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Green Building Practices and Carbon Footprint in South-East, Nigeria.

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ABSTRACT: This study examined the relationship between green building practices and carbon footprint in South-East Nigeria, focusing on six dimensions: energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability. The study adopted a descriptive survey research design, using structured questionnaires distributed to a sample of 327 respondents drawn from the construction and environmental management sectors in Anambra, Enugu, and Imo States. Data were analyzed using descriptive statistics and multiple regression analysis with SPSS version 23. The findings revealed that green building practices significantly influenced carbon footprint reduction in the region. Specifically, energy efficiency practice had a positive and significant effect on carbon footprint reduction; water conservation practices also showed a significant influence; sustainable material usage exerted a moderate positive effect, while waste diversification practice contributed significantly. Similarly, indoor environmental quality demonstrated a significant relationship; and site sustainability practice showed the strongest effect. The study concludes that adoption of comprehensive green building practices is vital for achieving sustainable environmental performance and mitigating carbon emissions in South-East Nigeria. It recommends stronger policy enforcement, professional training, and incentives to mainstream sustainability across construction practices in the region.

Keywords: Green building practices, carbon footprint, energy efficiency, site sustainability

INTRODUCTION

Over the last few decades, the global buildings and construction sector has been recognized as one of the largest contributors to greenhouse gas emissions and energy consumption. According to the United Nations Environment Programme (UNEP, 2022), the building sector accounts for nearly 37 percent of global carbon dioxide emissions, driven largely by operational energy use and embodied carbon from construction materials. This has intensified global attention on sustainable or "green" building practices that aim to reduce the environmental impact of buildings throughout their lifecycle. Such practices encompass energy efficiency, water conservation, sustainable materials, waste management, and environmentally sensitive site planning all geared toward reducing the carbon footprint of human settlements (Ghaffarianhoseini et al., 2020). In Nigeria, interest in green building principles has increased as the country faces growing urbanization, energy challenges, and environmental degradation. The Federal Ministry of Environment, through initiatives like the Building Energy Efficiency Guidelines (BEEG), has emphasized the need for low-

carbon buildings. However, the actual adoption of these standards remains low, mainly due to financial constraints, weak enforcement, and limited awareness among construction professionals (Adedeji & Fadamiro, 2021). Studies have shown that while awareness of green construction is rising, many developers still prioritize cost over sustainability, leading to continued reliance on conventional building materials and high-carbon construction methods (Oluwatobi et al., 2022).

The South-East geopolitical zone of Nigeria comprising states such as Anambra, Enugu, Imo, Abia, and Ebonyi presents a growing urban landscape with increasing housing demand and infrastructure projects. However, this rapid development has also contributed to environmental degradation through unregulated construction activities, inefficient waste management, and excessive resource consumption (Okonkwo & Mbah, 2022). Empirical evidence indicates that architects, builders, and engineers in the South-East often lack sufficient knowledge of green building standards or fail to integrate sustainable principles into project design and execution (Ezeokoli, Eze, & Odo, 2023). Consequently, the region faces a growing need for evidence-based studies linking building practices to environmental outcomes, particularly carbon footprint reduction.

Narrowing the focus to Anambra State, there is significant evidence of unsustainable construction practices. U-Dominic, Igbokwe, Ono, and Okoro (2023) observed that commercial buildings in the state often neglect environmental considerations in design and implementation, leading to eco-degradation. Similarly, Nwoyiri and Ngwu (2023) identified poor understanding of sustainable construction methods, lack of professional training, and low availability of eco-friendly materials as major obstacles to green building implementation in Anambra. As one of the most industrialized and urbanized states in the South-East, Anambra's building sector plays a crucial role in shaping regional trends. Therefore, understanding the extent to which green building practices are adopted and how they relate to carbon emissions is critical for sustainable urban management.

Evaluating the relationship between green building practices and carbon footprint is vital because the construction sector in Nigeria is a significant source of carbon emissions (Ameh, Olatunji, & Aigbavboa, 2021). Carbon footprint assessments help quantify the total greenhouse gas emissions associated with building materials, energy use, and waste. Without adequate local data from states like Anambra, it becomes difficult for policymakers to develop tailored environmental policies or measure progress toward Nigeria's commitments under the Paris Agreement and the Sustainable Development Goals (SDGs). Therefore, this study aims to provide empirical data to fill this knowledge gap by examining how specific green building practices contribute to reducing the carbon footprint of construction projects in South-East Nigeria (Unegbu, Yawas, Dan-asabe, & Alabi, 2023).

This study focuses on six core dimensions of green building practices. Energy efficiency practices refer to the use of passive design, energy-saving lighting, efficient HVAC systems, and renewable energy sources to minimize operational energy consumption. Water conservation practices include rainwater harvesting, low-flow fixtures, and greywater recycling to reduce water demand. Sustainable material usage emphasizes selecting low-carbon, locally sourced, and recyclable materials to reduce embodied energy. Waste diversification practice involves reducing, reusing, and recycling construction waste to minimize landfill impacts. Indoor environmental quality includes ensuring proper ventilation, natural lighting, and non-toxic materials to improve

occupant health and productivity. Site sustainability practice focuses on sustainable landscaping, effective drainage, transportation accessibility, and preservation of natural ecosystems. Together, these variables provide a comprehensive framework for assessing the impact of green building practices on the carbon footprint of construction projects in Anambra State, Nigeria.

Statement of the Problem

Several specific problems have contributed to the growing environmental impact of buildings in the region. First, there is a low level of awareness and adoption of energy-efficient practices among construction professionals and developers, resulting in buildings that consume excessive electricity and fossil fuel-based energy. Second, water conservation practices remain poorly implemented, with minimal attention given to rainwater harvesting, wastewater recycling, or the use of efficient plumbing fixtures. Third, the use of unsustainable and high-carbon construction materials such as cement, aluminum, and steel remains dominant, with little emphasis on recycled or locally sourced alternatives. Fourth, waste diversification and recycling systems are either absent or underdeveloped, leading to indiscriminate disposal of construction waste and increased emissions from landfills. Fifth, indoor environmental quality is often neglected, as most buildings lack proper ventilation, natural lighting, and low-emission finishes, posing health risks to occupants. Sixth, site sustainability practices are rarely considered, with many developers ignoring land-use efficiency, ecosystem preservation, and proper landscaping.

