Green Building Practices and Innovative Business Development in South-East, Nigeria

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ABSTRACT

This study investigated the effect of green building practices on innovative business development in South-East Nigeria. The study was driven by the growing need for sustainable construction methods that minimize environmental degradation while fostering innovation and economic growth. Specifically, the research examined the influence of six green building practices energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability on innovativeness among businesses in the region. A descriptive survey design was adopted, and data were collected from a population of 2,000 builders and construction professionals, with a sample size of 341 respondents selected using multistage sampling. Data were analyzed using descriptive and inferential statistics, particularly multiple regression analysis, with the aid of SPSS version 2023. The findings revealed that all six green building practices had significant positive effects on innovativeness. Energy efficiency had a beta of 0.312, $t = 6.276$, $p = 0.000$; water conservation practice recorded the strongest influence with $\beta = 0.369$, $t = 7.501$, $p = 0.000$; sustainable material usage had $\beta = 0.241$, $t = 5.023$, $p = 0.000$; waste diversification showed $\beta = 0.196$, $t = 3.755$, $p = 0.000$; indoor environmental quality had $\beta = 0.107$, $t = 2.212$, $p = 0.028$; and site sustainability practice exhibited $\beta = 0.266$, $t = 5.105$, $p = 0.000$. The overall regression model was statistically significant ($F = 53.323$, $p < 0.05$) with an R^2 value of 0.326, indicating that 32.6% of the variation in innovativeness was explained by these variables. The study concluded that adopting integrated green building practices significantly enhances organizational innovation and sustainable business development in South-East Nigeria.

Keywords: Green building, Energy efficiency, Water conservation, Sustainable material usage, Indoor environmental quality, Site sustainability.

BACKGROUND OF THE STUDY

Green building emerged globally from the growing realization that traditional construction methods consume enormous amounts of energy, water, and natural resources, leading to serious environmental degradation. The global shift toward sustainable development in the late twentieth century created the foundation for what is now called green building practices. Over time, building professionals, environmental experts, and policymakers have embraced green building as a key strategy for addressing climate change, improving human health, and promoting innovation in construction. Studies have shown that green building is no longer only an environmental agenda but also an avenue for economic growth and business innovation through cost savings, new product development, and employment generation (Akinola and Akinyele, 2023; Eze and Chukwu, 2023).

In Africa, the conversation on green building has intensified due to rapid urbanization, energy poverty, and waste management challenges. The demand for sustainable construction is increasing as urban populations expand, putting pressure on housing and infrastructure systems. Research shows that African countries are beginning to integrate green building concepts into their national frameworks, although progress remains uneven due to lack of awareness, inadequate funding, and weak institutional support (Ogunbiyi and Fadare, 2021; Olaniyan and Akinbode, 2023). In Nigeria, the construction industry has started to explore sustainable practices as part of the global push for climate resilience and sustainable urban development.

Historically, Nigeria's commitment to environmental sustainability began with the introduction of the National

Building Code and the National Environmental Standards and Regulations Enforcement Agency (NESREA), which promote eco-friendly building and environmental conservation. However, despite these regulatory efforts, the adoption of green building practices in Nigeria remains limited. Recent studies indicate that challenges such as high initial costs, lack of technical expertise, and poor enforcement of building regulations have slowed progress (Ogunleye and Adeoye, 2022). Nevertheless, the increasing awareness of green practices and the need for innovative approaches to business development in the construction sector have positioned green building as an emerging field for both environmental and economic transformation.

In the South-East region of Nigeria, where population density and industrial activity are high, environmental pressures have intensified over the years. The region faces issues such as deforestation, flooding, and energy shortages, which affect both the environment and business operations. Green building practices offer a viable solution to mitigate these challenges while promoting innovation in design, materials, and energy management. Scholars in the region have observed that integrating sustainability into building projects can lead to cost efficiency, reduced operational risks, and the development of new markets for environmentally friendly products and services (Eze and Nwankwo, 2020; Chukwu and Obi, 2022).

Narrowing this focus to Anambra State, evidence shows that while awareness of green building is growing, actual implementation is still at an early stage. Many public and private buildings are constructed without considering long-term environmental effects, which increases operational costs and reduces the sustainability of businesses. However, emerging practices such as energy-efficient lighting, rainwater harvesting, and the use of alternative building materials are becoming more visible, particularly in urban centers like Awka and Onitsha. Anambra State therefore presents an important context for studying how green building can stimulate innovative business development by creating opportunities in renewable energy supply, sustainable material production, waste management, and green consultancy services (Nwafor and Ijeoma, 2022; Olaniyan and Akinbode, 2023).

The study on green building practices and innovative business development in South-East Nigeria is timely because it addresses the dual challenge of environmental degradation and limited business innovation in the construction sector. With the global transition toward sustainable economies, Nigerian firms, especially in Anambra State, need to adopt environmentally responsible practices that enhance competitiveness and reduce operational costs. Understanding how specific green building practices contribute to innovative business development will provide evidence-based strategies for sustainable growth in the region.

Green building practices in this study will focus on six key variables. Energy efficiency practice refers to strategies that minimize energy use through improved insulation, efficient lighting, and renewable energy adoption. Water conservation practices involve methods such as rainwater harvesting, greywater recycling, and the installation of low-flow fixtures to reduce water waste. Sustainable material usage emphasizes the use of locally available, recycled, and low-carbon materials that reduce environmental impact. Waste diversification practice refers to recycling, reusing, and repurposing construction waste to reduce landfill dependence. Indoor environmental quality focuses on ventilation, lighting, and air quality to enhance occupant comfort and health. Lastly, site sustainability practice includes maintaining natural vegetation, proper drainage systems, and eco-friendly landscaping to minimize ecological disturbance (Eze and Chukwu, 2023; Akinola and Akinyele, 2023).

Statement of the Problem

In recent years, the worldwide focus on sustainable development has risen as governments contend with the negative implications of climate change, resource depletion, and environmental degradation. Buildings have been highlighted as one of the biggest contributors to energy usage, carbon emissions, and garbage creation. Despite this worldwide awareness, green construction practices which stress energy efficiency, water conservation, sustainable materials, and waste reduction remain neglected in Nigeria. The building business in the South-East area, notably in Anambra State, continues to rely heavily on conventional technologies that are energy-intensive and ecologically unfriendly. This condition not only undermines environmental sustainability but also restricts chances for creative commercial growth that may arise from the green construction value chain.

Several unique challenges contribute to the inadequate adoption of green construction methods in the region. First, there is low awareness and knowledge of green building principles among construction professionals, developers, and building owners. Many stakeholders still regard green building as costly and superfluous, rather than as an investment in long-term efficiency and economic innovation. Second, there is a lack of supportive policy framework and enforcement mechanisms to encourage green standards. Although national rules such as the National Building Code give direction, enforcement is inadequate at the state and municipal levels. Third, there is limited access to sustainable building materials and green technologies, since most materials used in construction are imported and pricey, hence inhibiting their usage.

Fourth, the absence of suitable training and technical expertise among construction workers and professionals has also inhibited the incorporation of sustainable design and construction techniques. Fifth, financial limitations and the absence of incentives such as tax rebates or green loans have deterred investors and developers from using green building solutions. Sixth, there is insufficient empirical data tying green construction techniques to creative company development, notably un Anambra State and the South-East area. This lack of localized research restricts knowledge of how adopting green practices may establish new business models, boost competitiveness, and promote regional economic growth.

As a result of these problems, green construction remains at a conceptual level throughout much of South-East Nigeria, with relatively few actual implementations. While other parts of the world have exploited green construction as a driver for innovation and sustainable business, the South-East region continues to lag behind. This study therefore seeks to fill this critical gap by examining the relationship between green building practices specifically energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability and innovative business development in South-East Nigeria. The findings will give factual data and practical insights on how green construction may be implemented as a strategic engine for sustainable business innovation and economic growth in the region.

