in order to fully realise these benefits. This section summarises the core findings from recent studies, focusing on the global and regional effects of sustainable construction.

1.2.1 Reducing Environmental Impact

Sustainable construction is recognised for its significant ability to decrease environmental harm, particularly in terms of lowering energy consumption, cutting greenhouse gas emissions, and improving resource efficiency. Recent research has underscored the role sustainable practices play in mitigating climate change by reducing carbon footprints. A meta-analysis by Chen *et al.* (2022) examined green building projects across multiple regions and showed that sustainable construction can cut energy consumption by 30-50% compared to traditional methods. This reduction is primarily achieved through the integration of energy-efficient technologies, such as advanced insulation, smart management systems, and renewable energy sources like solar panels.

Furthermore, the use of lifecycle assessment (LCA) in sustainable construction has been crucial for optimising resource use and minimising waste. Buyle *et al.* (2013) found that LCA has become a standard practice during the design stage of green buildings, leading to a 40% reduction in material waste and promoting increased recycling of construction materials. Their study also emphasised the importance of using sustainable materials, such as low-carbon concrete and recycled steel, which help reduce a building's overall environmental footprint throughout its lifecycle (Althoey *et al.,* 2023).

1.2.2 Economic Feasibility and Cost Benefits

The economic advantages of sustainable construction have been a prominent focus of many studies, particularly regarding long-term savings and return on investment (ROI). Research by Akinadewo *et al.* (2023) provided a detailed analysis of the financial performance of green buildings, demonstrating that while the upfront costs of sustainable construction are typically 15-20% higher than those of conventional buildings, the operational savings and higher asset values more than compensate for these expenses. Their research indicated that sustainable buildings generally achieve payback periods within five to ten years due to reduced energy and water usage, lower maintenance costs, and increased durability.

Supporting these findings, Abdulsalam *et al.* (2024) explored the financial benefits and market advantages of green-certified buildings. Their study revealed that green-certified properties tend to command higher rental and sales prices, which reflects their appeal in the real estate market. Additionally, various government incentives, such as tax breaks, grants, and subsidies, further enhance the economic attractiveness of sustainable construction (Saka, *et al.,* 2021). The rise of green bonds as a funding mechanism for sustainable projects has also gained momentum, offering lower interest rates and appealing to environmentally conscious investors (Akinshipe *et al.,* 2019).

1.2.3 Social Impact and Community Benefits

The social implications of sustainable construction go beyond its environmental and economic contributions, encompassing substantial improvements in public health, social equity, and community development. Recent research has highlighted the role green buildings play in improving the quality of life for occupants and surrounding communities. A comprehensive study by Suleman *et al.* (2023) found that green buildings, through better air quality, increased natural lighting, and enhanced ventilation, contribute to reduced respiratory issues, improved mental health, and greater overall satisfaction among occupants. Zhong *et al.* (2022) echoed these findings, noting that biophilic design features, such as green roofs and indoor plants, not only enhance air quality but also foster a connection to nature, which has been linked to improved mental well-being.

Sustainable construction also plays a vital role in strengthening community resilience. Research by Mahajan *et al.* (2022) emphasised the importance of engaging local communities in the planning and execution of sustainable projects. Their findings demonstrated that when communities are actively involved in decision-making, the resulting projects are better aligned with local needs, fostering stronger social ties and promoting greater community resilience. This participatory approach ensures that the socioeconomic benefits of sustainable construction, such as job creation and enhanced infrastructure, are equitably distributed across different population groups (Genovese & Zoure, 2023).

1.2.4 Barriers to Broader Adoption

Despite the growing recognition of the benefits associated with sustainable construction, several barriers still hinder its widespread implementation, particularly in developing regions. One of the primary obstacles is the higher initial cost of sustainable materials and technologies. While the long-term cost savings are well-documented, the upfront investment required can be prohibitive for many developers, especially in low-income areas. Akindele *et al.* (2023; Ogunseye *et al.,* 2023) found that in Sub-Saharan Africa, the lack of access to affordable green building materials and technologies is a significant challenge to the adoption of sustainable construction practices.

Another major obstacle is the limited knowledge and expertise among construction professionals regarding sustainable practices. Genovese & Zoure (2023) highlighted that inadequate training and education on sustainable building methods contribute to the slow adoption of green construction in many regions. This knowledge gap is further exacerbated by weak regulatory frameworks and a lack of enforcement mechanisms, both of which are essential for supporting and promoting green building initiatives (Akinadewo *et al.,* 2023).