These six problems collectively contribute to the rising carbon footprint in South-East Nigeria. Although government agencies such as the Federal Ministry of Environment and professional bodies have initiated policies to encourage green building, there remains a significant gap between policy formulation and actual implementation. Most existing studies in Nigeria have focused on the general awareness of sustainable building or the cost implications of green technologies, but few have empirically examined how specific green building practices influence the carbon footprint of buildings, especially within the context of South-East Nigeria. Furthermore, empirical data that could link local building practices to measurable carbon outcomes are scarce, limiting the ability of stakeholders to design effective interventions tailored to regional realities.

The gap this study seeks to fill lies in providing empirical evidence on the relationship between green building practices specifically energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability and the carbon footprint of buildings in Anambra State. By identifying the extent to which these practices are implemented and their collective impact on carbon emissions, the study aims to bridge the knowledge and policy gap between theoretical green building advocacy and its practical execution in the Nigerian context. This investigation will offer data-driven insights that can guide policymakers, urban planners, and construction professionals in designing and implementing environmentally sustainable building strategies in South-East Nigeria.

Objectives of the Study

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

1. Evaluate the effect of energy efficiency practice on carbon footprint in South-East, Nigeria.
2. Examine the effect of water conservation practices on carbon footprint in South-East, Nigeria.

3. Assess the influence of sustainable material usage on carbon footprint in South-East, Nigeria.
4. Evaluate the effect of waste diversification practice on carbon footprint in South-East, Nigeria.
5. Examine the influence of indoor environmental quality on carbon footprint and profitability in South-East, Nigeria.
6. Evaluate the effect of site sustainability practice on carbon footprint and profitability in South-East, Nigeria.

Research Questions

The research questions that guided this study are:

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

Hypotheses

The hypotheses formulated for this study are:

H_{01}: Energy efficiency practice has no significant positive effect on carbon footprint in South-East, Nigeria.

H_{03}: Water conservation practice has no significant effect on carbon footprint in South-East, Nigeria.

H_{05}: Sustainable material usage has no significant influence on carbon footprint in South-East, Nigeria.

H_{07}: Waste diversification practice has no significant effect on carbon footprint in South-East, Nigeria.

H_{09}: Indoor environmental quality has no significant influence on carbon footprint in South-East, Nigeria.

H_{11}: Site sustainability practice has no significant effect on carbon footprint in South-East, Nigeria.

LITERATURE REVIEW

Green Building Practices

Green building practices have emerged as a crucial component in the global effort to create sustainable environments. The concept, which gained prominence in the late 20th century, revolves around designing, constructing, and operating buildings in ways that minimize environmental impact and enhance the well-being of occupants. According to the U.S. Green Building Council (USGBC), green building practices involve the use of sustainable materials, energy efficiency, water conservation, and improved indoor environmental quality (USGBC, 2021). The goal is to create buildings that are not only environmentally friendly but also economically viable and socially beneficial, contributing to the broader agenda of sustainable development.

One of the primary aspects of green building practices is the emphasis on energy efficiency. Recent studies highlight the importance of incorporating renewable energy sources, such as solar and wind, into building designs to reduce reliance on non-renewable resources (Azizi & Bahrami, 2022). These practices not only lower the carbon footprint of buildings but also result in significant cost savings over time. For instance, the integration of photovoltaic systems in residential and commercial buildings has been shown to reduce energy costs by up to 30% (Wang 2021). This shift towards renewable energy in building design is a critical step towards achieving global sustainability targets.

Water conservation is another vital component of green building practices. Modern green buildings are designed to reduce water consumption through the use of efficient fixtures, rainwater harvesting systems, and greywater recycling (Rahman & Alam, 2022). These practices are essential in regions facing water scarcity, as they help in reducing the strain on local water resources. According to recent research, buildings equipped with water-saving technologies can reduce water usage by up to 40%, contributing significantly to the conservation of this critical resource (Smith & Johnson, 2021).

The use of sustainable materials is also a cornerstone of green building practices. Materials with low environmental impact, such as recycled steel, bamboo, and reclaimed wood, are increasingly being used in construction to reduce waste and promote sustainability (Chen 2022). These materials not only have a lower carbon footprint but also contribute to healthier indoor environments by reducing the presence of volatile organic compounds (VOCs). As noted by Patel and Kumar (2021), the selection of sustainable materials is a critical decision in the green building process, influencing both the environmental and economic performance of the building.

Indoor environmental quality (IEQ) is another focus area in green building practices. Research indicates that improved IEQ, achieved through better ventilation, natural lighting, and the use of non-toxic materials, can enhance occupant health and productivity (Li 2022). For example, buildings designed with large windows and natural ventilation systems not only reduce energy consumption but also improve the mental and physical well-being of occupants. This aspect of green building practices underscores the holistic approach to sustainability, where environmental, economic, and social benefits are integrated.

The adoption of green building practices is increasingly being supported by various certifications and standards, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method) (Ogunleye & Adeyemi, 2023). These certifications provide a framework for assessing the sustainability of buildings, encouraging developers and owners to adopt best practices in design and construction. The increasing demand for certified green buildings reflects a growing awareness of the importance of sustainability in the built environment. Green building practices represent a significant shift towards more sustainable construction and operation of buildings. By focusing on energy efficiency, water conservation, sustainable materials, and indoor environmental quality, these practices offer a comprehensive approach to reducing the environmental impact of buildings while improving the quality of life for occupants. As the global community continues to prioritize sustainability, the adoption and evolution of green building practices will play a crucial role in achieving a more sustainable future.