Objectives of the Study

The general objective of this study is to investigate the relationship between green building practices and innovative business development in South-East, Nigeria. The specific objectives are to:

1. Evaluate the effect of energy efficiency practice on innovativeness in South-East, Nigeria.
2. Examine the effect of water conservation practices on innovativeness in South-East, Nigeria.
3. Assess the influence of sustainable material usage on innovativeness in South-East, Nigeria.
4. Evaluate the effect of waste diversification practice on innovativeness in South-East, Nigeria.
5. Examine the influence of indoor environmental quality on innovativeness in South-East, Nigeria.
6. Evaluate the effect of site sustainability practice on innovativeness in South-East, Nigeria.

Research Questions

The research questions that guided this study are:

1. What is the effect of energy efficiency on innovativeness in South-East, Nigeria?
2. What is the effect of water conservation practice on innovativeness in South-East, Nigeria?
3. How does sustainable material usage influence innovativeness in South-East, Nigeria?
4. How does waste diversification practice effect innovativeness in South-East, Nigeria?
5. What is the influence of indoor environmental quality on innovativeness in South-East, Nigeria?
6. What is the effect of site sustainability practice on innovativeness in South-East Nigeria?

Hypotheses

The hypotheses formulated for this study are:

H_{02}: Energy efficiency practice has no significant positive effect on innovativeness in South-East, Nigeria.

H_{04}: Water conservation practice has no significant effect on innovativeness in South-East, Nigeria.

H_{06}: Sustainable material usage has no significant influence on innovativeness in South-East, Nigeria.

H_{08}: Waste diversification practice has no significant effect on innovativeness in South-East, Nigeria.

H_{10}: Indoor environmental quality has no significant influence on innovativeness in South-East, Nigeria.

H_{12}: Site sustainability practice has no significant effect on innovativeness in South-East, Nigeria.

REVIEW OF RELATED LITERATURE

Green Building Practices

Green construction approaches have become an important part of the worldwide drive to make habitats that last. The idea, which became popular in the late 20th century, is about building, planning, and running buildings in ways that have the least effect on the environment and improve the health of the people who live there. The U.S. Green Building Council (USGBC) says that green building practices include using materials that are good for the environment, saving energy, saving water, and making the air quality within buildings better (USGBC, 2021). The objective is to produce buildings that are good for the environment, good for the economy, and good for society, all of which are part of the larger goal of sustainable development.

Energy efficiency is one of the most important parts of green construction methods. Recent studies highlight the need of incorporating renewable energy sources, such as solar and wind, into building designs to lessen dependency on non-renewable resources (Azizi & Bahrami, 2022). These methods not only minimize the carbon footprint of buildings but also result in considerable financial savings over time. For example, adding solar systems to homes and businesses has been found to save energy expenses by up to 30% (Wang 2021). This move towards renewable energy in building design is a significant step towards meeting global sustainability objectives.

Another important part of green construction measures is saving water. Modern green buildings are meant to minimize water use through the use of efficient fixtures, rainwater harvesting systems, and greywater recycling (Rahman & Alam, 2022). These activities are vital in countries suffering water shortage, since they aid in lessening the demand on local water supplies. According to recent study, buildings fitted with water-saving technology can cut water use by up to 40%, helping greatly to the conservation of this essential resource (Smith & Johnson, 2021).

The use of sustainable materials is also a cornerstone of green construction methods. Materials with minimal environmental effect, such as recycled steel, bamboo, and recovered wood, are increasingly being utilized in construction to decrease waste and promote sustainability (Chen 2022). These materials not only have a smaller carbon footprint but also help to better interior environments by lowering the presence of volatile organic compounds (VOCs). As observed by Patel and Kumar (2021), the selection of sustainable materials is a vital step in the green construction process, impacting both the environmental and economic performance of the structure.

Indoor environmental quality (IEQ) is another major area in green building methods. Research suggests that increased IEQ, achieved through greater ventilation, natural lighting, and the use of non-toxic materials, can promote occupant health and productivity (Li 2022). For example, buildings constructed with wide windows and natural ventilation systems not only cut energy consumption but also improve the emotional and physical well-being of residents. This feature of green construction methods underlines the holistic approach to sustainability, where environmental, economic, and social advantages are combined.

The adoption of green building methods is rapidly being promoted by different certifications and standards, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method) (Ogunleye & Adeyemi, 2023). These certificates give a framework for analyzing the sustainability of buildings, encouraging developers and owners to adopt best

practices in design and construction. The increasing demand for certified green buildings indicates a growing understanding of the importance of sustainability in the built environment. Green building approaches indicate a dramatic change towards more sustainable construction and maintenance of structures. By concentrating on energy efficiency, water conservation, sustainable materials, and indoor environmental quality, these techniques offer a comprehensive approach to decreasing the environmental impact of buildings while increasing the quality of life for inhabitants. As the global society continues to emphasize sustainability, the adoption and advancement of green construction methods will play a critical part in attaining a more sustainable future.

Energy Efficiency

Energy efficiency, a notion that has changed greatly over the decades, refers to the ability to consume less energy to deliver the same service or accomplish the same end. Historically, the emphasis on energy efficiency gained impetus during the oil crises of the 1970s, when the world first grasped the limited nature of fossil fuels and the environmental consequences of their consumption. Since then, technical breakthroughs and governmental initiatives have continually influenced the understanding and execution of energy efficiency. According to the International Energy Agency (IEA), energy efficiency is one of the most effective approaches to manage global energy concerns, decrease greenhouse gas emissions, and increase energy security (IEA, 2021). The notion not only encompasses technological breakthroughs but also behavioral changes and legislative frameworks that support the optimal use of energy.

In recent years, the importance of energy efficiency has been underscored by its role in achieving sustainability goals. The United Nations' Sustainable Development Goal 7 (SDG 7) explicitly targets a doubling of the global rate of improvement in energy efficiency by 2030. This goal reflects the global consensus on the critical need to enhance energy efficiency to combat climate change and foster economic growth. A study by Li (2023) emphasizes that energy efficiency is not only an environmental imperative but also an economic opportunity, offering cost savings and boosting competitiveness for businesses that adopt efficient technologies.

Water conservation practices

Water conservation methods have become a major part of sustainable development in recent years, driven by rising water scarcity and the need to assure long-term availability of this important resource. Water conservation refers to the methods and activities performed to manage fresh water as a sustainable resource, maintain the water environment, and fulfill present and future human demand. The notion spans a wide variety of measures, including decreasing water waste, boosting water usage efficiency, and promoting the reuse and recycling of water. In the face of global issues such as climate change and population expansion, the necessity of water conservation has never been clearer.

Urban water conservation practices have also gained prominence, especially in cities facing water shortages due to rapid urbanization and climate variability. Strategies such as rainwater harvesting, grey-water recycling, and the use of water-efficient appliances have been widely promoted. For instance, rainwater harvesting systems, which collect and store rainwater for non-potable uses such as irrigation and flushing toilets, can significantly reduce the demand on municipal water supplies. A study by Kumar et al. (2022) highlights that implementing rainwater harvesting in urban households can reduce water demand by up to 25%, providing a viable solution to water scarcity in urban areas.

Sustainable Materials

The notion of sustainable materials has attracted substantial attention in recent years, especially as the global community grapples with the environmental implications of industrialization and the depletion of natural resources. Sustainable materials are described as those that have a low negative impact on the environment throughout their lifespan, from extraction to disposal. The development and use of these materials are vital in fostering environmental sustainability, since they assist lower carbon footprints, preserve resources, and minimize waste output. As companies and consumers alike grow more environmentally concerned, the need for sustainable materials continues to rise, spurring innovation and research in this field.

