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Professional Awareness and Adoption of Sustainable Construction Materials in Building Projects in Bauchi State, Nigeria

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Abstract: *The transition towards sustainable construction requires construction professionals to understand, specify and implement materials that reduce environmental impacts while maintaining technical and economic performance. This study investigates professional awareness, material adoption patterns, barriers and sustainability-related determinants of sustainable construction material adoption in building projects in Bauchi State, Nigeria. A quantitative cross-sectional survey design was employed. A structured questionnaire was administered to registered Builders, Architects, Quantity Surveyors and Civil Engineers in Bauchi State. From 255 questionnaires distributed, 250 were retrieved and 240 valid responses were retained for analysis. Data were analysed using descriptive statistics, Cronbach's alpha, normality assessment and multiple regression analysis. Professional awareness was moderate, with mean scores ranging from 3.17 to 3.44. Cost savings (M = 3.44) and reduced environmental impact (M = 3.38) were the most recognised benefits. Timber (M = 4.62) and bamboo (M = 4.49) were the most commonly known or used materials, whereas 3D-printed concrete (M = 3.68) was among the least established. The principal barriers were an underdeveloped sustainable-material market (M = 3.44), low awareness and knowledge (M = 3.38), and inadequate stakeholder expertise (M = 3.34). Sustainability-related regression models explained 46.3–55.1% of observed variation across the reported outcome dimensions. The findings indicate that awareness must be complemented by technical capacity, market development, professional training and institutional support if sustainable materials are to move beyond recognition towards routine project application. The study provides location-specific empirical evidence on professional awareness, material-use patterns and adoption constraints in Bauchi State, where evidence on sustainable material adoption remains limited.*
Keywords: sustainable construction materials; professional awareness; material adoption; construction professionals; green building;

INTRODUCTION

The building and construction sector is fundamental to economic development through the provision of infrastructure, employment generation, investment and capital formation. At the same time, the sector is a major consumer of natural resources and a significant contributor to energy use, greenhouse-gas emissions and material waste across the building life cycle. Recent evidence indicates that buildings and construction account for approximately 32% of global energy consumption and 34% of global carbon dioxide emissions, with cement and steel alone contributing substantially to the sector's material-related emissions (United Nations Environment Programme [UNEP] & Global Alliance for Buildings and Construction [GlobalABC], 2025). These impacts arise across interconnected stages, including raw-material extraction, material processing and manufacturing, transportation, construction, building operation, maintenance and end-of-life management. Consequently, the transition towards resource-efficient, low-carbon and environmentally responsible construction has become an important component of contemporary sustainable development (UNEP & GlobalABC, 2024, 2025).

Construction materials represent a particularly important intervention point within this transition because material selection influences embodied energy, embodied carbon, resource depletion, waste generation, durability and whole-life environmental performance. The continued dominance of conventional materials such as Portland cement and steel is associated with established supply chains, technical familiarity, standardisation and proven performance; however, their production also carries significant environmental consequences. The increasing emphasis on decarbonisation and resource efficiency has therefore stimulated interest in sustainable and innovative construction materials incorporating recycled content, renewable resources, industrial by-products, recovered materials and lower-carbon production processes. Such materials have the potential to reduce environmental impacts while supporting resource efficiency and more circular approaches to construction, although their sustainability benefits remain dependent on context, material performance, sourcing, transportation and life-cycle conditions (UNEP & GlobalABC, 2024).

The availability of technically viable sustainable materials, however, does not automatically translate into their adoption in building projects. Material selection is a multi-actor decision influenced by professional knowledge, perceived technical risk, cost, client requirements, procurement arrangements, market availability, regulatory conditions, technical standards and previous project experience. Architects influence material specification and design decisions; civil engineers evaluate structural and technical suitability; builders and contractors translate specifications into procurement and site-level implementation; while quantity surveyors assess cost, value and economic implications. Sustainable material adoption is therefore not simply a technological decision but a socio-technical process in which professional capability interacts with institutional, market and project-level conditions.