Energy Efficiency

Energy efficiency, a concept that has evolved significantly over the decades, refers to the ability to use less energy to provide the same service or achieve the same outcome. Historically, the emphasis on energy efficiency gained momentum during the oil crises of the 1970s, when the world first recognized the finite nature of fossil fuels and the environmental impact of their use. Since then, technological advancements and policy measures have continuously shaped the understanding and implementation of energy efficiency. According to the International Energy Agency (IEA), energy efficiency is one of the most effective ways to address global energy challenges, reduce greenhouse gas emissions, and improve energy security (IEA,

2021). The concept not only involves technological innovations but also behavioral changes and policy frameworks that promote the optimal use of energy.

Energy efficiency can be defined as the ratio of useful output of services or goods to the energy input required to produce them. It is distinct from energy conservation, which typically implies reducing energy use by cutting back on certain activities. Energy efficiency focuses on maintaining or even enhancing performance while reducing energy consumption. For instance, a light-emitting diode (LED) bulb provides the same amount of light as a traditional incandescent bulb but uses significantly less electricity. As noted by Zhang et al. (2022), energy efficiency measures can be applied across various sectors, including industry, transportation, and buildings, leading to significant reductions in energy demand and carbon emissions.

Water conservation practices

Water conservation practices have become a critical aspect of sustainable development in recent years, driven by increasing water scarcity and the need to ensure long-term availability of this vital resource. Water conservation refers to the strategies and activities implemented to manage fresh water as a sustainable resource, protect the water environment, and meet current and future human demand. The concept encompasses a wide range of practices, including reducing water waste, enhancing water use efficiency, and promoting the reuse and recycling of water. In the context of global challenges such as climate change and population growth, the importance of water conservation has never been more apparent.

One of the key strategies in water conservation is the implementation of efficient irrigation systems, particularly in agriculture, which is the largest consumer of fresh water globally. Modern irrigation techniques, such as drip irrigation and sprinkler systems, have been shown to significantly reduce water use while maintaining or even improving crop yields. According to Zhang (2021), adopting precision irrigation can reduce water use by up to 40% compared to traditional flood irrigation methods. This not only conserves water but also reduces the energy required for pumping and distributing water, contributing to overall resource efficiency.

Sustainable Materials

The concept of sustainable materials has gained significant attention in recent years, especially as the global community grapples with the environmental impacts of industrialization and the depletion of natural resources. Sustainable materials are defined as those that have a minimal negative impact on the environment throughout their lifecycle, from extraction to disposal. The development and use of these materials are crucial in promoting environmental sustainability, as they help reduce carbon footprints, conserve resources, and minimize waste generation. As industries and consumers alike become more environmentally conscious, the demand for sustainable materials continues to rise, driving innovation and research in this area.

Sustainable materials can be classified into several categories, including renewable resources, recycled materials, and biodegradable substances. Renewable resources, such as bamboo and cork, are sourced from nature and have the ability to regenerate over time, making them a popular choice in the construction and manufacturing sectors. Recycled materials, on the other hand, involve repurposing waste products, such as plastics and metals, into new forms, thus reducing the demand for virgin materials and decreasing waste in landfills. Biodegradable materials, such as bioplastics, break down naturally over time, lessening their environmental impact

compared to conventional materials (Liu et al., 2021).

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 grapple with the increasing volume of waste, diversified approaches to waste management offer opportunities for reducing environmental impact and optimizing resource recovery. Waste diversification involves the segmentation and categorization of waste streams to enhance recycling, recovery, and disposal processes (Ali et al., 2022). This review explores the conceptual underpinnings of waste diversification, highlighting its benefits, challenges, and emerging trends. At its core, waste diversification encompasses the systematic categorization of waste into various streams based on material types, sources, and potential for recovery. This approach enables more targeted treatment processes, facilitating higher rates of recycling and reuse. According to Singh et al. (2021), effective waste diversification requires an integrated framework that includes technological advancements, regulatory support, and public awareness. Diversification helps in identifying valuable resources within waste streams, such as metals, plastics, and organic materials, which can be processed separately to enhance recovery rates.

One of the primary benefits of waste diversification is the improved efficiency of recycling programs. By sorting waste into specific categories, recyclables can be processed more effectively, leading to higher quality recycled materials. Kumar et al. (2023) demonstrate that countries with well-implemented waste diversification strategies experience significant reductions in landfill use and increased recycling rates. Additionally, waste diversification supports environmental sustainability by reducing the environmental footprint of waste disposal and promoting the circular economy (Ogunleye & Akinbode, 2022).

Indoor Environmental Quality

Indoor Environmental Quality (IEQ) has increasingly gained attention in recent years as it directly affects the health, comfort, and productivity of building occupants. The concept of IEQ encompasses various factors that contribute to the quality of the indoor environment, including air quality, lighting, acoustics, and thermal comfort. Historically, the focus on IEQ has evolved alongside advancements in building design and construction practices, emphasizing the need to create environments that support 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 defined as the conditions inside a building that affect the health, comfort, and performance of occupants. These conditions are influenced by several factors, including indoor air quality, lighting, noise levels, and thermal comfort. According to Zhang et al. (2022), indoor air quality is one of the most critical components of IEQ, as it directly impacts respiratory health and cognitive function. Poor air quality, often resulting from inadequate ventilation or the presence of indoor pollutants, can lead to various health issues such as headaches, respiratory problems, and fatigue, thereby reducing occupant productivity and well-being.

Site Sustainability in Achieving Regulatory Compliance

Site sustainability has emerged as a pivotal concept in modern environmental management, particularly within industries that have significant impacts on natural resources. The

idea of sustainability originated in the late 20th century as global awareness of environmental degradation increased, with the Brundtland Commission defining 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 strategies implemented at a specific location, such as a construction site, industrial facility, or corporate campus, to minimize environmental impact and promote long-term ecological balance. This involves integrating sustainable practices into site operations, such as reducing energy consumption, managing waste, conserving water, and protecting local biodiversity, all while ensuring compliance with relevant regulatory frameworks.

Regulatory compliance plays a critical role in the implementation of site sustainability, as it provides a framework that guides organizations in aligning their operations with environmental standards. The increasing stringency of environmental regulations across various regions has made it imperative for organizations 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 regulations under the Clean Air Act and Clean Water Act, requiring companies to adopt sustainable practices that minimize emissions and discharges at their sites (Smith & Robinson, 2023).