The importance of sustainable materials extends beyond environmental benefits, as they also contribute to economic and social sustainability. The use of these materials often leads to cost savings in the long run, as they are typically more durable and require less maintenance compared to traditional materials. Moreover, the production of sustainable materials can create job opportunities and support local economies, particularly in regions rich in natural resources. Additionally, the adoption of sustainable materials aligns with global efforts to meet the United Nations Sustainable Development Goals (SDGs), particularly those related to responsible consumption and production, and climate action (Smith & Jones, 2022).

Waste Diversification

Waste diversification is a critical component of modern waste management strategies, reflecting a shift towards more sustainable and efficient resource utilization. As societies cope with the rising volume of garbage, various methods to waste management provide options for lowering environmental impact and enhancing resource recovery. Waste diversification comprises the separation and categorization of waste streams to increase recycling, recovery, and disposal procedures (Ali et al., 2022). This paper addresses the philosophical underpinnings of waste diversification, highlighting its benefits, problems, and new trends. At its heart, waste diversification comprises the systematic classification of garbage into multiple streams based on material kinds, origins, and possibilities for recovery. This technique offers more tailored treatment operations, permitting better rates of recycling and reuse. According to Singh et al. (2021), effective waste diversification requires an integrated framework that incorporates technical developments, governmental assistance, and public awareness. Diversification aids in finding valuable resources within waste streams, such as metals, plastics, and organic materials, which may be handled independently to boost recovery rates.

Indoor Environmental Quality

Indoor Environmental Quality (IEQ) has rapidly attracted attention in recent years since it directly impacts the health, comfort, and productivity of building inhabitants. The notion of IEQ incorporates several aspects that contribute to the quality of the interior environment, including air quality, lighting, acoustics, and thermal comfort. Historically, the focus on IEQ has grown alongside developments in building design and construction processes, emphasizing the need to create settings that promote human well-being. In the context of sustainable development, IEQ is often seen as a critical component that complements energy efficiency and environmental sustainability in buildings (Sundell, 2021).

IEQ is described as the circumstances within a building that impact the health, comfort, and performance of inhabitants. These circumstances are impacted by various elements, including indoor air quality, illumination, noise levels, and thermal comfort. According to Zhang et al. (2022), indoor air quality is one of the most significant components of IEQ, since it directly effects respiratory health and cognitive performance. Poor air quality, typically arising from poor ventilation or the presence of indoor contaminants, can contribute to numerous health conditions such as headaches, respiratory difficulties, and fatigue, consequently lowering occupant productivity and well-being.

Site Sustainability in Achieving Regulatory Compliance

Site sustainability has developed as a crucial concept in modern environmental management, particularly within businesses that have major impacts on natural resources. The notion of sustainability arose in the late 20th century as worldwide awareness of environmental degradation expanded, with the Brundtland Commission describing it as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Site sustainability, in particular, refers to the practices and tactics used in a specific area, such as a construction site, industrial facility, or corporate campus, to reduce environmental impact and promote long-term ecological balance. This requires incorporating sustainable practices into site operations, such as decreasing energy usage, managing waste, saving water, and safeguarding local biodiversity, all while ensuring compliance with necessary legal frameworks.

Regulatory compliance plays a vital part in the implementation of site sustainability, as it provides a

framework that helps firms in aligning their activities with environmental requirements. The rising stringency of environmental legislation across various countries has made it important for enterprises to adopt sustainable practices at their sites to avoid legal penalties and reputational damage. For instance, in the European Union, the Environmental Impact Assessment (EIA) Directive mandates comprehensive assessments of the potential environmental impacts of proposed projects before they can proceed, pushing organizations to integrate sustainability into their planning and execution stages (Jones, 2022). Similarly, in the United States, the Environmental Protection Agency (EPA) enforces rules under the Clean Air Act and Clean Water Act, requiring corporations to implement sustainable practices that reduce emissions and discharges at their facilities (Smith & Robinson, 2023).

Achieving site sustainability in line with regulatory compliance is not without its challenges. Organizations often face difficulties in balancing the cost of implementing sustainable practices with the need to meet regulatory requirements. This challenge is particularly pronounced in industries such as construction and manufacturing, where the upfront costs of sustainable technologies and practices can be substantial. However, recent studies suggest that investing in site sustainability can lead to long-term cost savings through improved efficiency and reduced waste (Brown et al., 2021). Additionally, failure to comply with environmental regulations can result in significant fines and legal actions, which further underscores the importance of integrating sustainability into site management strategies (Williams & Thompson, 2022).

Innovative business development

Innovation, as a concept, involves the act of converting ideas into commodities or services that produce value or enhance efficiency. According to Schilling (2020), innovation refers to the actual execution of ideas that result in the introduction of new goods or services or improvement in existing goods or services. This term covers both incremental and drastic changes that modify current systems. Innovation is generally regarded as a driving factor for competitive advantage, economic progress, and societal development in the 21st century.

The definition of innovation differs between fields. Dodgson et al. (2021) say that innovation is not simply about technology improvement but also encompasses organizational, marketing, and process changes. Similarly, Crossan and Apaydin (2020) noted that innovation may occur at the individual, group, corporate, and even national levels. These larger viewpoints underline that innovation is a multidimensional phenomena, founded in creativity, experimentation, and adaptability to change.

Recent studies have underlined the necessity of creativity in navigating uncertainty, especially in the post-COVID-19 environment. Roper and Turner (2021), organizations that prioritized innovation during the epidemic outperformed their rivals in recovery speed and resilience. Their analysis found that dynamic innovation techniques such as digital transformation, agile practices, and new business models enabled firms adapt to quick market changes and customer expectations.

THEORETICAL FRAMEWORK

This study was anchor on Triple Bottom Line (TBL) Theory.

Triple Bottom Line (TBL) Theory

The Triple Bottom Line (TBL) Theory, introduced by John Elkington in 1994, proposes that businesses should measure their success not only by financial performance but also by their impact on people (social responsibility) and the planet (environmental sustainability). Elkington's theory has become a foundational concept in the field of sustainable business development, advocating for a holistic approach to business performance. This framework aligns closely with the goals of green building practices, which aim to achieve environmental sustainability alongside economic and social benefits.

In 2006, Andrew Savitz expanded on Elkington's theory in his book "The Triple Bottom Line: How Today's Best-Run Companies Are Achieving Economic, Social, and Environmental Success." Savitz provided practical

examples of how companies can implement TBL principles and argued that businesses could achieve long-term success by balancing the needs of all stakeholders, including employees, communities, and the environment. Savitz's work provides a valuable framework for understanding how green building practices can contribute to sustainable business development by considering environmental, social, and economic outcomes.

Timothy F. Slaper, in 2011, contributed to the TBL framework by proposing specific metrics for measuring economic, social, and environmental performance. Slaper's work emphasized the importance of accountability and transparency in sustainable business practices, providing a method for assessing the broader implications of green building practices. His quantitative approach is particularly relevant for evaluating the impact of green building practices on business performance in Southeast Nigeria, as it allows for a comprehensive assessment of the benefits of these practices.

The TBL framework is directly applicable to green building practices, as it encourages businesses to consider the long-term benefits of sustainability. By focusing on environmental, social, and economic outcomes, companies in Southeast Nigeria can ensure that their green building practices not only reduce environmental impact but also contribute to social well-being and economic growth. This holistic approach to business performance can drive sustainable development in the region.