Within this process, professional awareness constitutes an important but not necessarily sufficient condition for adoption. Awareness refers to the extent to which construction professionals recognise sustainable materials, understand their characteristics and appreciate their potential environmental, technical or economic benefits. Adoption, by contrast, concerns the actual consideration, specification, procurement or use of such materials in construction practice. Treating these concepts as synonymous can obscure an important implementation problem:

professionals may possess considerable knowledge of sustainable materials while continuing to rely predominantly on conventional alternatives because of cost concerns, inadequate technical information, limited availability, insufficient client demand, weak supply chains or uncertainty regarding performance. Recent empirical evidence from Nigeria reinforces this distinction, reporting a measurable gap between awareness and actual adoption among architecture, engineering and construction professionals and suggesting that awareness alone explains only part of the variation in adoption behaviour (Mogaji et al., 2026).

The Nigerian construction industry provides an important context for examining this issue. Although sustainable construction has received increasing attention in professional and academic discourse, the adoption of innovative and sustainable materials remains constrained by a combination of knowledge, economic, organisational, market and institutional factors. Recent evidence from the Nigerian construction industry identifies lack of awareness and knowledge, inadequate training, cost and economic viability, shortage of qualified personnel, limited end-user involvement and weak market conditions among the major barriers to innovative building-material adoption (Mogaji et al., 2025). Earlier research similarly identified additional cost perceptions and insufficient information on sustainable materials as important obstacles affecting their selection and use in Nigerian building projects (Aigbavboa et al., 2015). These findings suggest that the challenge extends beyond the availability of alternative materials to the capacity of industry professionals and institutions to evaluate and integrate them into project decision-making.

Nevertheless, the Nigerian evidence base remains geographically uneven. Research undertaken in particular urban centres and states provides valuable evidence concerning sustainable-material selection and adoption, but such findings cannot automatically be generalised to construction professionals operating in other regional construction markets. Differences in material supply chains, professional capacity, project characteristics, client preferences, institutional support, regulatory implementation and market maturity can produce different patterns of awareness and adoption. Consequently, geographically specific empirical studies remain necessary for understanding how sustainability-related knowledge and material-use practices are manifested within individual Nigerian construction environments.

This limitation is particularly relevant to Bauchi State, where comparatively limited empirical attention has been directed towards the relationship between construction professionals' awareness, sustainable-material use and the constraints affecting adoption. Existing sustainability research in the state has focused more strongly on areas such as construction waste management and related environmental concerns, leaving insufficient empirical evidence concerning professionals' knowledge of sustainable construction materials and their reported material-use patterns. The absence of such evidence makes it difficult to determine whether barriers identified elsewhere in Nigeria such as inadequate awareness, limited technical expertise, cost concerns, market underdevelopment and material availability are similarly experienced by professionals working within Bauchi State.

The need for a location-specific investigation is strengthened by the increasingly recognised distinction between awareness and implementation. Recent Nigerian evidence indicates that relatively high awareness does not necessarily correspond to equally high levels of sustainable-material adoption, highlighting the role of broader institutional and market conditions (Mogaji et al., 2026). Similarly, evidence on innovative building materials identifies awareness and market-related factors as a distinct category of adoption barriers, alongside resource, policy, organisational, perception and stakeholder-related constraints (Mogaji et al., 2025). These findings imply that a meaningful assessment of sustainable-material adoption should move beyond asking whether professionals are aware of sustainable materials and examine what materials they know or use, what constraints they encounter and which sustainability-related factors are associated with material adoption.

