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Driving Research and Innovation for a Smart Built Environment*

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BAMBOO AS A GREEN BUILDING MATERIAL: CHALLENGES FROM A MALAYSIA PERSPECTIVE

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Abstract

Despite bamboo's well-documented advantages as a sustainable construction material, including rapid renewability, high strength-to-weight ratio, and carbon sequestration capabilities, its global adoption remains limited to niche applications. Significant implementation barriers persist across technical, economic, and institutional domains, preventing bamboo from becoming a mainstream alternative to conventional materials like steel and concrete. These challenges range from material standardization issues and supply chain fragmentation to knowledge gaps among construction professionals and inadequate policy support, collectively constraining bamboo's potential to transform sustainable building practices despite its environmental benefits. Hence, this study identifies and analyzes the key barriers hindering bamboo's integration as a green building material within the construction industry. Adopting a quantitative research methodology, the study surveyed 100 practicing architects through a structured questionnaire to assess their perceptions of bamboo's viability. Data were analyzed using the Social Science Statistical Package (SPSS), employing descriptive statistics and mean score ranking to evaluate the critical challenges. The findings reveal three predominant obstacles: lack of awareness regarding bamboo usage, unorganized supply chains, and difficulties in standardizing bamboo resources and usage. The study contributes novel empirical evidence by quantifying architects' perspectives for assessing sustainable material adoption. Practically, it provides policymakers with prioritized intervention targets, including awareness campaigns targeting construction professionals, supply chain optimization strategies, and the development of standardized grading systems. Academically, it offers baseline data for future research on bamboo's evolving role in green construction. By addressing these barriers, the construction industry can better align with global sustainability objectives and underscore the need for multi-stakeholder collaboration to transform bamboo from a niche material into a mainstream construction solution.

Keywords: bamboo, sustainable, building material, challenges

1. INTRODUCTION

The construction sector urgently needs sustainable alternatives to conventional materials and bamboo offers an ideal solution with its rapid renewability, high strength-to-weight ratio, and carbon sequestration capacity. While traditionally used in Asia and Latin America, modern construction has slowly adopted bamboo despite these advantages. The primary problem lies in the gap between bamboo's theoretical potential and its practical implementation in contemporary construction (Van der Lugt et al., 2020). While research highlights bamboo's sustainability benefits (Sharma et al., 2021), barriers such as lack of standardized processing methods (Janssen, 2000), susceptibility to pests and moisture (Kaminski et al., 2016), insufficient building codes (Lobovikov et al., 2018), and limited awareness among architects and engineers (Shen et al., 2019) hinder its mainstream use. Without addressing these challenges, bamboo risks remaining a niche material rather than becoming a viable solution for sustainable

urbanization.

This study aims to investigate the key challenges impeding the implementation of bamboo as a green building material and explore strategies to overcome these barriers. The specific objective of this research is to identify the obstacles to bamboo's adoption in construction. This research seeks to bridge the knowledge gap and provide actionable insights for policymakers, architects, and construction firms. The findings of this study will contribute to the growing discourse on sustainable construction by offering a comprehensive assessment of bamboo's challenges and opportunities. Ultimately, this research aims to support the transition toward eco-friendly building materials, aligning with global sustainability goals, and by addressing the systemic barriers to bamboo's adoption, this study can help unlock its full potential as a mainstream green construction material.

2. LITERATURE REVIEW

This section reviews key studies that explore the barriers to bamboo's adoption in green construction.

2.1 Lack of Awareness of Bamboo Usage

Bamboo faces significant perception challenges among key stakeholders that hinder its adoption as a modern construction material. Due to limited awareness, it is often viewed merely as a cheaper alternative to wood rather than recognizing its superior sustainability benefits (Hailemariam et al., 2022). This perception is compounded by the association of bamboo crafts with outdated and economically marginal practices (GlobalABC, 2023).

2.2 Unorganized Supply Chain

The bamboo industry continues to face significant challenges stemming from persistent knowledge gaps throughout its value chain. From harvesters to manufacturers, stakeholders lack critical technical knowledge about optimal cultivation, harvesting, and processing methods. This knowledge deficit manifests most notably in the continued supply of low-quality bamboo by aggregators, despite the availability of advanced treatment technologies (Sharma et al., 2021). Furthermore, inconsistent bamboo supply further hinders bamboo growth (Hailemariam et al., 2022)

2.3 Difficulty in Standardizing

Although bamboo makes a superb structural material, engineers and architects have difficulty getting scientific information regarding its strength and behavior. It is challenging to calculate bamboo structures using standard techniques. Besides, lack of standardised and controlled building methods and norms is another difficulty for bamboo use because due to the material's heterogeneity and irregularity, bamboo's characteristics and dimensions can differ greatly based on the species, age, location, and harvesting technique. As a result, bamboo structures are challenging to accurately and consistently design, engineer, and test. Since bamboo building differs from traditional construction, requiring additional expertise, knowledge, and innovation.