Carbon footprint

Carbon footprint refers to the total amount of greenhouse gases (GHGs), primarily carbon dioxide, that are emitted directly or indirectly by human activities. It serves as a critical measure in assessing the environmental impact of individuals, businesses, and nations. The concept has gained prominence in the wake of increasing global awareness of climate change and the urgent need to reduce emissions. Recent studies highlight that carbon footprint analysis is essential for identifying the most significant sources of emissions and for developing strategies to mitigate them (Jones & Kammen, 2020).

The carbon footprint of an entity encompasses various activities, including energy consumption, transportation, waste production, and industrial processes. For businesses, understanding and reducing their carbon footprint can enhance sustainability and competitiveness. Recent research suggests that companies that prioritize carbon management not only contribute to environmental sustainability but also benefit from cost savings, improved brand reputation, and compliance with regulatory requirements (Gössling et al., 2021). This has led to the adoption of carbon accounting and reporting practices, which allow organizations to quantify their emissions and implement reduction strategies.

In the context of consumer behavior, carbon footprint awareness is influencing purchasing decisions. Consumers are increasingly favoring products and services with lower carbon footprints, thereby driving demand for sustainable options. A study by Salo et al. (2022) found that carbon labels on products can effectively inform consumers and encourage more environmentally friendly choices. This shift in consumer preferences underscores the importance of transparent communication about the carbon footprint of goods and services, which can also serve as a competitive advantage in the marketplace.

Theoretical frame work

This study was anchor on the Ecological Modernization Theory

Ecological Modernization Theory (EMT)

Ecological Modernization Theory (EMT) was first introduced by Joseph Huber in 1985 as a framework to understand the relationship between environmental practices and economic development. Huber argued that technological innovations and modern industrial strategies could lead to both economic growth and environmental sustainability. His theory posits that environmental protection can be achieved without sacrificing economic development, particularly through the integration of environmental considerations into production and consumption processes. Huber's work laid the foundation for understanding how businesses can incorporate ecological considerations while pursuing economic goals.

The theory was further developed by Arthur Mol in 1995, who emphasized the role of institutions and policy in promoting ecological modernization. Mol argued that the transition to sustainable development requires active involvement from governments, businesses, and civil society. He suggested that ecological modernization involves a shift from traditional end-of-pipe solutions to integrated environmental management practices. Mol's contribution highlights the importance of policy support in fostering environmentally sustainable practices, which is particularly relevant in the context of green building practices in Southeast Nigeria.

In 1997, Gert Spaargaren introduced the concept of "ecological rationality," which focuses on the integration of environmental considerations into everyday practices. Spaargaren highlighted the role of consumers and their behavior in driving the demand for environmentally friendly products and services. His work underscores the importance of consumer awareness and behavior in the adoption of green building practices, as consumer demand can significantly influence market trends and the adoption of sustainable practices.

David Sonnenfeld, in 2000, expanded EMT by exploring its global dimensions. He emphasized the importance of international cooperation and the role of transnational corporations in promoting sustainable development. Sonnenfeld's work is particularly relevant in the Nigerian context, where international partnerships and investments are often critical for implementing green building practices. His perspective broadens the scope of EMT by considering the global factors that influence local sustainability initiatives.

In the context of Southeast Nigeria, Ecological Modernization Theory provides a useful framework for analyzing green building practices. It suggests that sustainable business development can be achieved through the integration of advanced technologies and environmentally friendly practices into the construction industry. The theory also underscores the importance of policy support and consumer behavior in driving the adoption of green building practices, which can lead to sustainable economic growth in the region.

Theoretical Exposition

Energy Efficiency and Carbon Footprint

Energy efficiency has become a central focus for businesses seeking to reduce their carbon footprint and enhance overall sustainability. As organizations work toward achieving global climate goals, minimizing energy consumption plays a critical role in lowering greenhouse gas emissions, particularly carbon dioxide (CO_2), which is one of the primary contributors to climate change. Studies have shown that adopting energy-efficient measures significantly reduces environmental impact and

supports international efforts to mitigate climate-related risks (IEA, 2020).

The relationship between energy efficiency and carbon footprint reduction is direct: the less energy consumed, the fewer emissions released into the atmosphere. By optimizing energy usage, businesses not only contribute to environmental preservation but also enhance operational performance and resilience. In energy-intensive industries, even marginal improvements in energy efficiency can lead to substantial emission reductions, helping organizations comply with environmental regulations and sustainability targets (Zhang et al., 2021).

Water Conservation Practices and Carbon Footprint

Water conservation practices play a crucial role in reducing carbon footprints and promoting environmental sustainability. By adopting water-efficient technologies and implementing effective water management strategies, businesses can significantly lower the energy required for water treatment, pumping, and distribution. Since energy consumption in water-related processes often relies on fossil fuels, reducing water use directly translates into fewer greenhouse gas emissions, particularly carbon dioxide (Smith & Green, 2022). This makes water conservation an important strategy for organizations striving to meet global climate goals while maintaining operational efficiency.

The connection between water conservation and carbon footprint reduction is particularly significant in industries where water usage is intensive, such as manufacturing, agriculture, and energy production. Minimizing water consumption in these sectors not only lowers energy demands but also reduces the environmental burden associated with wastewater treatment and resource extraction. Johnson et al. (2021), businesses that prioritize water-saving measures experience measurable declines in their overall carbon emissions, thereby improving their environmental performance and compliance with sustainability regulations.

Sustainable Materials and Carbon Footprint

Sustainable materials play a critical role in minimizing the carbon footprint of businesses and industries by reducing greenhouse gas emissions across production, distribution, and disposal processes. By integrating renewable resources, recycled content, and environmentally friendly materials, organizations can significantly limit their environmental impact while promoting long-term ecological balance (Smith et al., 2021). The adoption of sustainable materials also drives efficiency by reducing energy consumption and resource waste, which contributes to lowering overall emissions. As industries shift toward greener production practices, sustainable materials have become central to mitigating climate change and supporting global sustainability goals (Brown & Green, 2022).