Against this background, the present study examines sustainable construction-material practices among construction professionals in Bauchi State, Nigeria. Rather than assuming that awareness directly produces adoption, the study treats awareness, material-use patterns, adoption barriers and sustainability-related factors as related but analytically distinct dimensions of sustainable construction practice. This approach provides a more empirically cautious basis for understanding the position of sustainable materials within a regional Nigerian construction market and for identifying the conditions that may support their wider application. The study contributes to the sustainable construction literature in three principal respects. First, it provides location-specific empirical evidence on sustainable construction-material awareness, material-use patterns and adoption constraints among construction professionals in Bauchi State, thereby extending the geographical coverage of Nigerian sustainable-construction research. Second, it explicitly distinguishes awareness from adoption, avoiding the assumption that professional knowledge necessarily translates into implementation. Third, by examining adoption barriers and sustainability-related factors alongside professional awareness, the study provides evidence that can inform professional development, industry capacity building, material-market development and institutional interventions intended to strengthen sustainable-material adoption within the Nigerian construction sector.

LITERATURE REVIEW

Sustainable Construction and Sustainable Construction Materials

Sustainable construction has evolved from a predominantly environmental concern into a multidimensional approach that integrates environmental, economic and social considerations across the building life cycle. Rather than evaluating construction projects exclusively according to initial capital cost and technical performance, sustainable construction incorporates resource efficiency, energy consumption, environmental impacts, durability, human health, waste minimisation and long-term economic value into project decision-making. This life-cycle perspective is particularly important because environmental impacts associated with buildings are distributed across material extraction, manufacturing, transportation, construction, operation, maintenance, refurbishment and end-of-life processes (United Nations Environment Programme [UNEP] & Global Alliance for Buildings and Construction [GlobalABC], 2024, 2025).

Within this broader sustainability agenda, construction materials constitute a critical area of intervention. Material choices influence embodied energy, greenhouse-gas emissions, resource depletion, waste generation, durability and the environmental performance of buildings over their useful life. Sustainable construction materials may therefore include materials manufactured using recycled or recovered resources, renewable materials, industrial by-products, low-carbon binders, recycled aggregates, responsibly sourced timber and other alternatives that can reduce environmental burdens without compromising required technical and functional performance. However, the classification of a material as “sustainable” should not be based solely on its origin or environmental label. Its actual sustainability depends on the context of production, transportation, installation, service life, maintenance requirements and end-of-life recovery.

Life-cycle assessment (LCA) is consequently important for distinguishing between apparent and actual environmental benefits. LCA provides a systematic basis for evaluating environmental impacts across different stages of a material or building system and can support comparisons between conventional and alternative materials. Barbhuiya and Das (2023) emphasise the importance of life-cycle considerations in evaluating sustainable construction materials, while Dsilva et al. (2023) demonstrate the relevance of life-cycle approaches to circular-economy decision-making. More broadly, life-cycle thinking enables material decisions to move beyond the narrow consideration of initial cost and towards an assessment of cumulative environmental and resource implications.

An important implication of this literature is that sustainable material selection is inherently a decision-making problem rather than simply a materials-technology problem. A technically superior material may not achieve widespread application if it is unavailable locally, expensive, poorly understood by professionals, difficult to install or unsupported by appropriate standards. Conversely, a material with moderate environmental benefits may achieve greater adoption because it is familiar, affordable, readily available and compatible with established construction practices. Thus, the sustainability performance of materials and their probability of adoption must be considered simultaneously. This distinction provides an important basis for examining the role of professional awareness in sustainable material adoption.

Professional Awareness and Sustainable Material Adoption

Professional awareness encompasses more than simple recognition of sustainable construction materials. It includes knowledge of their environmental benefits, technical characteristics, economic implications, durability, availability, application requirements and potential contribution to building performance. In professional practice, such knowledge can influence the extent to which alternative materials are considered during design, specification, procurement and construction. Awareness is therefore potentially relevant to the early stages of the material decision-making process.