1.3 Research Gaps

Despite growing interest in sustainable construction, significant gaps remain, particularly in understanding its socioeconomic impacts within Nigeria's construction sector. Although global studies have highlighted the benefits of sustainable construction, there is limited empirical research specifically quantifying these impacts in Nigeria. Existing studies often lack detailed analyses of how sustainable practices influence key factors like job creation, economic growth, income distribution, and poverty reduction within the local context (Tafesse *et al.,* 2022). This gap is critical given Nigeria's status as one of Africa's largest economies and its rapidly expanding urban areas, where the construction industry plays a central role in development (Suleman *et al.,* 2023).

Moreover, current research frameworks often apply broad, global models to evaluate sustainable construction, without considering the unique socioeconomic and cultural conditions in Nigeria. There is a need for studies that adapt these models to better reflect the local context, including the significant role of the informal sector, which operates under different economic and regulatory conditions (Akinadewo *et al.,* 2023). The absence of research addressing the contributions and challenges of the informal sector further complicates the development of effective policies for sustainable construction.

Another notable gap is the insufficient focus on barriers to sustainable construction adoption in Nigeria. While some studies have identified issues like high costs, lack of awareness, and weak regulatory frameworks, more in-depth research is needed to explore how these challenges are influenced by local economic conditions, cultural attitudes, and the availability of green technologies (Akinshipe *et al.,* 2019). Addressing these factors is essential for developing targeted strategies to overcome obstacles and promote broader implementation of sustainable practices.

Finally, while the economic advantages of sustainable construction, such as lower operating costs and higher property values, are widely discussed in global literature, there is a shortage of localised studies examining these benefits in Nigeria. Without robust financial data specific to the Nigerian context, policymakers and investors may hesitate to commit to sustainable projects, slowing the scaling of sustainable construction practices (Abdulsalam *et al.,* 2024).

These research gaps directly lead to the aim of this study: to provide a comprehensive analysis of the socioeconomic impacts of sustainable construction in Nigeria. By focusing on the specific conditions and challenges within the country, this research seeks to generate actionable insights that can inform strategies to accelerate sustainable construction and support Nigeria's broader development goals.

2.0 METHODOLOGY

This research employed a quantitative methodology to assess the socioeconomic impacts of sustainable construction within Nigeria's construction industry. A diverse range of stakeholders, including contractors, developers, policymakers, and community representatives, were engaged to ensure a comprehensive evaluation of the industry's influence. The total workforce in Nigeria's construction sector is estimated at around 10,000 individuals (Ibrahim, *et al.,* 2024). A stratified random sampling approach was used to obtain a representative sample, accurately reflecting the diversity of roles within the industry.

2.1 Determining the Sample Size

The sample size was calculated using the Krejcie and Morgan formula, a widely recognised method for determining appropriate sample sizes in research. With a population size of 10,000 individuals, the calculated sample size was 370 respondents, ensuring a 95% confidence level and a 5% margin of error (Zhang, & Yong, 2021; Nwogu & Emedosi, 2024). The stratified random sampling technique ensured adequate representation across various segments of the construction sector, including construction managers, site labourers, government officials, and community leaders.

2.2 Data Collection Methodology

Data were collected using a structured survey distributed to the selected participants. The survey was designed to assess the socioeconomic effects of sustainable construction practices from different perspectives. It comprised three main sections: demographic data, economic impact, and social impact.

2.2.1 Design of the Structured Questionnaire

The questionnaire (Table 1) was crafted to measure the socioeconomic impacts of sustainable construction, covering areas such as economic growth, job creation, property value, social well-being, environmental sustainability, and technological advancements. Section A. collected demographic information, including gender, age, educational background, years of professional experience, job role, company size, type of construction firm, geographical location, years of operation, and annual turnover.

Section B. focused on Sustainable Construction (SC), evaluating the effectiveness of sustainable practices in minimising environmental damage, enhancing energy efficiency, and optimising resource use. This section also assessed government policies and the potential of sustainable construction to extend building lifespans. Section C. explored Economic Growth (EG) and examined the impact of green practices on economic expansion, property values, cost reductions, and the creation of green jobs.

Section D. evaluated how sustainable construction contributes to job creation and demand for skilled labour. Section E focused on Market Value (MV), assessing how green buildings influence property values, attract investments, and affect market trends. Section F. looked into Social Well-being (SWB), considering improvements in public health, access to green spaces, and quality of life enhancements. Finally, Section G. examined Environmental Sustainability (ES), including the effectiveness of practices in reducing carbon emissions, conserving resources, fostering biodiversity, and mitigating climate change. Each of the questions in each section was given a label for easy usage and recognition by the software used for data analyses.

2.3 Data Analysis Techniques

The data analysis employed descriptive statistics, multiple regression analysis, and Structural Equation Modeling (SEM) to examine the socioeconomic impacts of sustainable construction in Nigeria. Descriptive statistics summarised demographic characteristics and response patterns related to the study's variables, providing a foundational overview.