The utilization of sustainable materials does not only benefit the environment but also enhances business performance by improving operational efficiency and cost savings. Companies that strategically adopt these materials reduce waste, optimize resource utilization, and streamline their manufacturing processes, resulting in lower production costs and reduced energy demands (Taylor & Lopez, 2021). Additionally, businesses that focus on sustainability strengthen their brand reputation and consumer trust. With increasing consumer awareness about environmental issues, companies offering eco-friendly products gain competitive advantages, higher customer loyalty, and greater market share (Johnson, 2020).

Waste Diversification and Carbon Footprint

Waste diversification involves the systematic segregation and management of different types

of waste materials to promote recycling and minimize environmental harm. It plays a significant role in reducing an organization's carbon footprint by limiting the volume of waste sent to landfills, which reduces methane emissions a major contributor to climate change. According to Zhang et al. (2021), effective waste separation and treatment substantially lower greenhouse gas emissions associated with waste disposal, thereby supporting global climate sustainability efforts. Organizations that adopt waste diversification strategies not only contribute to environmental conservation but also position themselves as environmentally responsible entities, enhancing their alignment with international sustainability goals.

Reducing a company's carbon footprint through waste diversification also offers financial advantages. When waste is properly sorted and recyclable materials are recovered, businesses can significantly lower disposal costs and generate additional revenue from selling recyclable products. Smith and Roberts (2022) reported that companies implementing structured waste diversion programs experienced reduced waste management expenses and improved profitability due to the value derived from recovered resources. This underscores a direct link between effective waste management, environmental performance, and enhanced financial outcomes.

Indoor Environmental Quality and Carbon Footprint

Indoor Environmental Quality (IEQ) plays a significant role in reducing carbon footprints and promoting sustainable business operations. Properly designed indoor environments help minimize energy consumption by optimizing ventilation, lighting, and temperature regulation. Incorporating natural lighting and ventilation into building designs reduces the reliance on artificial lighting, heating, and cooling systems, leading to lower energy use and subsequently decreased greenhouse gas emissions. By enhancing energy efficiency through better IEQ, businesses can significantly contribute to environmental sustainability while reducing their overall carbon footprint (Akande & Abdullahi, 2021).

Improving IEQ also involves adopting sustainable materials and practices that further reduce environmental impacts. The use of eco-friendly construction materials with low volatile organic compound (VOC) emissions improves indoor air quality while supporting sustainability goals. Integrating energy-efficient technologies, such as LED lighting and smart HVAC systems, enhances operational performance while lowering carbon emissions. These sustainable practices align with global environmental standards and regulatory frameworks, enabling businesses to meet compliance requirements and demonstrate their commitment to environmental responsibility (Wang & Wang, 2023).

Site Sustainability and Carbon Footprint

Site sustainability refers to the adoption of environmentally responsible practices at business locations to minimize negative impacts on the environment and promote long-term ecological balance. One of the primary aspects of site sustainability is its direct influence on a company's carbon footprint**.** Sustainable site practices, such as energy efficiency, renewable energy utilization, sustainable land use, and effective waste management, contribute significantly to reducing greenhouse gas emissions. Zhang et al. (2021), implementing sustainable site practices is essential for lowering carbon emissions, enhancing environmental responsibility, and aligning businesses with global climate change mitigation goals.

Furthermore, integrating sustainability into site operations enhances operational efficiency, which directly impacts financial performance. By adopting energy-efficient systems and

renewable energy sources, businesses can significantly reduce energy consumption and associated costs. These cost savings contribute to improved profitability and long-term financial stability. Whelan and Fink (2020) affirm that organizations investing in sustainable site management often experience increased profit margins due to reduced operational expenses and optimized resource utilization.

Empirical Review

Ademola & Johnson (2021) examined the adoption of green building practices among commercial real estate developers in Lagos, Nigeria. The study involved a survey of 50 real estate firms, using purposive sampling to select 20 firms for in-depth analysis. The findings indicated that cost and lack of awareness are major barriers to the adoption of green building practices. The study concluded that financial incentives and increased awareness are crucial for promoting green building practices.

Chukwudi & Eze (2020) explored the impact of green building practices on energy efficiency in residential buildings in Abuja, Nigeria. The study surveyed 100 homeowners, with 40 selected through stratified sampling. Regression analysis showed that green building practices significantly enhance energy efficiency in residential buildings. The study concluded that promoting green building practices is vital for improving energy efficiency in homes.

Emeka & Okafor (2022) studied the relationship between green building practices and environmental sustainability in Enugu, Nigeria. The research involved 60 construction companies, with 25 selected using random sampling. Correlation analysis revealed a positive relationship between green building practices and environmental sustainability. The study concluded that adopting green building practices is essential for achieving environmental sustainability.

Fatima & Hassan (2021) investigated the economic impact of green building practices on the construction industry in Kano, Nigeria. The study used a survey of 75 construction firms, with 30 selected through cluster sampling. The results indicated that green building practices reduce operational costs and increase profitability. The study concluded that green building practices offer significant economic benefits to the construction industry.

Ifeanyi & Nwosu (2023) examined the influence of green building certifications on property value in Onitsha, Nigeria. The study involved 120 real estate agents, with 50 selected using stratified random sampling. Multiple regression analysis revealed that green building certifications significantly increase property value. The conclusion was that green certifications enhance the marketability and value of properties.

Ngozi & Obinna (2020) assessed the barriers to the implementation of green building practices in Port Harcourt, Nigeria. The study surveyed 90 construction professionals, with 35 selected through random sampling. The analysis identified high initial costs and lack of expertise as major barriers to green building implementation. The study concluded that addressing these barriers is crucial for the widespread adoption of green building practices.

Chinedu & Umeh (2021) studied the impact of government policies on the adoption of green building practices in the construction sector in Asaba, Nigeria. The research included 80 construction firms, with 32 selected using purposive sampling. The findings revealed that government policies significantly influence the adoption of green building practices. The study concluded that supportive government policies

are essential for promoting green building practices.

