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Eco-Friendly Materials and Communication in Advancing Green Architecture in Developing Economies

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ABSTRACT **Review Article**

Sustainable construction is increasingly recognised as a critical pathway for addressing environmental degradation in developing nations experiencing rapid urbanisation and resource constraints. This paper presents an integrative conceptual synthesis of sustainable construction practices and language mediation as complementary drivers of environmental sustainability. Drawing on a narrative review of 45 peer-reviewed journal articles published between 2013 and 2025, the study examines low-carbon construction materials, climate-responsive design strategies, and communication processes that influence public perception, policy legitimacy, and community participation. The findings indicate that while eco-friendly materials such as stabilised earth blocks, bamboo, and agro-waste composites offer substantial environmental and economic benefits, their adoption is strongly shaped by linguistic framing, cultural narratives, and inclusive communication. Language mediation emerges as a critical mechanism for translating technical knowledge into socially meaningful and widely accepted practices. The study concludes that integrating sustainable construction with effective communication enhances material acceptance, institutional support, and long-term environmental outcomes. By positioning architects and linguists as collaborative agents, the paper advances an interdisciplinary framework for promoting environmentally sustainable development in developing nations.

Keywords: Green architecture, Eco-friendly materials, Sustainable housing, Communication and discourse, Developing economies.

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Introduction

Green architecture has become an increasingly important response to the intertwined challenges of climate change, environmental degradation, and socio-economic inequality, particularly in developing economies where rapid urbanisation places intense pressure on natural and built systems. Globally, the construction sector is responsible for approximately 36% of carbon dioxide emissions and nearly 40% of total energy consumption, positioning buildings as a critical focal point for climate mitigation efforts (United Nations Environment Programme [UNEP], 2022). In developing regions, this challenge is compounded by housing deficits, rising construction costs, and dependence on carbon-intensive materials such as cement and steel, whose production processes generate high embodied energy and emissions (Andrew, 2019).

In response, scholarly attention has increasingly shifted toward eco-friendly building materials that combine environmental sustainability, affordability, and local availability. Materials such as bamboo, stabilised earth, and agro-waste-based composite panels have demonstrated significant potential to reduce embodied carbon, enhance thermal comfort, and lower construction costs (Adegun & Adedeji, 2017; Akande et al., 2021; Sharma et al., 2015). Empirical studies show that bamboo offers tensile strength comparable to steel while functioning as a renewable carbon

sink (Sharma et al., 2015; Kellogg et al., 2021), whereas stabilised earth technologies improve thermal regulation and reduce dependence on cement in hot climates (Adegun & Adedeji, 2017; Nduka et al., 2020). Composite panels derived from agricultural waste further support circular-economy principles by converting waste streams into durable construction products (Adedeji et al., 2011; Yadav et al., 2018).

Despite these technical advantages, the adoption of eco-friendly materials remains limited across many developing economies. Existing studies indicate that the barriers to uptake are not purely technical but deeply socio-cultural, institutional, and communicative (Amuda-Yusuf et al., 2020; Onyegiri & Uji, 2019). Negative perceptions of bamboo as "temporary" or earthen construction as "backward" continue to shape housing preferences, even where scientific evidence confirms performance reliability (Onyegiri & Uji, 2019; Le & Tam, 2021). These perceptions are sustained and reinforced through language, discourse, and symbolic meanings attached to materials, underscoring the importance of communication and linguistics in sustainability transitions.

Scholars in linguistics and environmental communication argue that sustainability is socially constructed through language, framing, and narrative (Fairclough, 2013; Kuchler, 2017). The way environmental issues and solutions are articulated influences public understanding, policy direction, and behavioural response (Lakoff, 2014; Flusberg & Thibodeau, 2023). In developing economies characterised by linguistic diversity and varying literacy levels, ineffective communication can exclude communities from sustainability initiatives, reinforcing resistance and limiting adoption (Litre et al., 2022). Conversely, inclusive and culturally resonant communication strategies have been shown to foster trust, legitimacy, and participation in sustainable housing initiatives (Acheampong et al., 2021; Kayumova & Tippins, 2021).

The literature further highlights the complementary roles of architects and linguists in advancing green architecture. Architects contribute technical expertise through material innovation, performance evaluation, and climate-responsive design, while linguists and communication scholars facilitate the translation of technical knowledge into accessible, persuasive, and culturally grounded narratives (Darko & Chan, 2018; Kress, 2010). This interdisciplinary interaction is particularly relevant in developing economies, where sustainability outcomes depend not only on technological feasibility but also on social acceptance and institutional legitimacy.