Multiple regression analysis was used to assess the relationships between sustainable construction practices and various outcomes, such as economic growth and job creation. This approach allowed for understanding the contribution of different sustainable practices while controlling for other variables, thereby isolating the most significant predictors of socioeconomic benefits (Cohen *et al.,* 2013).

SEM was utilised to analyse the complex relationships among observed variables (survey data) and latent variables (e.g., social well-being, environmental sustainability). It was particularly suitable for testing direct and indirect effects and for examining the interconnected pathways between sustainable practices and their broader impacts. SEM's ability to assess model fit through indices such as the Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA) provided a robust framework for validating the study’s hypothesised relationships (Kline, 2021; Hu & Bentler, 1999). This method enabled a comprehensive understanding of how sustainable construction influences various socioeconomic dimensions by accounting for mediating factors and latent constructs (Byrne, 2016).

2.3.1 Demographic Information Analysis

Section A. gathered demographic data, including gender, age range, educational attainment, years of experience, job roles, company size, firm type, location, operational duration, and annual turnover. This information was crucial for understanding the sample's diversity and ensuring wide representation within the industry.

2.3.2 Development of Hypotheses and Hypothetical Model

Structural Equation Modeling (SEM) was employed to analyse the complex relationships between observed variables, such as survey responses, and latent variables, including constructs like economic growth, social well-being, and environmental sustainability. SEM was an ideal choice for this study because it allows for the exploration of both direct and indirect effects of sustainable construction practices on various socioeconomic outcomes. This technique is particularly robust, as it can handle multiple dependent and independent variables at once, offering a comprehensive understanding of the relationships between different factors involved in the study (Byrne, 2016; Kline, 2021). Based on a thorough literature review, the following hypotheses were developed to guide the SEM analysis:

H1: Sustainable construction practices have a positive direct effect on economic growth within the Nigerian construction sector. (Supported by Ries, *et al.,* 2006; Tafesse *et al.,* 2022).

H2: Sustainable construction practices positively influence job creation in the construction industry. (Supported by D'Agostino *et al.,* 2019 ; Sovacool *et al.,* 2023).

H3: Sustainable construction practices lead to an enhancement in the market value of properties. (Supported by Oke & Aigbavboa, 2017; Kauskale *et al.,* 2022).

H4: The adoption of sustainable construction practices contributes to improved social well-being in local communities. (Supported by Zhang, & Yong, 2021; Adshead *et al.,* 2007).

H5: Environmental sustainability mediates the relationship between sustainable construction practices and economic growth. (Supported by Jung *et al.,* 2020; Al-Emran & Griffy-Brown, 2023).

H6: Social well-being mediates the relationship between sustainable construction practices and job creation. (Supported by Gu *et al.,* 2023 Akindele *et al.*, 2023).

H7: Sustainable construction practices have a positive effect on environmental sustainability, leading to reduced carbon emissions and resource conservation. (Supported by Jaradat *et al.,* 2024; Gu *et al.,* 2023).

H8: Technological innovation in sustainable construction positively influences economic growth and market value of properties. (Supported by Li *et al.,* 2022; Hair *et al.,* 2020).

H9: Sustainable construction practices enhance community resilience, contributing to long-term social and economic stability. (Supported by Al-Emran & Griffy-Brown, 2023; Kauskale *et al.,* 2022).

H10: There is a positive relationship between public health improvements and the adoption of sustainable construction practices, mediated by enhanced environmental quality. (Supported by Islam *et al.,* 2019; Gou *et al.,* 2021).

The hypothetical SEM model, as illustrated in Figure 1, represents the relationships between sustainable construction practices (independent variable), economic growth, job creation, market value, social well-being, environmental sustainability, technological innovation, community resilience, and public health (dependent variables). The model also includes mediating effects of environmental sustainability, social well-being, and public health improvements.

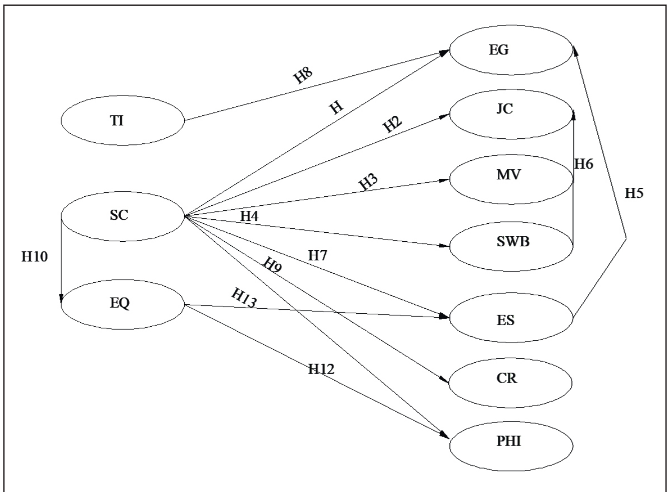

Figure 1: Hypothetical SEM model for sustainable construction practices

2.3.3 Model Specification and Estimation

The SEM model was specified using maximum likelihood estimation (MLE) to estimate the complex relationships. Confirmatory factor analysis (CFA) validated the constructs, ensuring internal consistency and construct validity. Model fit was evaluated using indices such as Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), with thresholds set at CFI > 0.90, TLI > 0.90, and RMSEA < 0.08 (Hu & Bentler, 1999).