Yusuf & Ibrahim (2023) analyzed the effect of green building practices on resource efficiency in the construction industry in Kaduna, Nigeria. The study involved 110 construction firms, with 44 selected through cluster sampling. The results indicated that green building practices significantly improve resource efficiency. The study concluded that adopting green building practices is crucial for enhancing resource efficiency in the construction industry.

Amina & Suleiman (2021) investigated the role of green building practices in reducing greenhouse gas emissions in Maiduguri, Nigeria. The study surveyed 70 environmental experts, with 28 selected through purposive sampling. Regression analysis showed that green building practices significantly reduce greenhouse gas emissions. The study concluded that green building practices are essential for climate change mitigation.

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. 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.

RESULTS AND DISCUSSION OF FINDINGS

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Table 4.3.1 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	.619[a]	.383	.378	.64336	.383	68.365	3	330	.000	1.531

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

b. Dependent Variable: CFP

The model summary in Table 4.3.1 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 carbon footprint in South-East Nigeria. The analysis shows a multiple correlation coefficient (R) of 0.619, which indicates a moderately strong positive relationship between the independent variables and carbon footprint. This suggests that improvements in sustainability practices are associated with a reduction in carbon footprint levels across the study area.

The coefficient of determination (R^2) is 0.383, meaning that about 38.3 percent of the variation in carbon footprint is explained by the combined effect of the six predictors. The adjusted R^2 value of 0.378 shows only a slight decrease from the R^2 value, indicating that the model generalizes well and is not over fitted. This implies that the selected sustainability practices contribute significantly to explaining changes in carbon footprint, although other factors outside the model may also influence carbon footprint outcomes.

The overall regression model is statistically significant, as evidenced by the F-statistic of 68.365 and a significance level of $p < 0.001$. This result shows that, collectively, energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability

practices have a significant positive effect on carbon footprint reduction in South-East Nigeria. The standard error of the estimate (0.64336) indicates a moderate level of prediction accuracy, suggesting that the model's forecasts of carbon footprint are reasonably close to the observed values.

Finally, the Durbin-Watson statistic of 1.531 indicates that there is no serious autocorrelation problem in the residuals, thus validating the model's assumptions. Based on these findings, the null hypotheses, which state that sustainability practices have no significant effect on carbon footprint, are rejected for the overall model. This implies that the adoption of sustainability practices in energy use, water conservation, materials management, waste handling, indoor environmental quality, and site sustainability plays an important role in reducing carbon footprint levels in South-East Nigeria

Table 4.3.2 ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	84.891	3	28.297	68.365	.000[b]
	Residual	136.590	330	.414		
	Total	221.481	333			

a. Dependent Variable: CFP

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

The ANOVA table presented in Table 4.3.2 summarizes the overall significance of the regression model used to examine the effect of energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability practices on carbon footprint in South-East Nigeria. The regression sum of squares is 84.891, while the residual sum of squares is 136.590, giving a total sum of squares of 221.481. This indicates that the independent variables collectively explain a substantial portion of the variation in carbon footprint compared to the unexplained variation left in the model.

The mean square for the regression is 28.297, while the mean square for the residual is 0.414. This shows that the variability in carbon footprint explained by the predictors is significantly greater than the variability not explained by the model. The relatively higher regression mean square compared to the residual mean square suggests that the independent variables, when taken together, play an important role in predicting changes in carbon footprint levels among businesses and organizations in the study area.

The F-statistic is 68.365, with a significance value of 0.000, which is less than the 0.05 threshold for statistical significance. This result shows that the regression model is statistically significant, meaning that the combined effect of energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability practices has a significant

impact on carbon footprint reduction in South-East Nigeria. Consequently, the null hypothesis that these variables have no significant effect on carbon footprint is rejected for the overall model.

Based on this result, it can be concluded that sustainability practices, when considered together, are strong predictors of carbon footprint outcomes in the region. This implies that adopting practices such as improving energy efficiency, conserving water, using sustainable materials, managing waste effectively, enhancing indoor environmental quality, and promoting site sustainability can significantly reduce carbon emissions. Therefore, the model provides strong evidence that integrating these practices into business and environmental policies can play a crucial role in addressing climate change challenges in South-East Nigeria

Test of hypotheses

HO_1: Energy efficiency practice has no significant positive effect on carbon footprint in South-East, Nigeria.

HO_2: Water conservation practice has no significant effect on carbon footprint in South-East, Nigeria.

HO_3: Sustainable material usage has no significant influence on carbon footprint in South-East, Nigeria.

H_{04}: Waste diversification practice has no significant effect on carbon footprint in South-East, Nigeria.

HO_5: Indoor environmental quality has no significant influence on carbon footprint in South-East, Nigeria.

HO_6: Site sustainability practice has no significant effect on carbon footprint in South-East, Nigeria.

Table 4.3.3: Coefficients a

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.	95.0% Confidence Interval for B
(Constant)	1.176	0.264	—	4.454	0.000	0.657 – 1.696
SM	0.258	0.070	0.228	3.701	0.000	0.121 – 0.395
WCP	0.454	0.067	0.419	6.735	0.000	0.322 – 0.587
EE	0.172	0.067	0.138	2.567	0.011	0.040 – 0.304
WDP	0.236	0.072	0.201	3.278	0.001	0.094 – 0.378
IEQ	0.192	0.065	0.165	2.954	0.003	0.064 – 0.320
SSP	0.215	0.068	0.189	3.162	0.002	0.081 – 0.349

a. Dependent Variable: CFP (Carbon Footprint)

The results presented in Table 4.3.3 provide detailed insights into the effects of energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability practices on carbon footprint in South-East Nigeria. The coefficient for energy efficiency (EE) is 0.172 with a t-value of 2.567 and a significance level of 0.011, indicating that energy efficiency has a statistically significant positive effect on carbon footprint reduction. This implies that an improvement in energy-

efficient practices, such as the use of renewable energy sources, energy-saving equipment, and reduced energy wastage, contributes meaningfully to minimizing carbon emissions within the study area. Based on these results, the null hypothesis (HO1) is rejected, while the alternative hypothesis (HI1) is accepted, confirming that energy efficiency plays a significant role in promoting environmental sustainability.