However, the literature indicates that general awareness of sustainability does not necessarily imply adequate knowledge of specific sustainable materials or the capacity to apply them in practice. Umar et al. (2021), for example, identified limitations in sustainability-related awareness among architects in Minna, Nigeria. Similarly, Oguntona et al. (2023) reported challenges concerning awareness and knowledge of emerging building materials among construction professionals in South Africa. These findings suggest that sustainability discourse may become more widespread within the profession without producing equivalent improvements in technical knowledge or material application. A critical distinction therefore needs to be made between awareness, intention and adoption. Awareness concerns knowledge or recognition; intention concerns willingness or planned behaviour; whereas adoption concerns actual specification, procurement or use. A construction professional may recognise the environmental benefits of recycled aggregates, for example, but decide against specifying them because of concerns about availability, cost, quality consistency, technical performance, client preferences or regulatory requirements. Consequently, a positive awareness level should not be interpreted automatically as evidence of widespread adoption.

This distinction is supported by evidence indicating that awareness and implementation can diverge. Simwero et al. (2024) demonstrate that awareness of sustainable construction practices does not necessarily translate directly into implementation. Similarly, research on sustainable building-material readiness indicates that organisational resources, technical capability, material availability and institutional conditions influence the capacity to translate sustainability knowledge into construction practice. The implication is that professional awareness should be conceptualised as one component of a broader adoption system rather than as a sufficient explanation of adoption. Awareness can increase the likelihood that professionals recognise the potential benefits of sustainable materials, but adoption remains conditional on economic feasibility, technical confidence, availability, client requirements, regulatory support and market maturity. This perspective is particularly important in developing construction markets where established materials benefit from extensive professional familiarity and well-developed supply networks.
Recent Nigerian evidence further strengthens this argument. Mogaji et al. (2025) identify awareness and knowledge, professional competence, cost, market conditions and other institutional and resource-related factors among the barriers to innovative building-material adoption in Nigeria. Mogaji et al. (2026) subsequently demonstrate the importance of distinguishing awareness from actual adoption among Nigerian architecture, engineering and construction professionals. Together, these studies indicate that the transition from awareness to implementation is not automatic and warrants empirical investigation at the regional level.

Diffusion of Innovation Perspective

The study is conceptually informed by Rogers' Diffusion of Innovation (DOI) theory, which explains how new ideas, technologies, products and practices spread within a social system. Sustainable construction materials can be understood as innovations because their adoption requires construction professionals and organisations to evaluate alternatives to established materials and integrate them into existing project practices. Rogers (2003) identifies five perceived attributes of innovations that influence their diffusion: relative advantage, compatibility, complexity, trialability and observability.

Relative advantage concerns the extent to which a sustainable material is perceived as superior to an established alternative. In construction, such advantage may relate to reduced environmental impacts, lower life-cycle costs, improved durability, resource efficiency or enhanced building performance. Compatibility refers to the degree to which an innovation is consistent with existing professional values, construction practices, technical standards, client expectations and procurement arrangements. Sustainable materials that conflict with established construction methods or regulatory requirements may encounter greater resistance even when their environmental benefits are recognised.

Complexity concerns the perceived difficulty of understanding and implementing an innovation. This dimension is particularly relevant to sustainable materials because professionals may require additional knowledge concerning material specifications, installation procedures, performance characteristics and life-cycle implications. Trialability refers to the extent to which an innovation can be tested before full-scale implementation, while observability concerns the extent to which the benefits and performance outcomes of the innovation are visible to potential adopters (Rogers, 2003).

The DOI perspective provides a useful theoretical lens for interpreting sustainable-material adoption because it shifts attention from the intrinsic characteristics of a material to how construction professionals perceive and experience the innovation within their institutional environment. For example, a low-carbon material may offer substantial environmental benefits but diffuse slowly if professionals perceive it as complex, incompatible with established practices or difficult to obtain. Conversely, materials that are familiar, demonstrably effective and readily available may diffuse more readily even where their sustainability advantages are relatively modest.

Sustainable Construction Materials in Nigeria

The Nigerian construction industry remains substantially dependent on conventional construction materials, although research and industry practice increasingly recognise the potential of low-carbon concrete, supplementary cementitious materials, recycled aggregates, bamboo, earth-based materials and other alternatives. The growing interest in these materials reflects increasing concern regarding resource consumption, construction waste, environmental degradation and the need for more resource-efficient construction practices.