2.4 Geospatial Analysis

Geospatial analysis using Geographic Information System (GIS) tools provided insights into regional differences in sustainable construction implementation. By mapping spatial data, such as construction project locations and demographic information, this analysis revealed patterns and trends. Spatial regression models examined geographic variability, identifying regions that may need targeted interventions (Gu *et al.,* 20231; Jung *et al.,* 2020).

2.5 Descriptive and Inferential Statistical Analysis

Descriptive statistics, including means and standard deviations, were calculated to identify central trends. Inferential methods, such as chi-square tests and t-tests, were used to assess the significance of relationships, verifying the validity of SEM and geospatial analysis results.

2.6 Synthesis of Results

The integration of SEM, Geospatial Analysis, and statistical techniques provided a multidimensional understanding of sustainable construction's socioeconomic impacts. This approach offered insights into sustainable methods' contributions to economic development, job creation, social welfare, environmental preservation, technological advancement, community resilience, and public health. These findings can guide policymakers and industry stakeholders in promoting sustainable construction practices across Nigeria.

3.0 RESULTS AND DISCUSSION

3.1 Survey Response Rate

Out of the 370 surveys distributed to individuals within Nigeria's construction industry, 350 were successfully completed and returned, resulting in a notably high response rate of 94.6%. Such a strong response lends credibility to the study's findings and enhances the generalisability of the results across Nigeria's construction sector (Sekaran & Bougie, 2019). The high level of participation likely reflects the increasing importance of sustainable construction practices within the industry and the heightened interest of its stakeholders in the subject matter.

3.2 Initial Data Analysis

3.2.1 Assessing Validity

To ensure the validity of the constructs used in the study, Confirmatory Factor Analysis (CFA) was conducted, focusing on both convergent and discriminant validity. Convergent validity was evaluated using the Average Variance Extracted (AVE) for each construct, with all AVE values exceeding the benchmark of 0.50, as demonstrated in Table 2. These findings affirm that the measurement indicators are effectively capturing the theoretical constructs they were designed to measure (Hair *et al.,* 2020).