Despite the growing body of literature on eco-friendly construction materials and the expanding scholarship on environmental communication, existing studies largely examine these domains in isolation. Research on green architecture in developing economies has predominantly focused on the technical performance, environmental benefits, and cost implications of alternative materials, with limited attention to the communicative processes that shape their societal acceptance. Conversely, studies in linguistics and environmental communication rarely engage with the material and technological realities of sustainable construction practice. This disciplinary separation has resulted in a critical gap in understanding how material innovation and language mediation interact as co-determinants of green architecture adoption. There remains a paucity of integrative reviews that systematically bridge architectural and linguistic perspectives to explain why technically viable eco-friendly materials continue to face resistance in developing economies. Addressing this gap is essential for advancing green architecture as both a technically sound and socially legitimate practice.

In response to the identified research gap, this study is guided by the following objectives:

i. To examine the environmental and economic contributions of selected eco-friendly building materials to green architecture in developing economies.

ii. To analyse the role of language, discourse, and communication strategies in shaping public and policy acceptance of eco-friendly construction materials.

iii. To synthesise architectural and linguistic perspectives in order to explain how material innovation and communication jointly influence the advancement of green architecture.

Methodology

Research Design

This study adopts an interdisciplinary narrative literature review design to examine how eco-friendly building materials and communication strategies jointly influence the advancement of green architecture in developing economies. A narrative review is appropriate for interdisciplinary research because it enables critical synthesis across technical, social, and linguistic domains, allowing concepts, theories, and empirical findings to be interpreted in relation to one another rather than assessed in isolation. This approach is particularly suited to studies that bridge architecture and linguistics, where evidence is dispersed across built-environment research, sustainability studies, and communication scholarship.

This study adopts a narrative literature review rather than a systematic review because of the interdisciplinary nature of the research, which integrates architectural sustainability and language mediation. Systematic reviews are best suited to narrowly defined empirical questions with homogeneous datasets, whereas the present study seeks conceptual synthesis across diverse theoretical, methodological, and disciplinary traditions. A narrative review, therefore, provides

the flexibility required to critically interpret and integrate architectural, environmental, and linguistic scholarship in order to develop a holistic understanding of sustainable construction practices in developing nations.

Sources of Data and Literature Selection

The review draws on 43 peer-reviewed journal articles published between 2013 and 2025, as already cited in the paper. Literature was sourced from established academic databases, including Scopus, Web of Science, and Google Scholar. Search terms reflected the interdisciplinary focus of the study. They included combinations of *green architecture*, *eco-friendly materials*, *bamboo construction*, *stabilised earth*, *composite panels*, *sustainable housing*, *communication strategies*, *environmental discourse*, and *developing economies*.

Inclusion criteria required that studies:

(i) addressed eco-friendly or low-carbon building materials relevant to architectural practice;
(ii) examined communication, discourse, perception, or stakeholder engagement related to sustainability; and
(iii) focused on developing or emerging economies.

Studies were excluded if they lacked relevance to either architectural sustainability or communication processes, or if they focused exclusively on developed-country contexts without transferable insights.

Analytical Framework

An integrative thematic analysis was employed to synthesise the selected literature. The reviewed studies were analysed and organised into two primary analytical domains. The first domain focused on architectural and material innovation, examining performance attributes such as embodied energy, thermal behaviour, affordability, durability, and constructability of eco-friendly materials. The second domain addressed communication and linguistic strategies, including framing, discourse, narrative construction, metaphor, and participatory communication approaches that influence public perception, policy acceptance, and user behaviour.

A third cross-cutting lens was applied to identify points of convergence between these domains, particularly where material adoption was shown to depend on communication practices, cultural meaning, and stakeholder engagement. This framework enabled systematic comparison of technical and socio-linguistic insights while maintaining disciplinary coherence.

Interdisciplinary Integration Approach

To ensure methodological rigour in integrating architecture and linguistics, the study applied a complementarity principle, whereby architectural studies provided evidence of material performance and environmental benefits. In contrast, linguistic and communication studies explained how meaning, perception, and legitimacy are constructed around those materials. Rather than privileging one discipline, the analysis treated technical performance and communicative framing as mutually reinforcing dimensions of sustainable construction practice.