In the context of Southeast Nigeria, the Triple Bottom Line theory provides a comprehensive approach to sustainable business development. It emphasizes the need for businesses to adopt green building practices that benefit the environment, enhance social equity, and contribute to economic prosperity. By applying TBL principles, companies in the region can create value that extends beyond financial returns, leading to a more sustainable and resilient business environment.

Energy efficiency and innovativeness

Energy efficiency and innovativeness are increasingly connected as organizations and economies strive toward sustainability and competitiveness. Energy efficiency has become a critical driver for decreasing operational costs and limiting environmental consequences, while innovation stimulates the development of sophisticated technologies and techniques that enable large efficiency improvements. International Energy Agency (IEA, 2022), advances in energy efficiency help directly to cutting carbon emissions, preserving resources, and attaining climate goals. However, meeting global sustainability objectives needs increased innovation in energy systems, manufacturing processes, and business models to bridge the present efficiency gap. Digital transformation plays a vital role in promoting innovation that promotes energy efficiency. Recent studies demonstrate that digital tools, such as artificial intelligence, sensors, data analytics, and Internet of Things (IoT)-enabled systems, boost firms' capacity to monitor and regulate energy use (Long et al., 2024). Industry 4.0 technologies are altering energy management techniques by allowing real-time data tracking and automation in manufacturing and service industries. In household and commercial contexts, smart energy management systems coordinate devices and optimize energy usage, enabling efficiency improvements without sacrificing service quality (Ayub et al., 2022).

Water Conservation Practices and innovativeness

Water conservation measures and innovativeness are increasingly interwoven as firms, governments, and individuals respond to mounting environmental concerns and sustainability demands. Water shortage and climate change have prompted enterprises to develop creative solutions that minimize water usage and enhance efficiency throughout operations. According to Gleick and Palaniappan (2021), novel water management solutions, including recycling, reuse, and smart monitoring, have become vital in tackling global water emergencies while promoting sustainable business practices. The incorporation of innovation into water conservation guarantees that limited water resources are handled effectively without compromising production or development.

Technological innovation plays a crucial role in developing water conservation measures throughout sectors. Recent studies highlight the use of Internet of Things (IoT)-enabled sensors, artificial intelligence, and data analytics to monitor water usage, detect leaks, and optimize consumption in real time (Li et al., 2022). For

example, smart irrigation systems in agriculture employ meteorological data and soil moisture sensors to supply precise amounts of water, decreasing loss while enhancing crop yields. Similarly, new water recycling and desalination technologies are altering the availability of clean water in urban and industrial areas (Zhang & Wang, 2023). These inventions are crucial to improve water-use efficiency while supporting environmental goals.

Sustainable Materials and Innovativeness

Sustainable materials play a significant role in boosting innovativeness as firms increasingly focus on producing environmentally friendly goods and processes. The trend towards employing renewable resources, recyclable content, and biodegradable materials has spurred firms to reconsider old manufacturing processes and develop creative solutions that reduce environmental effect (Smith et al., 2021). This transformation has offered opportunities for innovation, enabling firms to build goods that satisfy sustainability criteria while responding to the growing desires of eco-conscious consumers. By selecting sustainable materials, businesses are discovering new methods to reconcile environmental duty with economic success.The introduction of sustainable materials has also fostered innovation in manufacturing technology and resource optimization. Organizations are investing in research and development to create efficient techniques for creating high-quality, durable, and sustainable goods that decrease waste and energy consumption (Brown & Green, 2022). Advanced techniques such as 3D printing with biodegradable materials and circular production models have developed as creative solutions, supporting both operational efficiency and sustainability. These approaches help organizations to lessen their dependency on non-renewable commodities while boosting competitiveness in a continuously changing market.

Consumer demand for eco-friendly products has further driven the need for innovation in sustainable materials. As environmental awareness rises, organizations are considering inventive solutions to fulfill customer demands while retaining profitability (Johnson, 2020). For example, the utilization of recycled plastics, plant-based packaging, and repurposed raw materials has spawned unique product designs that appeal to environmentally concerned consumers. By integrating sustainable materials into their product lines, firms may differentiate themselves from competitors, develop deeper customer connections, and boost their market position.

Waste Diversification and Innovativeness

Waste diversification plays a crucial role in boosting innovativeness inside firms by stimulating the development of novel techniques for waste management and resource recovery. It includes dividing garbage into distinct streams such as plastics, metals, organics, and paper to increase recycling and lessen environmental effect. Zhang et al. (2021), enterprises that use advanced waste diversification strategies are more likely to invest in novel technologies that promote material recovery and minimize landfill reliance. These approaches not only help to sustainability but also stimulate creativity in establishing effective ways for managing resources. By implementing innovative waste management solutions, firms may convert traditional disposal processes into value-adding activities.

Innovativeness in waste diversification is typically driven by technology breakthroughs that enable organizations to maximize resource consumption. Emerging technologies, such as artificial intelligence, smart sorting systems, and waste-to-energy solutions, have enhanced efficiency in segregating and processing garbage. As emphasized by Lee and Park (2022), enterprises adopting new technology into trash management obtain increased recycling rates and decrease environmental damage. For example, AI-powered sorting machines may automatically identify recyclable items, enhancing recovery efficiency and minimizing operational expenses. This technology integration gives chances for enterprises to implement sustainable solutions while maintaining competitiveness in the marketplace.

Indoor Environmental Quality and Innovativeness

Indoor environmental quality (IEQ) plays a key role in developing innovativeness inside firms since it directly affects employees' comfort, health, and creativity. A well-optimized interior environment with sufficient

ventilation, natural lighting, and pleasant temperature conditions produces a suitable climate for idea development and problem-solving. Employees working in conditions that encourage physical and mental well-being are more likely to participate in innovative thinking and contribute to organizational success. Recent research have demonstrated that boosting IEQ can increase cognitive performance, which is vital for finding new solutions in competitive corporate situations (Zhao et al., 2022).

Innovativeness in firms is highly tied to workplace design and environmental quality. Open, well-ventilated areas and natural sunlight have been reported to increase cooperation and creative interactions among staff. When firms integrate green building technology and sustainable practices into their design, it not only enhances IEQ but also supports a culture of innovation by exhibiting adaptability and forward-thinking methods. Modern firms that prioritize IEQ are better positioned to recruit creative personnel, which further enhances innovation-driven performance (Rahman et al., 2021).

Site Sustainability and innovativeness

Innovativeness in site sustainability begins with strategic choices regarding how sites are designed, developed, and operated such that environmental performance becomes a source of competitive advantage. Leading organizations consider site sustainability as a platform for product and process innovation rather than a compliance burden, leveraging green procurement, energy systems integration, and nature-based solutions to unleash new efficiencies and services (World Economic Forum, 2025). This strategic conceptualization promotes cross-functional teams to experiment with low-carbon materials, circular supply chains, and integrated energy-water systems that achieve demonstrable sustainability outcomes while producing new economic value.

Practical solutions at the site level frequently focus on decreasing both operational and embodied carbon through retrofits, material reuse, and design for deconstruction. Research on building retrofits and lifetime emissions demonstrates that combining envelope improvements with low-carbon technology may considerably lower operating emissions while careful material choices and reuse techniques limit embodied carbon increases (Chen, 2024; CRREM, 2023). These technical solutions stimulate innovative engineering and procurement techniques, such as reclamation of structural parts and modular retrofitting, which in turn drive new service models for asset owners and contractors.

Empirical Reviews

Ahmed, Oduro & Emmanuel Mensah (2021) explored the impact of green building practices on local communities in Accra, Ghana. The study conducted a field survey of 80 community members near green building projects, selecting 32 participants through cluster sampling. The findings indicated that green buildings contribute to local economic development and environmental preservation. The study concluded that green building practices have a positive impact on local communities, recommending enhanced community involvement in green building projects.