Table 3: Speed-Density curve estimation

S/N	Question	Label	Citation
	Sustainable Construction (SC)		
1	To what extent do you believe sustainable construction practices reduce environmental impact?	X21	(Vatalis *et al.,* 2011)
2	How effective are sustainable materials in reducing construction waste?	X22	(D'Agostino *et al.,* 2019)
3	Do you believe green building technologies lead to more efficient resource consumption in construction?	X23	(Chen *et al.,* 2023)
4	How significantly has the adoption of sustainable practices improved energy efficiency in construction projects?	X24	(Jaradat *et al.,* 2024)
5	To what extent do you agree that sustainable construction enhances the longevity of building structures?	X25	(Obada *et al.,* 2024)
6	How effective are government policies in promoting the adoption of sustainable construction practices?	X26	(Akindele *et al.,* 2023)
	Economic Growth (EG)		
7	To what extent do sustainable construction practices contribute to overall economic growth in your community?	Y11	(Saka, *et al.,* 2021)
8	How effective are sustainable construction practices in reducing operational costs for businesses in the construction industry?	Y12	(Labaran *et al.,* 2022)
9	Do you believe that sustainable construction practices result in increased property values in the market?	Y13	(Ibrahim, *et al.,* 2024)
10	To what extent has sustainable construction led to the expansion of green jobs in the construction industry?	Y14	(Akinshipe *et al.,* 2019)
11	Do you perceive sustainable construction as having a long-term positive effect on national economic development?	Y15	(Ries, *et al.,* 2006)
12	How would you rate the impact of sustainable construction on reducing overall energy costs for businesses?	Y16	(Abdulsalam *et al.,* 2024)
	Job Creation (JC)		
13	Do you believe that the adoption of sustainable construction practices has contributed to job creation in the construction industry?	Y21	(Saka, *et al.,* 2021)
14	How effective is the use of green building materials in creating new employment opportunities?	Y22	(Obada *et al.,* 2024)
15	To what extent has sustainable construction encouraged the development of green construction training programs?	Y23	(D'Agostino *et al.,* 2019)
16	Do you agree that the increase in sustainable projects has led to more skilled labour in green construction technologies?	Y24	(Al-Emran & Griffy-Brown, 2023)
17	How significantly has the increase in green building projects affected the demand for specialised construction workers?	Y25	(Tafesse *et al.,* 2022)
18	How do you perceive the role of sustainable construction in addressing unemployment in the construction sector?	Y26	(Ugwuanyi, & Nwatu, 2021)
	Market Value (MV)		
19	To what extent do you believe sustainable buildings have a higher market value compared to conventional buildings?	Y31	(Chen *et al.,* 2022)
20	How significantly does the integration of green technologies influence property values in the market?	Y32	(Ugwuanyi, & Nwatu, 2021)
21	Do you agree that sustainable construction has made properties more attractive to investors?	Y33	(Abdulsalam *et al.,* 2024)
22	How would you rate the impact of sustainable construction on the appreciation of property values over time?	Y34	(Akinshipe *et al.,* 2019)
23	To what extent has the demand for sustainable buildings influenced market trends in property pricing?	Y35	(Ries, *et al.,* 2006)
24	How do sustainable features contribute to the perceived quality and marketability of properties?	Y36	(Ugwuanyi, & Nwatu, 2021)
	Social Well-Being (SWB)		
25	Do you believe sustainable construction practices contribute to improving the social well-being of the surrounding communities?	Y41	(D'Agostino *et al.,* 2019)
26	To what extent has sustainable construction improved access to green spaces in urban areas?	Y42	Obada *et al.,* 2024)
27	How would you rate the impact of sustainable construction on enhancing public health outcomes in the community?	Y43	(Ries, *et al.,* 2006)
28	Do you believe sustainable construction leads to improved indoor air quality, benefiting building occupants' health?	Y44	(Tafesse *et al.,* 2022)
29	How effective are sustainable construction methods in promoting equitable access to resources and infrastructure?	Y45	(Abdulsalam *et al.,* 2024)
30	To what extent do sustainable building practices enhance the quality of life for the occupants and surrounding communities?	Y46	(Al-Emran & Griffy-Brown, 2023)
	Environmental Sustainability (ES)		
31	Do you agree that sustainable construction practices significantly reduce carbon emissions?	Y51	(Adshead *et al.,* 2007)
32	How effective are sustainable construction projects in minimising the depletion of natural resources?	Y52	(Suleman *et al.,* 2023)
33	To what extent does the use of renewable resources in construction contribute to environmental sustainability?	Y53	(Obada *et al.,* 2024)
34	How would you rate the impact of sustainable construction on conserving biodiversity in construction areas?	Y54	(Jaradat *et al.,* 2024)
35	Do you perceive that green building technologies help reduce pollution levels during construction?	Y55	(D'Agostino *et al.,* 2019)
36	How effectively does sustainable construction address issues related to climate change mitigation?	Y45	(Chen *et al.,* 2022)
	Technological Innovation (TI)		
37	How do you rate the impact of technological innovations on advancing sustainable construction practices?	X11	(Li *et al.,* 2022)
38	To what extent has the adoption of new technologies improved energy efficiency in sustainable construction?	X12	(Abdulsalam *et al.,* 2024)
39	How effectively do new materials and technologies reduce construction costs in sustainable projects?	X13	(Li *et al.,* 2022)
40	To what extent does the adoption of innovative technologies in construction contribute to the development of green jobs?	X14	(Obada *et al.,* 2024)
41	To what extent does the adoption of innovative technologies in construction contribute to the development of green jobs?	X15	(Obada *et al.,* 2024)