This interdisciplinary positioning reflects contemporary sustainability research, which recognises that technological solutions alone are insufficient without effective communication and social acceptance, particularly in developing economies.

Scope and Contextual Focus

The methodological focus is on developing economies, with particular attention to Sub-Saharan Africa and parts of Asia where housing demand, resource constraints, and environmental vulnerability intersect. This contextual focus ensures that findings are grounded in socio-economic realities characterised by informal construction, limited regulatory enforcement, and strong cultural influence on building practices. The selected literature reflects these conditions and supports context-sensitive interpretation of results.

Although the reviewed literature spans multiple regions, this study places particular emphasis on Sub-Saharan Africa and parts of Asia, where rapid urbanisation, informal construction practices, environmental vulnerability, and linguistic diversity are most pronounced. These regions are prioritised due to their acute sustainability challenges and the availability of relevant empirical and policy-oriented studies. Consequently, the findings are context-specific and analytically transferable to comparable developing contexts, rather than universally generalisable across all global regions.

Methodological Limitations

As a narrative review, the study does not aim to provide statistical generalisation or meta-analysis. Instead, it prioritises conceptual integration and critical interpretation. While this approach enhances interdisciplinary insight, it is inherently interpretive and dependent on the quality and scope of existing studies. To mitigate potential bias, the review draws on a broad range of peer-reviewed sources and emphasises convergence of findings across multiple studies rather than isolated claims.

In addition, this study is entirely literature-based and does not involve the collection of primary empirical data. While this approach enables broad interdisciplinary synthesis and conceptual insight, it limits the ability to empirically validate observed relationships between sustainable construction practices and language mediation in specific contexts. The findings should therefore be interpreted as analytically integrative rather than empirically predictive.

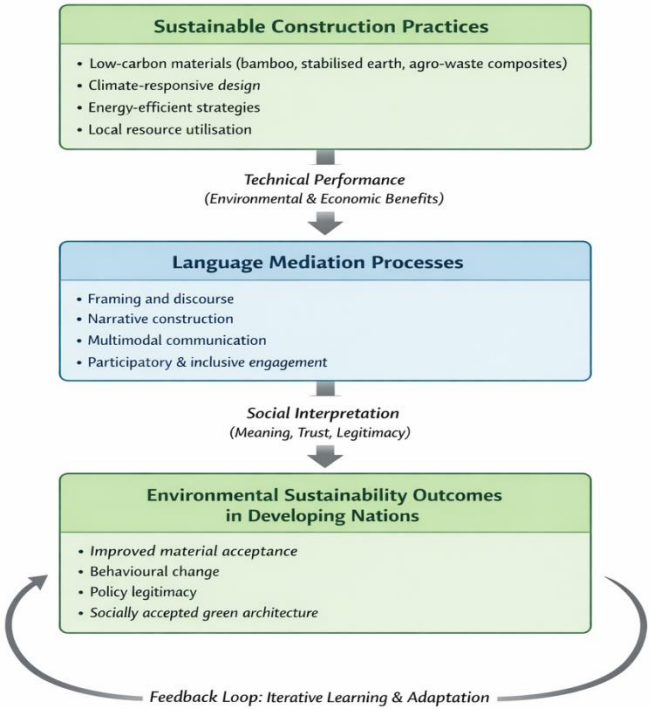

Figure 1. Conceptual framework illustrating the interaction between sustainable construction practices and language mediation in promoting environmental sustainability in developing nations.

The framework demonstrates how technical performance derived from sustainable construction practices is mediated through language, discourse, and communication processes to shape social interpretation, acceptance, and policy legitimacy. Environmental sustainability outcomes subsequently feed back into both construction practice and communication strategies, reinforcing iterative learning and adaptation.

Sustainable Construction Practices in Developing Nations (Framework-Guided Analysis)

Sustainable construction practices form the technical foundation for environmental sustainability in developing nations, where rapid urbanisation, housing deficits, and ecological vulnerability intersect. The construction sector is a major contributor to environmental degradation due to its intensive use of natural resources and high energy demand (Andrew, 2019; Huang et al., 2018; UNEP, 2022). As illustrated in Figure 1, transforming construction practices is therefore a strategic priority within broader climate and sustainability agendas.

Low-Carbon and Resource-Efficient Materials

A central theme in the literature is the transition toward low-carbon and resource-efficient materials as a means of reducing embodied energy and emissions. Conventional materials such as cement and steel are associated with high carbon intensity, particularly in developing contexts where production processes are often energy inefficient (Andrew, 2019; Ahmed et al., 2020). In contrast, alternative materials including stabilised earth blocks, bamboo, and agro-waste-based composites demonstrate notable environmental and economic advantages (Adegun & Adedeji, 2017; Sharma et al., 2015; Yadav et al., 2018).