However, the transition towards sustainable materials in Nigeria is influenced by more than technical availability. The ability of professionals to evaluate and specify alternative materials is affected by access to information, professional education, technical standards, supplier networks, cost considerations, client preferences and confidence in material performance. Unegbu et al. (2025) emphasise the potential contribution of life-cycle assessment to sustainable material selection within the Nigerian construction industry, reinforcing the importance of moving beyond initial acquisition cost when evaluating material alternatives. At the professional level, Matthias et al. (2025) identify continuing challenges associated with the transition of the Nigerian construction workforce towards sustainable practices. Similarly, Nyantau et al. (2025) report awareness and implementation constraints among construction professionals in Plateau State. These studies collectively suggest that professional capacity represents an important component of the sustainability transition but also demonstrate that awareness and implementation cannot be treated as identical outcomes.

A critical limitation of the existing Nigerian literature is its geographical concentration. Evidence from Lagos, Abuja, Minna and Plateau State provides useful insights into sustainable construction, but construction conditions vary across the country. Differences in material supply chains, professional networks, project types, economic conditions, institutional capacity and regulatory implementation can influence both awareness and adoption. Findings generated in one location should therefore not automatically be generalised to other Nigerian construction markets.

Barriers to Sustainable Construction Material Adoption

The literature indicates that sustainable-material adoption is constrained by multiple and interacting barriers rather than by a single deficiency. These barriers can be grouped into economic, technical, market, institutional and knowledge-related dimensions. Economic barriers include higher initial acquisition costs, uncertainty regarding life-cycle economic benefits and limited client willingness to pay for sustainability-related improvements. Although sustainable materials may provide longer-term environmental or operational benefits, project decisions are frequently influenced by short-term capital costs. Where clients and procurement systems prioritise lowest initial price, materials with higher upfront costs may face difficulties in gaining acceptance. Technical barriers include inadequate professional expertise, uncertainty regarding performance, limited practical experience and concerns about installation or maintenance. These barriers are particularly important for emerging materials because professionals may be reluctant to assume technical risks where local performance evidence is limited. A lack of practical experience can further reinforce uncertainty because professionals have fewer opportunities to observe successful applications.

Market barriers include limited suppliers, inconsistent material availability, weak distribution systems and underdeveloped sustainable-material markets. Even where professionals are aware of a material and consider it technically appropriate, adoption may not occur if the material cannot be obtained reliably within project time and cost constraints. Market limitations can therefore transform awareness into non-adoption.

Institutional barriers encompass inadequate standards, weak regulatory support, limited enforcement and insufficient incentives. Construction professionals often operate within formal systems of specifications, codes, procurement requirements and professional standards. Where sustainable materials are not adequately incorporated into these systems, professionals may perceive their use as involving additional uncertainty or approval requirements. Knowledge barriers include limited sustainability education, inadequate continuing professional development and insufficient exposure to life-cycle assessment, embodied carbon and sustainable-material specification. Such limitations can affect not only awareness but also the professional capacity required to translate awareness into appropriate project decisions.

Importantly, these barriers are interdependent rather than mutually exclusive. Limited professional knowledge can increase perceptions of technical risk; technical uncertainty can reduce client confidence; weak client demand can limit supplier investment; and limited market development can reduce professionals' opportunities to acquire practical experience. This creates a reinforcing cycle in which low adoption limits experience and market development, while limited experience and market development further discourage adoption. Mogaji et al. (2025) similarly demonstrate that barriers to innovative building-material adoption in Nigeria extend across knowledge, resources, economic, policy, organisational and market dimensions. The literature therefore suggests that sustainable-material adoption should be examined as a socio-technical and market-mediated process. Professional awareness remains relevant, but its practical significance depends on whether the surrounding construction environment provides the knowledge, resources, markets, standards and institutional support necessary for implementation.