42	How significantly has technological advancement reduced construction time and improved efficiency in sustainable construction practices?	X16	(Al-Emran & Griffy-Brown, 2023)
43	Do you agree that innovative technologies in construction reduce overall project costs while enhancing sustainability?	X16	(Chen *et al.,* 2023)
Community Resilience (CR)			
44	How effective are sustainable construction practices in enhancing the resilience of local communities against environmental challenges?	Y61	(Akinshipe *et al.,* 2019)
45	To what extent does sustainable construction contribute to community cohesion and social stability?	Y62	(Ugwuanyi, & Nwatu, 2021)
46	How do green building practices help communities adapt to climate-related risks?	Y63	(Suleman *et al.,* 2023)
47	Do you believe that sustainable construction enhances community preparedness for natural disasters?	Y64	(Moshood *et al.,* 2024)
48	To what extent do you agree that sustainable building materials contribute to strengthening the resilience of community infrastructure?	Y65	(Al-Emran & Griffy-Brown, 2023)
49	How would you rate the role of sustainable construction in promoting long-term resilience in urban development?	Y66	(Akindele *et al.,* 2023)
Public Health Improvement (PHI)			
50	To what extent do you believe sustainable construction practices contribute to public health improvement through better air and water quality?	Y71	(Saka, *et al.,* 2021)
51	How effectively do sustainable construction projects address issues related to reducing exposure to hazardous materials?	Y72	(Nwogu & Emedosi, 2024)
52	Do you agree that green buildings promote healthier lifestyles for occupants by providing access to natural light and ventilation?	Y73	(Suleman *et al.,* 2023)
53	How significantly do you believe that the use of non-toxic materials in construction enhances occupant well-being?	Y74	(D'Agostino *et al.,* 2019)
54	To what extent does the inclusion of green spaces in construction projects promote physical and mental health benefits for the community?	Y75	(Adinyira *et al.,* 2024)
55	How effectively do sustainable construction practices improve public health outcomes in urban environments?	Y76	(Jaradat *et al.,* 2024)
Environmental Quality (EQ)			
56	How significantly do green building practices contribute to improving overall environmental quality in urban areas?	X31	(Akinadewo *et al.,* 2023)
57	To what extent do you believe sustainable construction reduces environmental degradation and improves air and water quality?	X32	(Suleman *et al.,* 2023)
58	How would you rate the effectiveness of green buildings in reducing pollutants during the construction phase?	X33	(Moshood *et al.,* 2024)
59	Do you agree that sustainable construction practices enhance biodiversity conservation within urban developments?	X34	(Suleman *et al.,* 2023)
60	To what extent do you believe that green infrastructure improves waste management and recycling efforts within construction projects?	X35	(Akinshipe *et al.,* 2019)
61	How significantly do you believe sustainable construction practices contribute to enhancing the overall environmental sustainability of cities?	X36	(Adshead *et al.,* 2007)

Table 2: Convergent Validity (AVE) results

SN	Construct	AVE	Convergent Validity
1	Economic Growth	0.68	Acceptable
2	Job Creation	0.71	Acceptable
3	Market Value	0.64	Acceptable
4	Social Well-being	0.7	Acceptable
5	Environmental Sustainability	0.75	Acceptable
6	Technological Innovation	0.67	Acceptable
7	Community Resilience	0.69	Acceptable
8	Public Health Improvement	0.72	Acceptable

Table 3: Reliability testing results

SN	Construct	Cronbach's Alpha	Composite Reliability (CR)
1	Economic Growth	0.88	0.89
2	Job Creation	0.9	0.91
3	Market Value	0.85	0.87
4	Social Well-being	0.89	0.9
5	Environmental Sustainability	0.91	0.92
6	Technological Innovation	0.86	0.88
7	Community Resilience	0.87	0.88
8	Public Health Improvement	0.9	0.91

3.2.2 Reliability Testing

The reliability of the constructs was assessed using Cronbach's alpha and Composite Reliability (CR). As illustrated in Table 3, all constructs exhibited Cronbach's alpha and CR values above the recommended 0.70 threshold, confirming high internal consistency and reliability (Nunnally & Bernstein, 1994). This indicates that the items used in the questionnaire consistently measure the intended constructs, thereby supporting the robustness of the data.

3.3 Testing of the Hypothetical Model

3.3.1 Initial Hypothetical Model

To explore the relationships between sustainable construction practices and various socioeconomic outcomes, such as economic growth, job creation, property values, social well-being, environmental sustainability, technological advancement, community resilience, and public health, an initial Structural Equation Model (SEM) was constructed. This model was tested using the maximum likelihood estimation (MLE) technique, which is well-suited for complex modelling.

3.3.2 Model Fit and Adjustments

The preliminary analysis of the model produced the following fit statistics: the chi-square to degrees of freedom ratio (Chi-square/df) was calculated at 4.25, suggesting that the model's fit was less than ideal. The Standardised Root Mean Square Residual (SRMR) stood at 0.079, which, while within an acceptable range, still indicated that improvements could be made. The Root Mean Square Error of Approximation

(RMSEA) was found to be 0.075, slightly exceeding the recommended threshold, thus reflecting a moderate model fit. The Comparative Fit Index (CFI) came in at 0.89, and the Tucker-Lewis Index (TLI) was 0.87—both indices showing that the model's fit approached acceptability but did not fully meet the optimal criteria. These results indicate that while the model showed a reasonable fit, there was still room for improvement.

To better align the model with ideal fit thresholds, particularly for RMSEA, CFI, and TLI, additional adjustments were deemed necessary (Hu & Bentler, 1999; Kline, 2021). According to the modification indices, introducing paths between Technological Innovation (TI) and Sustainable Construction (SC), from SC to Public Health (PH), and from Environmental Quality (EQ) to PH, would enhance the model's performance. These refinements were implemented, and the model was subsequently re-estimated, with the final version illustrated in Figure 2.