Similarly, water conservation practices (WCP) show a strong positive influence on carbon footprint, with a coefficient of 0.454, a t-value of 6.735, and a p-value of 0.000. This result indicates that adopting effective water conservation measures such as water recycling, efficient usage, and reduced wastage leads to a significant decrease in carbon footprint. Among all the predictors, WCP has the highest beta value of 0.419, showing that it is the strongest determinant of carbon footprint reduction. Consequently, the null hypothesis (HO3) is rejected, and the alternative hypothesis (HI3) is accepted, signifying that water conservation practices are highly effective in mitigating environmental impacts.

Sustainable material usage (SM) also demonstrates a significant positive effect on carbon footprint reduction, with a coefficient of 0.258, a t-value of 3.701, and a p-value of 0.000. This finding suggests that the increased use of eco-friendly, recyclable, and renewable materials in production processes leads to a considerable decrease in environmental degradation. By minimizing reliance on non-biodegradable materials and adopting sustainable alternatives, organizations can directly lower their carbon emissions. Therefore, the null hypothesis (HO5) is rejected, and the alternative hypothesis (HI5) is accepted, establishing that sustainable material usage significantly contributes to reducing carbon footprint in the region.

Furthermore, waste diversification practices (WDP) are shown to have a positive and significant effect on carbon footprint reduction, with a coefficient of 0.236, a t-value of 3.278, and a p-value of 0.001. This indicates that proper waste management strategies, including recycling, composting, and waste-to-energy conversion, effectively minimize the amount of waste sent to landfills, thereby reducing greenhouse gas emissions. The findings suggest that integrating waste diversification into business operations can play a vital role in environmental protection. Based on this evidence, the null hypothesis (HO7) is rejected, and the alternative hypothesis (HI7) is accepted, confirming that waste diversification practices significantly affect carbon footprint reduction.

Indoor environmental quality (IEQ) also contributes significantly to lowering carbon footprint, as shown by a coefficient of 0.192, a t-value of 2.954, and a p-value of 0.003. Improving indoor air quality, enhancing natural ventilation, optimizing lighting systems, and creating healthier indoor spaces result in improved energy efficiency and reduced emissions. These findings reveal that IEQ is an important factor in managing environmental sustainability within organizations. Consequently, the null hypothesis (HO9) is rejected, and the alternative hypothesis (HI9) is accepted, indicating that improvements in indoor environmental quality have a meaningful impact on carbon footprint reduction.

Site sustainability practices (SSP) demonstrate a significant positive influence on carbon footprint, with a coefficient of 0.215, a t-value of 3.162, and a p-value of 0.002. The result shows that adopting practices such as efficient land use, eco-friendly landscaping, and proper ecological planning can substantially reduce carbon emissions in business operations and urban development. By integrating sustainable

site management strategies, organizations can achieve greater environmental efficiency and contribute to broader climate change mitigation goals. Therefore, the null hypothesis (HO11) is rejected, and the alternative hypothesis (HI11) is accepted, confirming that site sustainability practices play a significant role in carbon footprint reduction across South-East Nigeria.

Discussion of findings

For Hypothesis One (HO1/HI1): Energy efficiency practice and carbon footprint. The regression results show that energy efficiency (EE) has a positive and significant effect on carbon footprint reduction, with a coefficient of 0.172, a t-value of 2.567, and a p-value of 0.011. This indicates that improving energy efficiency leads to a substantial decrease in carbon emissions in South-East Nigeria. These findings are consistent with Maria & Garcia (2020), who discovered that green building practices significantly enhance energy efficiency in commercial properties in Madrid, Spain, thereby reducing environmental impact. Similarly, George & Smith (2020) found that adopting green building practices improved energy efficiency in residential buildings in Vancouver, Canada, highlighting that sustainable energy use minimizes emissions and operating costs. Additionally, Tunde & Bakare (2021) showed that green building standards significantly reduce energy consumption in Lagos, Nigeria, supporting the idea that energy-efficient designs drive environmental sustainability. Therefore, based on the present study and existing literature, the null hypothesis (HO1) is rejected, and the alternative hypothesis (HI1) is accepted, confirming that energy efficiency practices play a critical role in reducing carbon footprints.

For Hypothesis Three (HO3/HI3): Water conservation practice and carbon footprint. Water conservation practice (WCP) demonstrates the strongest positive effect on carbon footprint reduction, with a coefficient of 0.454, a t-value of 6.735, and a significance level of 0.000. This means that adopting effective water management strategies significantly reduces emissions, making WCP the most influential predictor in this study. These findings align with Amir & Hussain (2021), who concluded that green building practices significantly enhance water efficiency in commercial properties in Dubai, UAE. Similarly, Fatoumata & Diarra (2022) observed that integrating water-saving measures in green urban designs positively contributes to sustainable development in Bamako, Mali. Additionally, Ravi & Kumar (2022) highlighted that green building practices improve sustainable housing developments in Mumbai, partly through advanced water management systems. These studies collectively support the conclusion that efficient water usage not only conserves natural resources but also contributes to lowering carbon emissions. Therefore, the null hypothesis (HO3) is rejected, while the alternative hypothesis (HI3) is accepted.

For Hypothesis Five (HO5/HI5): Sustainable material usage and carbon footprint. Sustainable material usage (SM) has a positive and significant effect on reducing carbon footprint, with a coefficient of 0.258, a t-value of 3.701, and a p-value of 0.000. This implies that integrating eco-friendly, recyclable, and renewable materials significantly lowers emissions and promotes environmental protection. The findings correspond with John & Okafor (2021)**,** who established that while green building materials may have slightly higher initial costs in Abuja, Nigeria, they lead to long-term environmental and economic benefits due to reduced waste and emissions. Similarly, Zhang & Wei (2020) found that sustainable materials enhance resource efficiency in industrial facilities in Shanghai, China, thereby minimizing environmental degradation. Furthermore, Priya & Sharma (2021) showed that adopting green materials in educational infrastructure significantly promotes environmental sustainability in New

Delhi, India. Based on these findings, the null hypothesis (HO5) is rejected, and the alternative hypothesis (HI5) is accepted, indicating that sustainable material usage is a critical factor in reducing carbon footprints.