Literature Gap

Three related gaps emerge from the literature. First, existing studies have established that sustainable construction and innovative materials are increasingly recognised within the Nigerian construction sector, but evidence concerning professionals' specific knowledge and reported use of sustainable materials remains geographically uneven. Second, previous studies frequently discuss awareness and adoption together without sufficiently distinguishing knowledge from actual material-use behaviour. Third, limited evidence exists concerning how market, technical, client-related and educational barriers shape sustainable-material adoption within Bauchi State. The present study responds to these gaps by empirically examining professional awareness, sustainable-material recognition/use, adoption barriers and sustainability-related factors within a defined population of construction professionals in Bauchi State. The resulting framework is therefore both context-sensitive and theoretically informed, while avoiding the assumption that awareness alone determines sustainable-material adoption.

METHODOLOGY

Research Design

A quantitative cross-sectional survey design was adopted. The design was appropriate because the study sought to obtain standardised information from construction professionals concerning their awareness, material-use patterns, perceived barriers and sustainability-related adoption factors. The source study explicitly adopted a survey design to examine professionals' awareness and usage of sustainable construction materials and used structured questionnaires to obtain quantitative responses.

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Study Population

The target population comprised registered construction professionals involved in building construction activities in Bauchi State. Four professional groups were included:

S/N	Professional group	Population
1	Builders	250
2	Quantity Surveyors	135
3	Architects	82
4	Civil Engineers	67
	Total	**534**

The sampling frame was reported to have been compiled from relevant professional bodies, including the Nigerian Institute of Building, Nigerian Institute of Quantity Surveyors, Nigerian Institute of Architects and the Council for the Regulation of Engineering in Nigeria.

Sample Size and Sampling

Using the Krejcie and Morgan sample-size determination approach, a sample of 226 respondents was initially determined from the population of 534 professionals. A stratified random sampling procedure was employed to ensure representation across the four professional categories. The population was divided into professional strata, after which respondents were selected within the strata.

Instrument and Data Collection

Primary data were collected using a structured questionnaire. The questionnaire consisted of closed-ended items measured predominantly on a five-point Likert scale. A pilot study was conducted before the main survey to assess clarity and consistency. Questionnaires were administered through face-to-face contact, with research assistants supporting distribution and retrieval. Of the 255 questionnaires distributed, 250 were retrieved and 240 were considered valid for analysis, giving a usable response rate of 94.1% of those distributed and 96.0% of retrieved questionnaires. The source report records the 240 valid responses as 96.0% of the distributed questionnaires, which should be corrected in the final manuscript because 240/255 = 94.1%. Content validity was established through expert assessment of the questionnaire. Internal consistency was evaluated using Cronbach's alpha.

S/N	**Construct**	**Cronbach's α**
1	Sustainable construction materials awareness	0.701
2	Types of sustainable materials known/used	0.731
3	Barriers to adoption	0.792
4	Factors influencing adoption	0.763

All coefficients were at or above 0.70, indicating acceptable internal consistency for the reported constructs.

Data Analysis

Data were analysed using SPSS. Descriptive statistics comprised frequencies, percentages, means and standard deviations. Skewness and kurtosis were examined to assess distributional characteristics. Multiple regression analysis was used for the reported sustainability-related adoption models. Statistical significance was assessed at the 5% level.

RESULTS

Respondent Characteristics

The final analytical dataset comprised 240 valid responses. Builders constituted 36.67% of respondents, followed by Architects (32.92%), Quantity Surveyors (24.17%) and Civil Engineers (6.25%). The largest experience category was 1–5 years (39.58%), followed by 6–10 years (27.92%). Regarding educational qualification, B.Sc. holders constituted 39.58%, PGD holders 22.92%, Master's degree holders 16.67%, HND holders 16.67% and PhD holders 4.17%. The respondent profile therefore indicates representation from the principal professional groups involved in building projects, although the distribution across professional categories was uneven.

Professional Awareness of Sustainable Construction Materials

Professional awareness was moderate across the assessed dimensions.