Mohammad, Hassan & Saeed Ahmed (2023) investigated the impact of green building practices on sustainable business development in Kabul, Afghanistan. The study compared sustainable business outcomes in green and non-green buildings, surveying 45 business owners, with 20 selected through purposive sampling. The findings indicated that businesses in green buildings experience better growth and sustainability. The study concluded that green building practices support long-term business sustainability, recommending their promotion as part of business development strategies.

Lara & Smith (2022) studied the integration of green building materials in the construction industry in Johannesburg, South Africa. The study surveyed 60 construction firms, selecting 25 through purposive sampling. The findings revealed that the use of green materials reduces environmental impact and operational costs. The study concluded that promoting the use of sustainable materials is vital for the construction industry, recommending increased investment in green materials.

Samuel & Ochieng (2021) investigated the impact of green building practices on the operational efficiency of

manufacturing firms in Nairobi, Kenya. The study involved a sample of 80 manufacturing firms, with 30 selected through stratified random sampling. The results showed that green building practices significantly enhance operational efficiency. The study concluded that adopting green building practices is crucial for improving operational efficiency, recommending policy support for green initiatives.

Ahmed & Al-Sayed (2020) examined the role of green building practices in enhancing water conservation in Cairo, Egypt. The study surveyed 100 residential buildings, selecting 40 through random sampling. Regression analysis indicated that green building practices significantly improve water conservation efforts. The study concluded that green building practices are essential for water sustainability, recommending the adoption of green technologies in residential construction.

Emily & Johnson (2023) explored the impact of green building practices on employee well-being in office buildings in New York, USA. The study involved 120 office buildings, with 50 selected through stratified random sampling. The findings revealed that green buildings significantly enhance employee well-being and productivity. The study concluded that green building practices positively affect employee well-being, recommending their implementation in office design.

Michael & Brown (2021) assessed the economic benefits of green building certifications in commercial real estate in London, UK. The study surveyed 75 commercial properties, with 35 selected through purposive sampling. The results indicated that green certifications increase property value and rental income. The study concluded that green building certifications offer significant economic advantages, recommending their widespread adoption in commercial real estate.

METHODOLOGY

The research adopted a descriptive survey design, which was considered most appropriate for gathering information from a large population of builders and analyzing data to understand the relationship between green building practices and sustainable business development in Southeast Nigeria. This design provided a comprehensive overview of existing practices, challenges, and benefits associated with green building within the region. The study was carried out in Southeast Nigeria, a region comprising Abia, Anambra, Ebonyi, Enugu, and Imo States. The area was selected due to its rapid urbanization, increasing construction activities, and growing awareness of environmentally sustainable building practices. Builders, architects, and construction professionals in this region are beginning to embrace green building techniques aimed at reducing energy consumption, minimizing waste, and promoting environmental sustainability.

The population of the study comprised 2,000 builders actively involved in construction projects across the Southeast. These builders were drawn from members of the Real Estate Developers Association of Nigeria (REDAN), the Nigerian Institute of Builders (NIOB), and the Nigerian Institute of Architects (NIA). To determine the sample size, the Krejcie and Morgan (1970) formula was used, producing a sample size of 341 respondents at a 95% confidence level and a 5% margin of error. A multistage sampling technique was adopted for the study. In the first stage, judgmental sampling was used to select qualified construction companies that met specific criteria, including membership in REDAN, NIA, and NIOB. In the second stage, stratified random sampling ensured representation from each of the five states in the Southeast. Finally, simple random sampling was employed to select individual builders from the identified companies, ensuring equal chances of participation.

The primary instrument for data collection was a structured questionnaire designed to obtain relevant information on the builders' knowledge, attitudes, and practices regarding green building, as well as their perceptions of its influence on sustainable business development. The questionnaire was divided into sections to cover demographic information, awareness, adoption levels, challenges, and perceived benefits of green building practices. Data were collected through self-administered questionnaires distributed with the assistance of trained research assistants to ensure accuracy and a high response rate. The validity of the instrument was established through expert review by professionals in construction and sustainability fields, as well as academic supervisors, who evaluated the content for clarity, relevance, and appropriateness.

To ensure reliability, the questionnaire was subjected to a pilot study using the test-retest method. It was administered twice to a small sample of builders not included in the main study, with a two-week interval between tests. The reliability was assessed using Cronbach's alpha coefficient, with a value of 0.7 or above indicating acceptable internal consistency. Data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize and describe the responses, while inferential statistical tools, including multivariate analysis, were used to test the study's hypotheses and determine the relationship between green building practices and sustainable business development. All data analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 2023.

Data presentation and Analysis

Test of hypotheses

HO_2: Energy efficiency practice has no significant positive effect on innovativeness in South-East, Nigeria.

HI_2: Energy efficiency practice has significant positive effect on innovativeness in South-East, Nigeria.

HO_4: Water conservation practice has no significant effect on innovativeness in South-East, Nigeria.

HI_4: Water conservation practice has significant effect on innovativeness in South-East, Nigeria.

HO_6: Sustainable material usage has no significant influence on innovativeness in South-East, Nigeria.

HI_6: Sustainable material usage has significant influence on innovativeness in South-East, Nigeria.

HO_8: Waste diversification practice has no significant effect on innovativeness in South-East, Nigeria.

HI_8: Waste diversification practice has no significant effect on innovativeness in South-East, Nigeria.

HO_{10}: Indoor environmental quality has no significant influence on innovativeness in South-East, Nigeria.

HI_{10}: Indoor environmental quality has significant influence on innovativeness in South-East, Nigeria.

HO_{12}: Site sustainability practice has no significant effect on carbon footprint in South-East, Nigeria.

HI_{12}: Site sustainability practice has significant effect on carbon footprint in South-East, Nigeria.

Table 1: Model Summary [b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.571[a]	.326	.320	.57207	.326	53.323	3	330	.000	1.813

a. Predictors: (Constant), EE, WCP, SM, WDP, IEQ, SSP

b. Dependent Variable: INNO

The model summary in Table 4.3.4 presents the results of a multiple regression analysis conducted to examine the effect of energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability practices on innovativeness in South-East Nigeria. The analysis shows a multiple correlation coefficient (R) of 0.571, which indicates a moderate positive relationship between the combined independent variables and innovativeness. This suggests that improvements in sustainability practices are associated with increased levels of innovation within organizations and businesses in the study area.

The coefficient of determination (R^2) is 0.326, meaning that about 32.6 percent of the variation in innovativeness is explained by the combined effect of the six predictors. The adjusted R^2 value of 0.320 shows only a slight difference from the R^2 value, which indicates that the model is well-fitted and does not suffer from over fitting. This suggests that while the six predictors significantly explain innovativeness, other factors outside the model also contribute to variations in innovative practices among organizations in South-East Nigeria.

The F-statistic of 53.323, with a significance level of p = 0.000, shows that the overall regression model is statistically significant. This implies that energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability practices collectively have a significant effect on innovativeness in the study area. In other words, improvements in these sustainability practices are likely to enhance innovation in production processes, product development, service delivery, and environmental management among organizations.

The Durbin-Watson statistic of 1.813 indicates that there is no serious problem of autocorrelation in the model, meaning the residuals are independent. Based on these findings, the null hypotheses that state there is no significant relationship between the sustainability practices and innovativeness are rejected for the overall model. This result demonstrates that adopting integrated sustainability practices not only promotes environmental efficiency but also drives organizational innovativeness across South-East Nigeria.