Stabilised earth construction reduces cement dependency and improves thermal performance, making it well suited to hot climatic conditions (Nduka et al., 2020). Bamboo combines rapid renewability with high tensile strength, positioning it as a viable structural material when appropriately treated (Sharma et al., 2015). Agro-waste composites further support circular economy principles by converting agricultural residues into functional building components, thereby reducing material waste and environmental pressure (Akande et al., 2021). Within Figure 1, these materials contribute directly to the technical performance layer that underpins sustainability outcomes.

Climate-Responsive and Energy-Efficient Design

Beyond material selection, sustainable construction in developing nations places strong emphasis on climate-responsive and energy-efficient design strategies. Passive approaches such as natural ventilation, appropriate building orientation, shading devices, and thermal mass optimisation reduce reliance on mechanical systems and improve indoor comfort (Adegun & Adedeji, 2017; Maina et al., 2020). These strategies are particularly relevant in regions with limited access to reliable energy infrastructure and high energy costs.

Empirical studies indicate that climate-responsive buildings achieve long-term operational savings while enhancing occupant well-being (Akande et al., 2021). As reflected in Figure 1, such design strategies strengthen technical performance by extending sustainability benefits across the building life cycle rather than concentrating them solely at the construction stage.

Institutional and Socio-Economic Dimensions

Sustainable construction practices are embedded within broader institutional and socio-economic contexts that influence their effectiveness. The use of locally available materials and labour reduces transportation-related emissions and supports local economies, linking environmental sustainability with social and economic development goals (Lin & Agyeman, 2020). However, widespread adoption is often constrained by limited material standardisation, weak regulatory recognition, and inconsistent enforcement mechanisms (Amuda-Yusuf et al., 2020).

Within the conceptual framework (Figure 1), these institutional and socio-economic factors shape how technical performance outcomes are filtered before entering the language mediation layer. This reinforces the central argument that technical solutions alone are insufficient and

must be supported by communicative and institutional processes to achieve sustained environmental impact.

Language Mediation and Environmental Sustainability

Building on the technical performance of sustainable construction practices discussed in Section 3, Figure 1 illustrates that environmental sustainability outcomes do not arise automatically from material and design innovation. Instead, these technical outputs are mediated through language, discourse, and communication processes that shape understanding, perception, and acceptance among policymakers, professionals, and communities. The literature consistently demonstrates that sustainability transitions are socio-technical in nature, with language functioning as a critical mechanism through which environmental knowledge is framed, interpreted, and legitimised (Fairclough, 2013; Kuchler, 2017). In developing nations characterised by cultural diversity and linguistic plurality, effective language mediation therefore plays a central role in translating sustainable construction from technical possibility into socially accepted practice.

Framing and the Construction of Meaning

Environmental sustainability is socially constructed through language and discourse. How sustainable construction is described influences how it is understood by policymakers, professionals, and communities (Lakoff, 2014; Flusberg & Thibodeau, 2023). In many developing nations, sustainability discourse relies heavily on technical or bureaucratic language that limits engagement among non-expert stakeholders.

When sustainability is framed as abstract or externally imposed, public resistance tends to increase, particularly in contexts characterised by socio-economic vulnerability and institutional mistrust (Lin & Agyeman, 2020). In contrast, framing sustainable construction in relation to everyday concerns such as affordability, comfort, health, and resilience enhances relevance and social legitimacy, thereby improving acceptance and engagement.

Discourse and Material Perception

Discursive narratives shape material acceptance. Bamboo and earth-based materials are often associated with poverty or informality despite evidence of their durability and performance (Adegun & Adedeji, 2017; Onyegiri & Uji, 2019). These perceptions constrain adoption.

Reframing materials as innovative, efficient, and resilient alters these narratives and improves acceptance (Lakoff, 2014; Awoyera & Adesina, 2020). This demonstrates that resistance is discursively produced rather than technically justified.

Multimodal and Participatory Communication

Language mediation extends beyond verbal discourse to include visualisation, demonstration projects, and participatory engagement (Kress, 2010). Multimodal communication makes sustainability tangible and supports understanding across diverse literacy levels (Fernández-Fontecha et al., 2019).