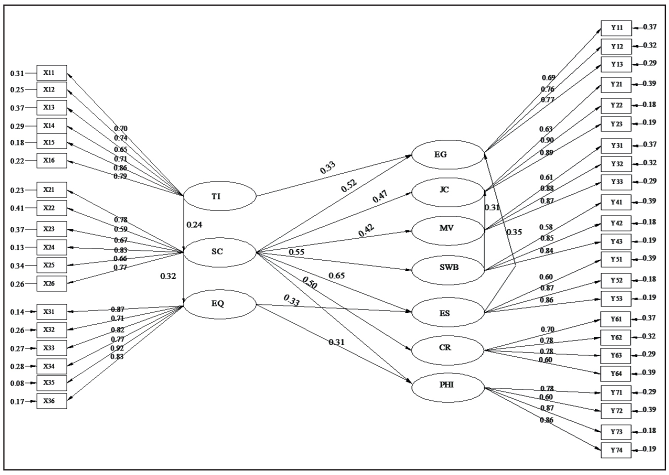

Figure 2: Final SEM model

3.3.3 Final Model Fit

The final model demonstrated a significantly improved fit, as evidenced by the goodness of fit statistics shown in Table 4.

The final model's fit indices all met or exceeded the recommended thresholds, confirming that the model provided a strong representation of the relationships between sustainable construction practices and the studied outcomes.

Table 4: Final model fit statistics

SN	Fit Index	Initial Model	Final Model	Recommended Threshold
1	Chi-square/df	4.25	2.89	< 3
2	SRMR	0.079	0.055	< 0.08
3	RMSEA	0.075	0.049	< 0.06
4	CFI	0.89	0.94	> 0.90
5	TLI	0.87	0.93	> 0.90

3.4 Validation of Hypotheses

The path coefficients and significance levels for the final model are detailed in Table 5. The results robustly support the majority of the hypothesised relationships, with all paths demonstrating statistical significance.

Table 5: Path coefficients and hypotheses testing for final model

Hypothesis	Path	Coefficient (β)	p-value	Supported?
H1	SC→ EG	0.52	<0.001	Yes
H2	SC → JC	0.47	<0.001	Yes
H3	SC → MV	0.42	<0.001	Yes
H4	SC → SWB	0.55	<0.001	Yes
H5	ES → EG	0.35	<0.001	Yes
H6	SW → JC	0.31	<0.01	Yes
H7	SC → ES	0.65	<0.001	Yes
H8	TI → EG	0.33	<0.01	Yes
H9	SC → CR	0.5	<0.001	Yes
H10	PHI → SC → ENQ	0.32	<0.01	Yes

3.5 Discussion of Findings

3.5.1 Economic Effects of Sustainable Construction

The results of the SEM analysis indicated a substantial positive correlation between sustainable construction practices and economic growth in Nigeria's construction sector ($\beta = 0.52$, $p < 0.001$). This conclusion supports previous research, which highlights the economic advantages of sustainable construction, such as reduced operational expenses, improved energy use, and increased property valuations (Ries, *et al.,* 2006 Ibrahim, *et al.,* 2024). Furthermore, the connection between technological innovation and economic expansion ($\beta = 0.33$, $p < 0.01$) underscores the importance of advanced technologies in driving economic progress within the construction industry (Li *et al.,* 2022). These findings suggest that sustainable construction investments yield not only environmental benefits but also significant economic returns.

3.5.2 Job Generation and Social Benefits

The study revealed that sustainable construction plays a crucial role in creating jobs ($\beta = 0.47$, $p < 0.001$), reinforcing previous findings that highlight green construction as a key contributor to job growth, particularly in industries such as renewable energy, waste management, and the development of sustainable materials (D'Agostino *et al.,* 2019 ; Sovacool *et al.,* 2023). Additionally, the mediating influence of social well-being in the relationship between sustainable construction and job creation ($\beta = 0.31$, $p < 0.01$) suggests that broader social benefits—such as enhanced quality of life and increased social equity—are essential in fostering job opportunities (Zhang, & Yong, 2021). These results align with the view that sustainable construction not only drives economic growth but also strengthens the social cohesion of communities.

3.5.3 Environmental Sustainability and Health Benefits

The analysis showed that sustainable construction practices have a significant positive impact on environmental sustainability ($\beta = 0.65$, $p < 0.001$), which also leads to economic growth ($\beta = 0.35$, $p < 0.001$). This finding is consistent with current research, which emphasises that practices such as using renewable energy, incorporating energy-efficient designs, and utilising low-carbon materials are critical for reducing the environmental harm caused by construction activities (Jaradat *et al.,* 2024, 2020; Gu *et al.,* 2023). Additionally, the significant link between improvements in public health and sustainable construction, mediated through enhanced environmental quality ($\beta = 0.32$, $p < 0.01$), highlights the role of green construction in creating healthier environments for living and working (Adshead *et al.,* 2007). These findings emphasise the dual role of sustainable construction in both safeguarding the environment and promoting public health.