Awareness indicator	Mean	SD	Rank
Cost savings	3.44	0.83	1
Reduced environmental impact	3.38	0.81	2
Improved indoor air quality	3.34	0.86	3
Increased durability	3.28	0.80	4
Higher upfront costs	3.28	0.79	5
Limited availability	3.22	0.75	6
Lack of knowledge	3.17	0.74	7

The highest awareness score concerned cost savings (M = 3.44), followed by reduced environmental impact (M = 3.38). The lowest score concerned lack of knowledge (M = 3.17).

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These findings indicate that respondents were aware of the potential economic and environmental advantages of sustainable materials, but knowledge and practical accessibility remained weaker dimensions.

Sustainable Materials Known or Used

The material-use results show a clear distinction between established sustainable materials and emerging technologies.

S/N	Sustainable material	Mean	SD
1	Timber	4.62	0.73
2	Bamboo	4.49	0.79
3	Cork	4.31	0.69
4	Straw bales	4.24	0.72
5	Recycled plastic	4.22	0.84
6	Recycled glass	4.09	0.76
7	Recycled steel	4.01	1.22
8	Reclaimed wood	3.90	0.75
9	Mycelium	3.87	0.71
10	Pollution-absorbing brick	3.69	0.84
11	Plant-based polyurethane rigid foam	3.69	0.87
12	3D-printed concrete	3.68	0.85

Timber recorded the highest mean score (M = 4.62), followed by bamboo (M = 4.49). Conversely, 3D-printed concrete recorded the lowest mean (M = 3.68). The pattern suggests that respondents were more familiar with renewable materials that have relatively established construction applications, whereas technologically advanced materials remained less established.

Barriers to Adoption

The most prominent barrier was the underdeveloped sustainable construction market (M = 3.44). This was followed by low awareness and knowledge (M = 3.38) and inadequate stakeholder expertise (M = 3.34). The findings indicate that adoption constraints are not exclusively individual-level knowledge problems. They also reflect the wider construction-market environment.

S/N	Barrier	Mean	Rank
1	Underdeveloped/unsaturated sustainable construction market	3.44	1
2	Low awareness and knowledge	3.38	2
3	Stakeholder lack of knowledge/expertise	3.34	3
4	Misunderstanding of sustainability concepts	3.28	4

5	Limited client awareness of benefits	3.28	5
6	Poor education in sustainable design	3.22	6
7	Limited expert experience	3.17	7

Regression Results

The regression analysis examined the relationships among the sustainability dimensions associated with the adoption of sustainable construction materials. For each regression model, one sustainability dimension was specified as the dependent variable (DV), while the remaining sustainability dimensions served as independent variables (IVs). The results demonstrate that the sustainability dimensions are statistically interconnected.

Table 1. Regression Model for Operational Energy Efficiency

Independent Variable (IV)	Standardised β	p-value	Decision
Environmental sustainability	0.298	<0.001	Significant
Carbon-footprint reduction	0.221	0.002	Significant
Waste reduction	0.176	0.007	Significant
Resource efficiency	0.141	0.025	Significant
Ecosystem protection	0.109	0.055	Not significant
Other predictor 1	Not reported	Not reported	—
Other predictor 2	Not reported	Not reported	—
R^2	0.551	—	—
F-statistic	25.614	<0.001	Significant
Degrees of freedom	7, 146	—	—

The model was statistically significant, $F(7,146) = 25.614$, $p < 0.001$, with an R^2 of 0.551. Thus, the IVs collectively explained 55.1% of the variance in operational energy efficiency. Environmental sustainability had the largest reported positive effect ($\beta = 0.298$, $p < 0.001$), followed by carbon-footprint reduction ($\beta = 0.221$, $p = 0.002$), waste reduction ($\beta = 0.176$, $p = 0.007$), and resource efficiency ($\beta = 0.141$, $p = 0.025$). Ecosystem protection did not reach statistical significance at the 5% level. The regression model was statistically significant, $F(7,146) = 19.842$, $p < 0.001$, and explained 48.2% of the variance in carbon-footprint reduction ($R^2 = 0.482$). Operational energy efficiency was a significant positive predictor ($\beta = 0.276$, $p = 0.001$), followed by environmental sustainability ($\beta = 0.241$, $p = 0.004$) and socio-economic sustainability ($\beta = 0.198$, $p = 0.011$). Ecosystem protection was not statistically significant ($\beta = 0.101$, $p = 0.082$). The model was statistically significant, $F(7,146) = 22.456$, $p < 0.001$, and accounted for 51.7% of the variance in environmental sustainability. Waste reduction ($\beta = 0.263$, $p = 0.003$) and resource efficiency ($\beta = 0.248$, $p = 0.006$) were significant positive predictors. Socio-economic sustainability was also reported as a significant contributor, although its coefficient was not provided.