Table 2: ANOVA [a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	52.353	3	17.451	53.323	.000[b]
	Residual	107.998	330	.327		
	Total	160.350	333			

a. Dependent Variable: INNO

b. Predictors: (Constant), EE, WCP, SM, WDP, IEQ, SSP

The ANOVA table shows the overall significance of the regression model in explaining the effect of energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability on innovativeness in South-East Nigeria. The F-value of 53.323, with a significance level of 0.000, indicates that the regression model is statistically significant at a 5% level of significance. This means that at least one of the independent variables significantly contributes to explaining variations in innovativeness. Therefore, the model is a good fit for predicting the relationship between the environmental sustainability practices and innovativeness.

The regression sum of squares (52.353) compared to the residual sum of squares (107.998) indicates that the model explains a substantial proportion of the variance in innovativeness. Specifically, a higher regression sum of squares relative to the residual implies that the predictors collectively account for a meaningful variation in the dependent variable. This suggests that practices such as energy efficiency, water conservation, sustainable material usage, and indoor environmental quality significantly contribute to explaining the observed differences in innovativeness among businesses in the South-East region of Nigeria.

The degrees of freedom for the regression model are 3, and for the residuals, it is 330, with a total degree of freedom of 333. This shows that the model is based on a sufficient number of data points to ensure reliable estimates. The mean square value for regression is 17.451, which is notably higher than the residual mean square of 0.327, further confirming that the independent variables explain a significant proportion of the variance in innovativeness compared to random error.

Since the p-value (0.000) is less than the 0.05 threshold, the null hypotheses for the predictors can be rejected where significant effects are observed. This implies that environmental sustainability practices collectively influence innovativeness positively and significantly. Hence, companies that adopt strategies such as energy efficiency, water conservation, and sustainable material usage are more likely to achieve higher levels of innovativeness in South-East Nigeria.

Table 3: Coefficients a

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.	95.0% Confidence Interval for B
(Constant)	1.248	0.266	—	4.692	0.000	0.725 – 1.771
EE	0.295	0.047	0.312	6.276	0.000	0.203 – 0.387
WCP	0.378	0.050	0.369	7.501	0.000	0.279 – 0.477
SM	0.221	0.044	0.241	5.023	0.000	0.134 – 0.308
WDP	0.184	0.049	0.196	3.755	0.000	0.087 – 0.281
IEQ	0.117	0.053	0.107	2.212	0.028	0.013 – 0.222
SSP	0.233	0.046	0.266	5.105	0.000	0.143 – 0.322

Dependent Variable: INNO.

The coefficient table shows the relationship between energy efficiency, water conservation practice, sustainable material usage, waste diversification practice, indoor environmental quality, and site sustainability practice on innovativeness in South-East Nigeria. The constant value of 1.248 indicates that if all other independent variables are held constant, the baseline level of innovativeness remains at 1.248. This provides a foundation for understanding the incremental contribution of each sustainability practice to innovativeness within the study area.

Energy efficiency practice has a positive and statistically significant effect on innovativeness, with an unstandardized coefficient (B) of 0.295, a standardized beta of 0.312, and a t-value of 6.276 at a significance level of 0.000. This implies that for every one-unit increase in energy efficiency, innovativeness improves by 0.295 units, holding all other variables constant. The positive relationship suggests that firms that adopt energy-efficient technologies and practices tend to become more innovative, possibly due to cost savings, technological advancement, and improved resource management.

Water conservation practice also demonstrates a significant positive influence on innovativeness, with a coefficient (B) of 0.378 and a standardized beta of 0.369. The t-value of 7.501 and significance level of 0.000 confirm that this variable strongly contributes to enhancing innovativeness. This implies that organizations that adopt effective water conservation measures are more likely to develop innovative solutions and operational strategies, as these practices promote resource optimization and encourage the exploration of alternative technologies to sustain productivity.

Sustainable material usage has a positive and significant impact on innovativeness, reflected in a coefficient (B) of 0.221, a beta value of 0.241, and a t-value of 5.023, with a significance level of 0.000. This indicates that firms integrating sustainable materials into their operations are more inclined toward innovative practices, including the development of environmentally friendly products and processes. By utilizing materials that reduce waste and environmental harm, organizations create opportunities for innovation and maintain competitive advantages.

Waste diversification practice is also a significant predictor of innovativeness, with a coefficient (B) of 0.184, a beta value of 0.196, and a t-value of 3.755, significant at the 0.000 level. This shows that organizations engaging in practices such as recycling, reusing, and adopting circular economy strategies are likely to enhance

their innovative capacities. Diversifying waste management encourages creativity in developing new products, reducing environmental impact, and improving operational efficiency.

Finally, indoor environmental quality and site sustainability practices have significant positive effects on innovativeness. Indoor environmental quality has a coefficient of 0.117 and a t-value of 2.212, significant at 0.028, indicating that improving workplace conditions, air quality, and employee comfort fosters creativity and innovation. Site sustainability practice has a coefficient (B) of 0.233, a beta of 0.266, and a t-value of 5.105, significant at 0.000, showing that sustainable site management supports innovative strategies. Overall, all six variables significantly contribute to innovativeness, confirming that sustainability practices are critical drivers of innovation in South-East Nigeria.

DISCUSSION OF FINDINGS

For hypothesis two (HO2), which states that energy efficiency practice has no significant positive effect on innovativeness, the regression results reveal an unstandardized coefficient (B) of 0.295, a standardized beta of 0.312, a t-value of 6.276, and a significance level of $p = 0.000$. Since the p-value is below the 0.05 threshold, the null hypothesis is rejected, and the alternative hypothesis is accepted. This means energy efficiency significantly and positively influences innovativeness among businesses in South-East Nigeria. These findings align with the study by Maria and Garcia (2020), who discovered that green building practices significantly enhance energy efficiency in commercial buildings, creating opportunities for technological innovation and improved performance. Similarly, Tunde and Bakare (2021) confirmed that green building practices reduce energy consumption and improve business competitiveness, supporting the conclusion that energy efficiency fosters innovation and operational sustainability.

For hypothesis four (HO4), which proposes that water conservation practice has no significant effect on innovativeness, the results indicate a coefficient (B) of 0.378, a beta of 0.369, a t-value of 7.501, and a p-value of 0.000. Since the effect is statistically significant, the null hypothesis is rejected, confirming that water conservation practices positively influence innovativeness. This finding agrees with the study by Amir and Hussain (2021), which revealed that green building practices significantly enhance water efficiency in commercial properties, leading to the adoption of innovative technologies like water recycling and smart metering. Additionally, Fatoumata and Diarra (2022) emphasized that integrating water conservation practices into urban planning accelerates sustainable development and promotes creativity in resource management. Therefore, adopting water-saving technologies and designs drives innovation by encouraging firms to explore environmentally friendly operational strategies.

Regarding hypothesis six (HO6), which states that sustainable material usage has no significant influence on innovativeness, the regression analysis shows a coefficient (B) of 0.221, a beta of 0.241, a t-value of 5.023, and a significance level of $p = 0.000$. These results indicate a significant positive effect, leading to the rejection of the null hypothesis. The implication is that organizations that integrate sustainable materials into their operations tend to be more innovative, especially in product development and waste reduction strategies. This aligns with John and Okafor (2021), who found that although green materials may initially increase construction costs, they enhance long-term sustainability and cost efficiency, encouraging innovative material management practices. Similarly, Zhang and Wei (2020) concluded that adopting sustainable materials improves resource efficiency in industrial facilities, enabling companies to create new products and processes while reducing environmental impacts.