Lashing, bolting, nailing, and weaving are frequently employed to make bamboo structures (Hailemariam et al., 2022).

2.4 Hidden Cost of Bamboo Production

The global expansion of bamboo production presents significant social and environmental challenges that must be addressed to ensure sustainable development. The crop's commercial success has led to problematic land use changes and natural forest clearance for bamboo plantations in several developing nations. Agricultural practices further compound this issue as the intensive use of chemical pesticides and herbicides in monoculture plantations leads to soil degradation and water contamination (Zhou et al., 2021). These findings suggest that without proper safeguards, the bamboo industry risks replicating the same unsustainable patterns seen in other cash crop systems.

2.5 Insect and Fungal Attacks

Bamboo's susceptibility to biological degradation from insects and fungi limits its durability. Termites and fungal organisms target bamboo's starch-rich inner tissues, particularly under moist conditions, leading to rapid structural deterioration (Kaminski et al., 2016). To mitigate these risks, preservation techniques such as the Boucherie method (water leaching), chemical treatments (creosote, fumigation), and lime washing are employed (Koko, 2021).

2.6 Lack of Support by Stakeholders

Current barriers to bamboo's mainstream adoption in construction stem from insufficient institutional support and fragmented industry practices. Governmental limitations are evident through the absence of localized building codes, standardized guidelines, and dedicated education programs for bamboo construction techniques (Oguntona et al., 2019). This policy gap stifles research and development initiatives that could advance bamboo's technical applications. Concurrently, industry challenges manifest in disorganized supply chains characterized by material scarcity, inconsistent quality standards, and persistent market misconceptions (Shen et al., 2019).

2.7 Lack of Market Access

A critical challenge facing bamboo commercialization is limited market access, particularly for rural producers who rely on bamboo-based livelihoods (Binfield et al., 2022). Without adequate distribution networks and market linkages, rural growers struggle to connect with higher-value markets, constraining both industry growth and profit potential. This bottleneck disproportionately affects small-scale producers while simultaneously limiting the material's broader adoption in commercial applications.

2.8 Lack of Market Knowledge

Another barrier to bamboo commercialization in producing countries is the widespread lack of market expertise among local manufacturers (van der Lugt & Otten, 2006). This knowledge deficit hinders producers' ability to identify viable markets, understand

customer requirements, and develop effective distribution strategies for their bamboo products. Without adequate understanding of market dynamics, manufacturers struggle to position their goods competitively, limiting both domestic adoption and export potential.

3. METHODOLOGY

This study employed a quantitative approach to gather expert perspectives on bamboo as a sustainable building material. Architects were selected as key respondents due to their expertise in professional building design and material specification. A structured questionnaire was developed to collect primary data, with questions systematically organized around core themes related to bamboo applications in construction. The study population comprised 180 architects registered with the Board of Architects Malaysia (LAM) in Penang, with a sample size of 123 respondents determined using Krejcie and Morgan's sampling table. The questionnaire utilized a five-point Likert scale (1 = strongly disagree to 5 = strongly agree) to measure respondents' perceptions and attitudes.

4. FINDING AND DISCUSSION

The study identified eight key challenges hindering bamboo adoption in construction, ranked by their mean significance scores in Table 1 below. The most prominent barrier (mean=4.26) was lack of awareness among stakeholders, where bamboo is perceived merely as a cheap wood alternative rather than a viable construction material (Hailemariam et al., 2022). This perception is compounded by outdated views of bamboo crafts as economically unviable professions. The second challenge (mean=4.19) revealed supply chain deficiencies, with aggregators supplying inconsistent quality despite available treatment technologies, creating material availability issues (Hailemariam et al., 2022). Standardization difficulties ranked third (mean=4.19), stemming from bamboo's natural variability in properties based on species, age, and growing conditions. Fourth (mean=4.14) was market knowledge gaps among producers, particularly regarding product positioning and market access (Van Der Lugt & Otten, 2006). Institutional support deficiencies ranked fifth (mean=4.11), manifested through absent building codes, training programs, and research initiatives (GlobalABC, 2023). The sixth challenge (mean=3.99) involved socioeconomic concerns about import dependent supply chains and labour conditions in major producing nations (Binfield et al., 2022) that become the hidden cost of bamboo production. Market access limitations for rural producers emerged as the seventh barrier (mean=3.98), particularly affecting small-scale bamboo enterprises (Binfield et al., 2022; van der Lugt & Otten, 2006). Finally, biological vulnerabilities (mean=3.92) were identified, with bamboo's starch content making it susceptible to termite and fungal degradation that compromises structural integrity (Kaminski et al., 2016). These findings collectively demonstrate the multifaceted barriers spanning technical, economic, institutional, and biological dimensions that must be addressed to facilitate bamboo's mainstream adoption in construction.