DISCUSSION

Awareness and Adoption

The moderate awareness scores demonstrate that professionals possess a reasonable recognition of the benefits of sustainable materials. However, the relatively lower scores associated with knowledge, availability and upfront cost indicate that recognition does not necessarily provide sufficient conditions for implementation. This finding is consistent with the broader sustainable-construction literature, which distinguishes between awareness and implementation. Sustainable material adoption requires more than professional familiarity; it requires technical competence, reliable suppliers, client acceptance, appropriate standards and organisational support.

The finding that cost savings represented the highest awareness dimension is particularly important. It suggests that professionals may be more responsive to sustainability when its environmental benefits are accompanied by identifiable economic value. This reinforces the relevance of life-cycle cost thinking in sustainable material decisions.

Established Renewable Materials Versus Emerging Technologies

The strong scores for timber and bamboo indicate greater familiarity with relatively established renewable materials. By contrast, lower scores for mycelium, pollution-absorbing bricks, plant-based polyurethane foam and 3D-printed concrete indicate weaker familiarity with emerging technologies. This pattern is compatible with the Diffusion of Innovation perspective. Established materials benefit from greater observability, familiarity and compatibility with existing practices. Emerging materials often require greater technical knowledge, testing, demonstration and confidence before professionals can integrate them into routine projects. The implication is that innovation policy should not assume that introducing a technically superior material will automatically generate adoption. Demonstration projects, performance evidence and professional training are necessary to reduce uncertainty.

CONCLUSION

This study examined professional awareness, material-use patterns, barriers and sustainability-related factors associated with sustainable construction material adoption in building projects in Bauchi State, Nigeria. The findings show that construction professionals possess a moderate level of awareness of sustainable construction materials. Cost savings and reduced environmental impact were the most recognised benefits. Timber and bamboo were the most commonly known or used materials, whereas emerging technologies such as 3D-printed concrete were less established. The principal barriers were an underdeveloped sustainable-material market, low awareness and knowledge, and inadequate stakeholder expertise. These findings demonstrate that the transition towards sustainable materials cannot be addressed through awareness campaigns alone. Professional competence, market availability, technical support, client awareness and institutional mechanisms must develop simultaneously. The reported regression models further show substantial relationships among sustainability dimensions, particularly operational energy efficiency, environmental sustainability, carbon-footprint reduction, waste reduction and resource efficiency. These findings reinforce the multidimensional character of sustainable material adoption. Overall, the study demonstrates that Bauchi State possesses a foundation of professional awareness upon which wider sustainable-material adoption can be developed, but implementation remains constrained by knowledge, technical and market conditions. Future interventions should therefore combine professional education with supply-chain development, practical demonstration, technical standards and institutional support.

Recommendations

Based directly on the findings, the following actions are recommended:

1. Professional bodies and training institutions should provide structured training on sustainable construction materials, life-cycle assessment, embodied carbon and sustainable procurement.
2. Demonstration projects and pilot applications should be used to provide professionals with practical experience with emerging materials.
3. Suppliers, government agencies and industry organisations should support stronger supply networks and local availability of sustainable materials.
4. University construction programmes should integrate sustainable-material selection, life-cycle assessment and circular-economy principles more systematically.
5. Clients should receive information on whole-life economic and environmental benefits rather than relying exclusively on initial material cost.

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