For hypothesis eight (HO8), which assumes that waste diversification practice has no significant effect on innovativeness, the findings reveal a coefficient (B) of 0.184, a beta value of 0.196, a t-value of 3.755, and a p-value of 0.000. Since the result is significant, the null hypothesis is rejected, confirming that waste diversification positively affects innovativeness among organizations in South-East Nigeria. This conclusion is consistent with David and Thompson (2020), who reported that green building practices significantly reduce construction waste and encourage firms to adopt innovative recycling and reuse strategies. Similarly, Enoch and Kofi (2020) highlighted that adopting green practices in the construction industry leads to innovative waste management solutions, helping firms minimize costs and environmental impact. Thus, waste

diversification contributes to innovation by promoting circular economy approaches and fostering the development of new technologies for resource recovery.

For hypothesis ten (HO10), which proposes that indoor environmental quality has no significant influence on innovativeness, the regression results show a coefficient (B) of 0.117, a beta value of 0.107, a t-value of 2.212, and a p-value of 0.028. Since the effect is statistically significant, the null hypothesis is rejected, confirming that indoor environmental quality positively impacts innovativeness. This finding agrees with John and Mwangi (2021), who found that improving indoor air quality and ventilation enhances employee well-being and stimulates creativity. Similarly, Olivia and Thompson (2022) reported that green building practices in educational institutions significantly improve indoor air quality and lighting conditions, fostering innovative learning environments. Enhancing indoor environmental quality therefore promotes greater productivity and creative problem-solving within organizations.

hypothesis twelve (HO12) posits that site sustainability practice has no significant effect on innovativeness, but the regression analysis shows a coefficient (B) of 0.233, a beta value of 0.266, a t-value of 5.105, and a p-value of 0.000. Since the relationship is statistically significant, the null hypothesis is rejected. This result suggests that sustainable site management positively influences innovativeness among businesses in South-East Nigeria. The findings are supported by Ravi and Kumar (2022), who revealed that integrating green building practices into housing developments fosters sustainability and innovative urban designs. Similarly, Ali and Reza (2023) demonstrated that site sustainability measures improve climate resilience and promote creative approaches to urban planning. Therefore, site sustainability enhances innovation by encouraging organizations to design environmentally friendly spaces and adopt adaptive operational strategies.

Summary of Findings

This study examines the effect of various green building practices on innovativeness in Southeast Nigeria. The findings revealed that:

1. Energy efficiency had a significant positive effect on innovativeness, with a coefficient of 0.312, a t-value of 6.276, and a p-value of 0.000.
2. Water conservation practices demonstrated a highly significant positive influence on innovativeness, with a coefficient of 0.369, a t-value of 7.501, and a p-value of 0.000.
3. Sustainable materials were found to significantly affect innovativeness, with a coefficient of 0.241, a t-value of 5.023, and a p-value of 0.000.
4. Waste diversification also showed a significant positive effect on carbon footprint, with a coefficient of 0.196, a t-value of 3.755, and a p-value of 0.000.
5. Indoor environmental quality had a statistically significant positive effect on innovativeness, with a coefficient of 0.107, a t-value of 2.212, and a p-value of 0.028.
6. Site sustainability exhibited a significant positive effect on innovativeness, with a coefficient of 0.266, a t-value of 5.105, and a p-value of 0.000.

CONCLUSION

For Model 2**,** which examined the relationship between these factors and innovativeness, water conservation practices again showed the strongest effect ($\beta = 0.369$, $p < 0.001$), followed by energy efficiency ($\beta = 0.312$, $p < 0.001$) and sustainable materials ($\beta = 0.241$, $p < 0.001$). Waste diversification, indoor environmental quality, and site sustainability equally contributed positively to organizational innovation. These findings imply that adopting sustainable environmental practices not only enhances carbon footprint performance but also drives organizational innovativeness, enabling firms to remain competitive, reduce operational costs, and improve overall environmental and economic outcomes.

RECOMMENDATIONS

1. Organizations should integrate energy-efficient solutions into their production and operational processes, as this fosters technological advancement and promotes innovative practices.

2. Companies should adopt innovative water-saving technologies, as optimizing water use can inspire creative solutions and enhance competitive advantage.
3. Encouraging the use of sustainable materials can stimulate innovative product designs and eco-friendly solutions, enabling firms to remain competitive in green markets.
4. Firms should view waste as a resource and develop innovative recycling and up cycling strategies that create new revenue streams and support circular economy initiatives.
5. A healthy and comfortable indoor environment promotes employee creativity and productivity. Companies should invest in air quality systems, natural lighting, and ergonomic designs to foster innovation.
6. Green building designs, energy-smart infrastructure, and eco-friendly landscaping should be adopted to stimulate innovative operational approaches and position firms as sustainability leaders.

REFERENCES

1. Ahmed, M., & Al-Sayed, R. (2020). The role of green building practices in enhancing water conservation in Cairo, Egypt. Journal of Environmental and Urban Studies, 8(2), 145–160.
2. Ahmed, S., Oduro, F., & Mensah, E. (2021). Impact of green building practices on local communities in Accra, Ghana. African Journal of Sustainable Development, 9(1), 33–48.
3. Akinola, B. T., & Akinyele, S. O. (2023). Green innovation and environmental sustainability in Nigeria's construction sector. African Journal of Sustainable Development, 8(1), 33–48.
4. Ali, K., & Reza, M. (2023). Site sustainability measures, climate resilience, and innovative approaches to urban planning. Journal of Urban Sustainability and Design, 11(4), 221–238.
5. Ali, S., Khan, H., & Ibrahim, T. (2022). Waste diversification and sustainable resource management in developing countries. International Journal of Waste Management, 45(3), 201–219.
6. Amir, R., & Hussain, M. (2021). Green building practices and water efficiency in commercial properties. Environmental Management and Policy Review, 12(2), 89–104.
7. Ayub, M., Hassan, A., & Bello, J. (2022). Digital transformation and energy efficiency innovation in developing economies. Journal of Energy and Innovation Studies, 10(3), 77–92.
8. Azizi, M., & Bahrami, H. (2022). Renewable energy integration in green building design: A pathway to sustainability. International Journal of Renewable Energy Systems, 15(1), 50–66.
9. Brown, D., & Green, R. (2022). Sustainable materials and technological innovation in manufacturing industries. Journal of Sustainable Materials Research, 14(2), 87–102.
10. Brown, L., James, P., & Umeh, F. (2021). Cost implications of sustainable site practices in the construction sector. International Journal of Environmental Economics, 9(4), 55–70.
11. Chen, L. (2022). Recycled materials and environmental performance in green building design. Sustainable Construction Journal, 17(2), 114–127.
12. Chen, X. (2024). Low-carbon technologies and innovative construction retrofits for sustainable buildings. Journal of Building Performance, 21(1), 11–28.
13. Chukwu, L. U., & Obi, N. C. (2022). Sustainable construction and business competitiveness in Southeast Nigeria. Nigerian Journal of Environmental Research and Development, 7(2), 112–125.
14. Crossan, M. M., & Apaydin, M. (2020). A multi-dimensional framework of organizational innovation: Literature review and future research. Journal of Management Studies, 57(2), 217–243.
15. CRREM. (2023). Carbon Risk Real Estate Monitor: Pathways to decarbonization in real estate. Retrieved from https://www.crrem.org
16. David, J., & Thompson, S. (2020). Reducing construction waste through green building practices. International Journal of Construction Management, 18(4), 144–158.
17. Dodgson, M., Gann, D. M., & Phillips, N. (2021). Innovation: A very short introduction. Oxford University Press.
18. Emily, R., & Johnson, P. (2023). Green building practices and employee well-being in office environments. Journal of Workplace Innovation, 13(1), 60–76.
19. Enoch, A., & Kofi, M. (2020). Green construction practices and innovative waste management in Ghana's building industry. Journal of Sustainable Infrastructure, 8(2), 98–115.
20. Eze, C. F., & Chukwu, A. N. (2023). Green entrepreneurship and business innovation in Nigeria's building industry. Journal of Business and Environmental Studies, 11(1), 84–97.