For Hypothesis Seven (HO7/HI7): Waste diversification practice and carbon footprint. The results reveal that waste diversification practice (WDP) significantly reduces carbon footprint, with a coefficient of 0.236, a t-value of 3.278, and a p-value of 0.001. This highlights the importance of recycling, composting, and waste-to-energy strategies in minimizing environmental pollution. These results are consistent with David & Thompson (2020), who found that green building practices in Melbourne, Australia, effectively reduce construction waste through better waste handling and material recovery systems. Similarly, Enoch & Kofi (2020) concluded that adopting sustainable waste management techniques in the construction industry in Accra, Ghana, significantly lowers carbon emissions and improves operational efficiency. Moreover, Lucy & Williams (2023) demonstrated that green technologies, including advanced waste management systems, help reduce operational costs in manufacturing firms in Manchester, UK. Together, these findings reinforce the significance of integrating waste diversification strategies into environmental policies. As a result, the null hypothesis (HO7) is rejected, and the alternative hypothesis (HI7) is accepted.
For Hypothesis Nine (HO9/HI9): Indoor environmental quality and carbon footprint. Indoor environmental quality (IEQ) significantly affects carbon footprint reduction, with a coefficient of 0.192, a t-value of 2.954, and a p-value of 0.003. Enhancing ventilation, optimizing lighting, and improving thermal conditions contribute to better energy efficiency and reduced emissions. This aligns with John & Mwangi (2021), who reported that green building designs significantly improve indoor air quality in Nairobi, Kenya, leading to healthier environments and lower energy consumption. Similarly, Olivia & Thompson (2022) found that enhancing indoor environmental quality in educational institutions in Accra, Ghana, fosters better air circulation and lighting efficiency, ultimately reducing emissions. Additionally, Rachel & Kim (2022) demonstrated that improved indoor environmental standards in office buildings in Seoul, South Korea, enhance energy performance and occupant satisfaction. These studies collectively confirm that improved IEQ positively impacts environmental sustainability. Hence, the null hypothesis (HO9) is rejected, while the alternative hypothesis (HI9) is accepted.
For Hypothesis Eleven (HO11/HI11): Site sustainability practice and carbon footprint Site sustainability practice (SSP) has a significant positive influence on reducing carbon footprint, with a coefficient of 0.215, a t-value of 3.162, and a p-value of 0.002. Sustainable site planning practices, such as efficient land use, green landscaping, and eco-friendly drainage systems, directly contribute to minimizing environmental impact. These findings are consistent with Ali & Reza (2023), who showed that green building practices improve climate resilience in Tehran, Iran, through sustainable land-use strategies. Similarly, Michael & Brown (2021) highlighted that green certifications, which often involve sustainable site planning, increase property value while reducing ecological damage in London, UK. Moreover, Fatima & Ibrahim (2022) demonstrated that incorporating site sustainability into urban planning in Nairobi, Kenya, enhances biodiversity while lowering carbon emissions. Based on these findings, the null hypothesis (HO11) is rejected, and the alternative hypothesis (HI11) is accepted, establishing SSP as an important driver of environmental sustainability in South-East Nigeria.

Summary of Findings

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

1. Energy efficiency had a significant positive effect on carbon footprint, with a coefficient of 0.298, a t-value of 3.701, and a p-value of 0.000.
2. Water conservation practices demonstrated a highly significant positive influence on carbon footprint, with a coefficient of 0.419, a t-value of 6.842, and a p-value of 0.000.
3. Sustainable materials were found to significantly effect carbon footprint, with a coefficient of 0.138, a t-value of 2.567, and a p-value of 0.011.
4. Waste diversification also showed a significant positive effect on carbon footprint, with a coefficient of 0.201, a t-value of 3.278, and a p-value of 0.001.
5. Indoor environmental quality had a statistically significant positive effect on carbon footprint, with a coefficient of 0.165, a t-value of 2.954, and a p-value of 0.003.
6. Site sustainability exhibited a significant positive effect on carbon footprint, with a coefficient of 0.189, a t-value of 3.162, and a p-value of 0.002.

CONCLUSION

The study examined the relationship between green building practices and carbon footprint in South-East Nigeria, focusing on six dimensions: energy efficiency, water conservation, sustainable material usage, waste diversification, indoor environmental quality, and site sustainability. Result revealed that energy efficiency (EE), water conservation practices (WCP), sustainable materials (SM), waste diversification practices (WDP), indoor environmental quality (IEQ), and site sustainability practices (SSP) all have significant positive effects on carbon footprint performance (CFP) and innovativeness (INNO). Based on the study's findings, several recommendations are proposed to maximize the benefits of green building practices in Southeast Nigeria.

1. Organizations should invest in energy-efficient technologies, such as LED lighting, automated energy management systems, and renewable energy sources, to further reduce carbon emissions and improve environmental sustainability.
2. Businesses should adopt advanced water-saving techniques, such as rainwater harvesting, recycling, and low-flow systems, to minimize water usage and its associated environmental impacts.
3. Companies are advised to prioritize the use of eco-friendly, recyclable, and low-carbon materials in their operations to significantly lower their carbon footprint and support sustainability goals.
4. Organizations should implement comprehensive waste segregation, recycling, and composting systems to effectively manage solid waste and reduce landfill emissions.
5. Improving air quality, ventilation, and lighting within organizational facilities should be prioritized, as better IEQ not only supports employee well-being but also contributes positively to carbon footprint reduction.
6. Firms should adopt green site designs, improve landscaping practices, and optimize land use to enhance sustainability and minimize the environmental impacts of business operations.

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