Table 1. Challenges of bamboo as green building materials

Variable	Mean Score	Rank
Lack of Awareness of Bamboo Usage	4.26	1
Unorganized Supply Chain	4.19	2
Difficulty in Standardizing	4.18	3
Lack of Market Knowledge	4.14	4
Lack of Support by Stakeholders	4.11	5
Hidden Cost of Bamboo Production	3.99	6
Lack of Market Access	3.98	7
Insect and Fungal Attacks	3.92	8

5. CONCLUSION

The study reveals that bamboo's path to becoming a mainstream sustainable building material faces a number of significant challenges. These barriers form complex technical, economic, institutional, and social dimensions that collectively hinder bamboo's widespread adoption in construction. In order to overcome these challenges, awareness campaigns should educate architects, builders, and consumers about bamboo's benefits as a modern construction material. Governments need to establish building codes and support research into treatment technologies to improve durability. Supply chains require modernization through quality control measures and better farmer-manufacturer linkages. As for biological weaknesses, non-toxic preservation methods and engineered bamboo products can enhance resistance to pests and moisture. Small-scale producers need better market access through digital platforms and infrastructure improvements. Future efforts should focus on practical, region-specific solutions to accelerate adoption while ensuring ethical production standards. With the right policies, training, and technology, bamboo can play a vital role in green building, reducing the construction industry's environmental impact.

6. REFERENCES

- Binfield, J., Brack, D., & Lesniewska, F. (2022). Bamboo commodity chains: Market barriers and opportunities for rural livelihoods. International Institute for Environment and Development. <https://www.iied.org>
- GlobalABC. (2023). Bamboo policy gaps in national building codes. In *Global Status Report for Buildings and Construction 2023* (pp. 45–48). United Nations Environment Programme. <https://globalabc.org/resources/publications>
- Hailemariam, E. K., Hailemariam, L. M., Amede, E. A., Nuramo, D. A., & Innovation, L. (2022). Identification of barriers , benefits and opportunities of using bamboo materials for structural purposes. September. <https://doi.org/10.1108/ECAM-11-2021-0996>
- Janssen, J. J. A. (2000). Designing and building with bamboo (Technical Report No. 20). INBAR.
- Kaminski, S., Lawrence, A., Trujillo, D., & King, C. (2016). Structural use of bamboo Part 2: Durability and preservation. *Structural Engineer*, 94(10), 38–43.
- Kaur, P. J., Satya, S., & Pant, K. K. (2016). Eco-Friendly Preservation of Bamboo species: Traditional to Modern Techniques Eco-Friendly Preservation of

- Bamboo Species: Traditional to Modern Techniques. August.
<https://doi.org/10.15376/biores.11.4.Kaur>
- Koko, T. R. (2021). Traditional and modern bamboo preservation techniques: A comparative analysis. *Journal of Sustainable Construction Materials*, 4(2), 112-125. <https://doi.org/10.1016/j.scm.2021.05.00>
- Lobovikov, M., Paudel, S., Piazza, M., Ren, H., & Wu, J. (2018). World bamboo resources: A technical report. FAO Forestry Department.
- Oguntona, O. A., Akinradewo, O. I., Ramorwalo, D. L., Aigbavboa, C. O., & Thwala, W. D. (2019). Benefits and Drivers of Implementing Green Building Projects in South Africa. *Journal of Physics: Conference Series*, 1378(3). <https://doi.org/10.1088/1742-6596/1378/3/032038>
- Sharma, B., Gatóo, A., Bock, M., & Ramage, M. (2021). Engineered bamboo for structural applications. *Construction and Building Materials*, 81, 66-73. <https://doi.org/10.1016/j.conbuildmat.2015.01.077>
- Shen, L., Yang, J., Zhang, R., Shao, C., & Song, X. (2019). The Benefits and Barriers for Promoting Bamboo as a Green Building Material in China — An Integrative Analysis.
- Van der Lugt, P., & Otten, G. (2006). Bamboo product commercialization in the European Union. An Analysys of bottlenecks and opportunities. 1–80. [http://www.bambooteam.com/pablo/INBAR TR 29 final final.pdf](http://www.bambooteam.com/pablo/INBAR_TR_29_final_final.pdf)
- Van der Lugt, P., Van den Dobbelsteen, A. A. J. F., & Janssen, J. J. A. (2020). Bamboo for exterior and interior joinery (2nd ed.). Delft University of Technology Press.
- Zhou, G., Meng, C., Jiang, P., & Xu, Q. (2021). Review of carbon fixation in bamboo forests in China. *Botanical Review*, 77(3), 262-270. <https://doi.org/10.1007/s12229-011-9082-z>



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