Participatory communication further strengthens legitimacy by involving communities in dialogue and decision-making, particularly in multilingual and informal contexts (Kayumova & Tippins, 2021; Litre et al., 2022). Such approaches enhance trust and long-term commitment.

Integration of Sustainable Construction and Language Mediation

The literature shows that sustainable construction and language mediation function most effectively as an integrated socio-technical system. Sustainable construction delivers technical solutions, while language mediation determines how these solutions are interpreted, legitimised, and adopted.

Translating Performance into Social Value

Although sustainable materials demonstrate strong environmental and economic performance (Adegun & Adedeji, 2017; Sharma et al., 2015; Yadav et al., 2018), adoption depends on how these benefits are communicated. Language mediation translates technical attributes into socially meaningful values such as safety, comfort, durability, and affordability, thereby enhancing acceptance (Onyegiri & Uji, 2019).

Bridging Expert Knowledge and Public Understanding

A recurring barrier is the gap between expert knowledge and public understanding. Technical language limits engagement, whereas simplified explanations, metaphors, and narratives improve comprehension without reducing accuracy (Lakoff, 2014; Fairclough, 2013; Darko & Chan, 2018). Demonstration projects and visual tools further reinforce credibility and trust.

Cultural and Institutional Integration

Cultural meanings strongly influence both material choice and communication effectiveness (Kuchler, 2017). Sustainability narratives that ignore local values often encounter resistance, even when technical benefits are evident (Lin & Agyeman, 2020). Integrated approaches that align sustainable construction with local cultural narratives are, therefore, more durable.

At the institutional level, policies supporting low-carbon construction are more effective when communicated in inclusive and accessible language (Amuda-Yusuf et al., 2020). Interdisciplinary collaboration among architects, linguists, planners, and policymakers strengthens implementation capacity and social legitimacy.

Synthesis of Integrated Practice

Integrating sustainable construction with language mediation transforms sustainability from a technical aspiration into a socially embedded practice. Technical innovation reduces environmental impact, while communication shapes perception, trust, and behaviour. Together, they provide a robust pathway for environmentally sustainable, culturally meaningful, and socially accepted development in developing nations.

Discussion

This study set out to explore how eco-friendly building materials and communication strategies jointly contribute to the advancement of green architecture in developing economies. The synthesis of the reviewed literature confirms that sustainable construction is not solely a technical or material challenge, but a socio-technical process shaped by environmental performance, cultural meaning, linguistic framing, and institutional context. The discussion below interprets the key findings in relation to interdisciplinary theory and practice, and highlights their implications for architects, linguists, and policymakers.

Interdependence of Material Innovation and Communication

The findings reveal a strong interdependence between material innovation and communication processes. Eco-friendly materials such as bamboo, stabilised earth, and agro-waste composites demonstrate clear advantages in reducing embodied energy, lowering emissions, and improving thermal comfort (Adegun & Adedeji, 2017; Andrew, 2019). However, their uptake remains limited where these technical attributes are poorly communicated or culturally misaligned. This supports the argument that technological solutions alone are insufficient to drive sustainability transitions in the built environment.

From a linguistic perspective, the meanings attached to materials significantly influence acceptance. Negative discourses portraying alternative materials as inferior or temporary undermine their legitimacy, regardless of performance evidence (Onyegiri & Uji, 2019). Conversely, strategic reframing and narrative construction reposition such materials as innovative, resilient, and modern, thereby enhancing social acceptance. This reinforces the view that communication functions as a critical mediator between material performance and user behaviour.

Implications for Architectural Practice

For architects, the findings underscore the need to expand professional roles beyond technical design to include communicative engagement. Architects act as translators between scientific knowledge, policy objectives, and user expectations. When architects actively communicate the benefits of eco-friendly materials through drawings, prototypes, demonstration projects, and accessible language, they reduce uncertainty and build trust among clients and communities (Darko & Chan, 2018).

The discussion also highlights the value of participatory design processes, where users are involved in material selection and construction decisions. Such engagement not only improves acceptance but also enhances maintenance and long-term performance. This aligns with broader sustainability literature advocating for user-centred and context-responsive architectural practice in developing economies.

Contributions from Linguistics and Communication Studies

From the perspective of linguistics, the study contributes to understanding how discourse, framing, and narrative shape environmental action. The reviewed literature demonstrates that sustainability messages are more effective when they connect ecological goals with everyday concerns such as comfort, affordability, and cultural identity (Lakoff, 2014; Fairclough, 2013). Linguists, therefore, play a vital role in designing communication strategies that bridge abstract environmental concepts and lived experience.