21. Eze, J. O., & Nwankwo, P. I. (2020). Environmental sustainability and green building adoption among construction firms in Anambra State, Nigeria. International Journal of Sustainable Construction Management, 5(3), 101–115.
22. Fatoumata, S., & Diarra, A. (2022). Urban water conservation and innovation in African cities. Journal of Environmental and Water Resources, 8(3), 130–146.
23. Gleick, P. H., & Palaniappan, M. (2021). Innovations in water management and sustainability solutions. Annual Review of Environment and Resources, 46(1), 287–310.
24. International Energy Agency (IEA). (2021). Energy efficiency 2021: Analysis and outlooks to 2030. Paris: OECD/IEA.
25. International Energy Agency (IEA). (2022). Energy efficiency: The key to achieving net zero. Paris: OECD/IEA.
26. John, E., & Mwangi, P. (2021). Indoor air quality, employee productivity, and workplace innovation in Kenya. African Journal of Occupational Health and Environment, 9(2), 77–92.
27. John, K., & Okafor, L. (2021). Cost efficiency and innovation in the use of sustainable materials for construction in Nigeria. Journal of African Built Environment, 13(3), 101–115.
28. Johnson, H. (2020). Sustainable product design and consumer-driven innovation. Journal of Sustainable Business, 15(2), 90–106.
29. Jones, R. (2022). Environmental Impact Assessment and sustainable construction compliance. Journal of Environmental Law and Policy, 20(3), 150–165.
30. Kumar, A., Sharma, R., & Patel, D. (2022). Urban rainwater harvesting and water reuse technologies in sustainable cities. Journal of Sustainable Urban Planning, 19(2), 75–89.
31. Lara, T., & Smith, J. (2022). Integration of green building materials in South Africa's construction industry. African Journal of Building Technology, 14(1), 45–59.
32. Lee, D., & Park, S. (2022). Artificial intelligence in waste management and recycling innovation. Waste Management and Research, 40(5), 642–656.
33. Li, F. (2022). Indoor environmental quality and occupant well-being in sustainable buildings. Journal of Environmental Psychology, 13(3), 215–230.
34. Li, H. (2023). Energy efficiency as a pathway to sustainable business growth. Journal of Energy Economics and Policy, 17(2), 44–58.
35. Li, X., Zhao, J., & Xu, L. (2022). Smart water management systems: Integrating IoT and AI for efficient resource use. Journal of Environmental Technology and Innovation, 27(4), 85–101.
36. Long, M., Yusuf, A., & Adewale, K. (2024). Digital energy management and industrial innovation in emerging economies. Journal of Sustainable Energy Systems, 10(1), 56–72.
37. Maria, L., & Garcia, P. (2020). Green building practices and energy efficiency in commercial real estate. Journal of Environmental and Energy Studies, 14(2), 98–112.
38. Michael, T., & Brown, P. (2021). Economic benefits of green building certifications in commercial real estate. Journal of Property Economics, 10(3), 77–92.
39. Mohammad, F., Hassan, R., & Ahmed, S. (2023). Impact of green building practices on sustainable business development in Afghanistan. International Journal of Sustainable Business Management, 8(2), 66–80.
40. Nwafor, C. E., & Ijeoma, P. C. (2022). Adoption of sustainable building materials and the role of innovation in the Nigerian construction sector. Journal of Engineering, Project, and Production Management, 12(4), 256–266.
41. Olaniyan, O. P., & Akinbode, R. A. (2023). Assessment of green building awareness and adoption among construction professionals in Southwest Nigeria. Journal of Construction and Building Research, 14(2), 58–72.
42. Olivia, S., & Thompson, A. (2022). Green building practices and indoor environmental quality in educational institutions. Journal of Sustainable Education, 10(4), 33–49.
43. Ogunbiyi, A. F., & Fadare, T. M. (2021). Barriers to implementing green building practices in developing economies: Evidence from Nigeria. Journal of Construction in Developing Countries, 26(2), 95–111.
44. Ogunleye, A. M., & Adeoye, K. T. (2022). Challenges of implementing sustainable construction policies in Nigeria. International Journal of Built Environment and Sustainability, 9(3), 143–157.

45. Ogunleye, M., & Adeyemi, S. (2023). LEED and BREEAM standards as drivers of sustainable construction practices. Journal of Sustainable Architecture and Engineering, 8(1), 29–45.
46. Patel, S., & Kumar, V. (2021). Sustainable materials selection and environmental performance in building projects. Journal of Materials and Design Innovation, 11(3), 121–137.
47. Rahman, A., & Alam, R. (2022). Water conservation and sustainable building practices in developing regions. Journal of Environmental Management, 16(2), 110–125.
48. Rahman, T., Smith, D., & Bello, R. (2021). Workplace design, environmental quality, and employee innovation. Journal of Organizational Behavior and Innovation, 12(1), 47–61.
49. Ravi, S., & Kumar, R. (2022). Green housing and urban design innovation in India. International Journal of Urban Sustainability, 15(2), 103–118.
50. Roper, S., & Turner, J. (2021). Innovation and business resilience in the post-COVID-19 era. International Journal of Innovation Management, 25(6), 55–71.
51. Samuel, J., & Ochieng, M. (2021). Impact of green building practices on the operational efficiency of manufacturing firms in Kenya. East African Journal of Business and Economics, 7(2), 92–109.
52. Schilling, M. A. (2020). Strategic management of technological innovation (6th ed.). McGraw-Hill Education.
53. Singh, K., Adewale, L., & Obi, A. (2021). Integrated waste management and diversification strategies for resource recovery. Environmental Engineering Journal, 9(1), 40–58.
54. Smith, J., & Johnson, M. (2021). Water-saving technologies and sustainable urban development. Journal of Water and Sustainability, 18(3), 72–87.
55. Smith, P., & Jones, C. (2022). Sustainable materials and the circular economy in construction. Journal of Environmental Sustainability, 14(2), 122–136.
56. Smith, W., & Robinson, T. (2023). Environmental protection and site sustainability compliance in the United States. Environmental Policy Review, 19(3), 155–172.
57. Sundell, J. (2021). Indoor environmental quality and human health: A review of recent findings. Building and Environment, 197(1), 107–123.
58. Tunde, F., & Bakare, S. (2021). Green building practices and business competitiveness in the Nigerian construction sector. Journal of Sustainable Business Practices, 9(2), 101–117.
59. United States Green Building Council (USGBC). (2021). Green building and LEED core concepts guide. Washington, DC: USGBC.
60. Wang, Y. (2021). Solar energy and sustainable building design for carbon reduction. Journal of Energy and Environmental Design, 12(2), 65–80.
61. Williams, R., & Thompson, K. (2022). Environmental compliance and sustainable site management. International Journal of Environmental Policy, 18(1), 77–92.
62. World Economic Forum. (2025). Building sustainable sites for a net-zero future: Innovation in green construction. Geneva: WEF Publications.
63. Zhang, L., & Wei, P. (2020). Resource efficiency and sustainable material use in industrial production. Journal of Industrial Ecology, 24(4), 201–214.
64. Zhang, Q., & Wang, F. (2023). Smart desalination and water recycling technologies in urban sustainability. Journal of Environmental Innovation, 22(1), 51–68.
65. Zhang, Y., Chen, X., & Wu, L. (2022). Indoor air quality and cognitive performance in green-certified buildings. Building and Environment, 210(4), 108–121.
66. Zhao, T., Li, H., & Xu, J. (2022). Indoor environmental quality and employee creativity in sustainable workplaces. Journal of Organizational Innovation and Environment, 10(3), 188–203.