3.5.4 Property Market Value and Community Resilience

The results confirmed that sustainable construction practices significantly enhance the market value of properties ($\beta = 0.42$, $p < 0.001$). This outcome aligns with previous studies, which have found that properties built with sustainability in mind are often perceived as more valuable due to their long-term cost savings, reduced environmental impact, and improved energy efficiency (Oke & Aigbavboa, 2017; Kauskale *et al.,* 2022). Moreover, the significant positive effect of sustainable construction on community resilience ($\beta = 0.50$, $p < 0.001$) suggests that such practices contribute not only to individual property owners but also to the overall stability and sustainability of entire communities (Al-Emran & Griffy-Brown, 2023). In Nigeria, this is particularly relevant, as sustainable construction practices can help address both economic and environmental challenges faced by communities.

3.6 Comparison with Existing Research

The outcomes of this research are largely in agreement with the current body of work on the socioeconomic impacts of sustainable construction. The positive effects of sustainable practices on economic growth, job creation, and environmental protection are consistent with findings from studies conducted in various regions, including both advanced and emerging economies (Ries, *et al.,* 2006; Tafesse *et al.,* 2022; Gu *et al.,* 2023; Saka, *et al.,* 2021). However, this research adds a valuable contribution by presenting empirical evidence specific to Nigeria, a region often underrepresented in sustainability research on a global scale. By utilising sophisticated methodologies such as Structural Equation Modeling (SEM) and Geospatial Analysis, this study offers a more detailed understanding of how sustainable construction can optimise socioeconomic benefits within the context of a developing nation.

5.0 CONCLUSION

This study provides a comprehensive evaluation of the socioeconomic impacts of sustainable construction practices in Nigeria, employing a quantitative approach supported by Structural Equation Modeling (SEM) and Geospatial Analysis. The research makes significant contributions to the field of sustainable construction, particularly within a developing country context, and offers valuable insights for policymakers, industry professionals, and researchers.

The findings confirm that sustainable construction positively influences various socioeconomic factors, including economic development, job creation, increased property values, social welfare, environmental sustainability, technological innovation, community resilience, and public health. Notably, the study underscores that sustainable construction serves as a catalyst for economic growth in Nigeria, providing benefits such as higher property valuations, expanded employment opportunities, and improved energy efficiency. These results align with prior research, demonstrating that sustainable construction contributes to both economic and environmental progress.

The study also reveals the complexity and interconnectedness of the relationship between sustainable construction and socioeconomic outcomes. For example, the data shows that the impact of sustainable construction on job creation is significantly mediated by enhancements in social well-being, suggesting that the broader societal benefits of sustainable practices are essential for translating economic gains into employment opportunities. Additionally, the findings emphasise the role of environmental sustainability in fostering economic growth, indicating that strategies aimed at reducing carbon emissions and promoting resource conservation are not only environmentally beneficial but also economically advantageous.

The geospatial analysis identifies substantial regional disparities in the adoption of sustainable construction practices across Nigeria. Urban areas such as Lagos and Abuja exhibit higher concentrations of sustainable projects, which correlate with more pronounced socioeconomic benefits in these regions. This finding highlights the need for targeted policies to promote sustainable construction in less developed areas, ensuring that the benefits of sustainability are more equitably shared across the country.

The research also underscores the critical role of technological innovation in driving the economic and environmental advantages of sustainable construction. The observed positive link between technological advancements and economic growth suggests that investments in cutting-edge technologies, including renewable energy systems and energy-efficient materials, are essential for unlocking the full potential of sustainable construction practices.

Overall, this study demonstrates the pivotal role that sustainable construction can play in addressing the dual challenges of economic development and environmental protection in Nigeria. The results provide strong evidence that sustainable construction is not only feasible but also crucial for ensuring long-term socioeconomic stability and resilience in the country. The findings suggest that policymakers and industry leaders should prioritise sustainable construction as a strategic initiative, leveraging its multifaceted benefits to support Nigeria's broader development objectives.

Future research should build on these findings by exploring the long-term impacts of sustainable construction, particularly concerning climate change and global sustainability standards. Additionally, further studies could investigate the barriers to widespread adoption of sustainable construction in Nigeria, offering potential solutions to accelerate the transition towards a more sustainable built environment.

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- **Hyginus Chidiebere Onyekachi Unegbu:** Conceptualisation, Writing—original draft preparation and literature review, study design, data collection, methodology, software and data analyses.
- **Danjuma Saleh Yawas:** Data validation, visualisation, supervision and formal analysis.
- **Bashar Dan-asabe:** Data validation, visualisation, supervision and formal analysis.
- **Abdulmumin Akoredeley Alabi:** Data validation, visualisation, and software implementation. ■

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