The findings also suggest that multimodal communication, combining verbal language, visual representation, and experiential demonstration, is particularly effective in conveying the value of green architecture (Kress, 2010). This has implications for education, public engagement, and policy communication, especially in contexts characterised by linguistic diversity and varying literacy levels.

Policy and Institutional Implications

The findings of this study have important implications for policy and institutional practice in developing nations. While many governments have introduced sustainability-oriented construction policies, their effectiveness is frequently undermined by weak enforcement mechanisms and limited public understanding. The review indicates that policy success depends not only on technical standards for sustainable construction but also on how these standards are communicated to professionals, communities, and stakeholders.

Policies that legitimise alternative building materials through performance-based regulations, while simultaneously employing clear, inclusive, and culturally sensitive language, are more likely to gain acceptance and compliance. Furthermore, integrating communication expertise into sustainability policymaking can enhance transparency, trust, and behavioural change. Institutional collaboration between architects, planners, linguists, and policymakers is therefore essential for translating sustainability policies into effective and socially accepted construction practices.

Contribution to Knowledge and Research Gaps

This study contributes to existing knowledge by explicitly integrating architectural material research with linguistic and communication perspectives. While prior studies have examined eco-friendly materials or sustainability communication independently, this review demonstrates that their interaction is central to the success of green architecture. The interdisciplinary framework advanced here provides a more holistic understanding of sustainable construction as both a material and communicative practice.

Nevertheless, the discussion also reveals research gaps. Empirical studies examining long-term user responses to integrated material-communication interventions remain scarce, particularly in informal and low-income contexts. Future research should therefore adopt mixed methods approaches that combine performance assessment with discourse analysis and user perception studies.

Synthesis of Discussion

Overall, the discussion reinforces the central argument of this paper that environmental sustainability in developing nations emerges from the convergence of sustainable construction practices and effective language mediation. Technical innovation provides the means for reducing environmental impact, but language shapes the pathways through which these innovations are understood, legitimised, and sustained. Recognising and operationalising this interdependence is therefore essential for architects, linguists, and policymakers seeking to translate sustainability from concept into socially accepted practice.

Conclusion

This study has examined the interconnected roles of eco-friendly building materials and communication strategies in advancing green architecture within developing economies. Through a narrative review of interdisciplinary literature, the paper demonstrates that sustainable construction is not achieved solely through technical innovation but through the integration of material performance, cultural meaning, and communicative practice. Eco-friendly materials such as bamboo, stabilised earth, and agro-waste composite panels offer significant advantages in reducing embodied energy, lowering greenhouse gas emissions, and improving thermal comfort. However, their widespread adoption remains constrained by socio-cultural perceptions, limited regulatory support, and ineffective communication.

It is important to reiterate that this study is based solely on secondary literature and does not draw on primary empirical data. While this limits empirical generalisation, it enables a comprehensive interdisciplinary synthesis that highlights conceptual relationships and explanatory patterns across architectural and linguistic scholarship. Future empirical research is therefore necessary to test and refine the integrated propositions advanced in this study.

The findings highlight that communication strategies, including linguistic framing, narrative construction, multimodal representation, and participatory engagement, play a decisive role in shaping how green materials are perceived and accepted. Architects and linguists emerge as complementary actors: architects validate sustainability through design and performance, while linguists and communication scholars translate technical knowledge into culturally resonant and socially legitimate narratives. The study, therefore, concludes that green architecture in developing economies is best understood as a socio-technical process that requires interdisciplinary collaboration to bridge the gap between innovation and acceptance.

Recommendations

Based on the findings, several recommendations are proposed. First, architectural practice should explicitly incorporate communication strategies into design processes, using accessible language, visualisation, and demonstration projects to convey the benefits of eco-friendly materials. Second, policy and regulatory frameworks should legitimise alternative materials through performance-based standards while communicating sustainability goals in inclusive and aspirational terms. Third, interdisciplinary collaboration between architects, linguists, planners, and educators should be strengthened through joint research, professional training, and curriculum development. Fourth, community-centred engagement should be prioritised, particularly in informal and low-income contexts, to align green architecture with local values and lived experiences. Finally, future research should adopt mixed-methods approaches that combine material performance assessment with discourse analysis and user perception studies to generate context-specific and transferable insights.

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