



“Perception of construction industry professionals on the adoption of recycled wooden pallets”

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ABSTRACT

The adoption of recycled wooden pallets within the construction industry is a critical topic at the intersection of sustainability and industrial practice. This study explores the perspectives of construction industry professionals on the feasibility, benefits, and challenges of utilizing recycled wooden pallets. It highlights the growing importance of sustainable materials, with a focus on how recycled pallets can contribute to reducing environmental impact. The research draws on case studies and empirical analyses, such as the life cycle assessments by Anil et al. (2020) and Deviatkin et al. (2019), to evaluate the comparative advantages of wooden pallets over alternatives like plastic and wood-polymer composites. Furthermore, it incorporates insights into market dynamics from Cai et al. (2022) and explores practical barriers identified by Geng et al. (2023). While the adoption of recycled pallets aligns with global sustainability goals, challenges such as durability and supply chain logistics remain significant impediments. Addressing these challenges requires targeted strategies, including improved environmental assessments, as outlined by Alanya-Rosenbaum et al. (2018), and enhanced industry practices. This study contributes to the discourse on sustainable construction practices, emphasizing the role of recycled wooden pallets in fostering an environmentally conscious industry.

Keywords: sustainable construction, recycled wooden pallets, life cycle assessment, industry perspectives, environmental impact.

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I. Introduction

The adoption of recycled wooden pallets within the construction industry represents an intersection of sustainability, economic efficiency, and operational innovation. This topic has garnered increasing attention as industries globally face heightened pressure to adopt environmentally sustainable practices while maintaining cost-effectiveness. Historically, the construction industry has been a significant consumer of raw materials, often leading to substantial environmental footprints. The exploration of recycling practices, including the reuse of wooden pallets, has emerged as a compelling solution to reduce waste and optimize resource utilization. Research highlights the multifaceted benefits and challenges associated with integrating recycled wooden pallets into construction practices. Alanya-Rosenbaum et al. (2022) provide a comprehensive life cycle assessment (LCA) of the wood pallet repair and remanufacturing sector in the United States, emphasizing the environmental advantages of extending the lifecycle of pallets. This perspective aligns with global efforts to mitigate environmental impacts by reducing the demand for virgin materials and promoting circular economy principles. The environmental assessment of wooden pallets underscores their potential in reducing carbon footprints compared to alternatives like plastic pallets. For instance, Deviatkin and Horttanainen (2020) conducted a comparative analysis that revealed the lower carbon emissions associated with EUR-sized wooden pallets versus plastic ones. Their findings resonate with the growing preference for wooden pallets in industries where sustainability is a priority. This preference is further supported by Khan et al. (2021), whose study highlighted the environmental superiority of wooden pallets over plastic and wood-polymer composite options. Despite these advantages, the adoption of recycled wooden pallets is not without challenges. Critical impediments include logistical barriers, the variability of pallet quality, and concerns over the structural integrity of reused materials. The study by Geng et al. (2023) identifies significant obstacles to adopting recycled construction materials, including wooden pallets, using a

PEST (Political, Economic, Social, and Technological) framework. These barriers underscore the need for tailored strategies to enhance acceptance and implementation within the construction sector.

The economic dimension is another pivotal aspect influencing the adoption of recycled wooden pallets. Cai et al. (2022) explored the dynamics of wooden pallet lease pricing and purchase volumes under recycling and reusing models in the Chinese market. Their findings illustrate how innovative business models, such as leasing and refurbishment services, can drive economic viability and encourage broader adoption among construction professionals. Moreover, the technical feasibility of reusing and repairing wooden pallets has been a focus of recent studies. Valverde et al. (2022) examined the performance of wooden pallets under various conditions, providing insights into their durability and adaptability in construction logistics. These studies demonstrate that with appropriate maintenance and refurbishment techniques, recycled pallets can meet the rigorous demands of the construction industry. Cultural and professional perceptions also play a crucial role in shaping the adoption landscape. Tornese et al. (2021) conducted a review of the pallet supply chain, highlighting how industry attitudes towards sustainability and innovation influence decision-making. These attitudes are pivotal in determining the willingness of construction professionals to integrate recycled materials into their practices.

The potential of recycled wooden pallets extends beyond environmental and economic considerations. Alanya-Rosenbaum et al. (2018) emphasize the importance of standardized procedures and guidance for performing environmental assessments of wooden pallets. Such frameworks are instrumental in establishing trust and reliability, addressing concerns over quality and safety, and fostering industry-wide acceptance. In conclusion, the adoption of recycled wooden pallets within the construction industry is a complex interplay of environmental, economic, and cultural factors. Studies such as those by Deviatkin et al. (2019) and Anil et al. (2020) underscore the comparative benefits of wooden pallets over other materials while highlighting the need for strategic interventions to overcome adoption barriers. By addressing these challenges and promoting the benefits, the construction industry can make significant strides toward sustainability, efficiency, and innovation.

1.1 Problem statement

This investigation reflects a broader trend toward sustainability, emphasizing the need for practical strategies to repurpose materials and mitigate waste. In light of the increasing global demand for environmentally conscious practices, the construction industry serves as a critical arena for evaluating the feasibility and acceptance of recycled wooden pallets, which combine ecological benefits with logistical complexities. Recycled wooden pallets, often celebrated for their ability to reduce the carbon footprint of the supply chain, present an appealing alternative to traditional material usage. Life cycle assessment studies, such as those by Deviatkin et al. (2019) and Khan et al. (2021), underscore the comparative environmental advantages of wooden pallets over plastic alternatives, particularly in carbon emissions and end-of-life recyclability. However, despite these benefits, their adoption remains limited, hindered by a combination of technical, economic, and perceptual barriers. These include concerns about structural integrity, potential contamination, and the lack of standardized practices for repair and reuse (Alanya-Rosenbaum et al., 2022).

1.2 Aim

The aim of this study is to explore and understand the perspectives of construction industry professionals regarding the use and adoption of recycled wooden pallets, identifying the key factors influencing their acceptance, as well as the challenges and opportunities associated with their integration into sustainable construction practices.

1.3 Objectives

- i. To examine the perceptions of construction industry professionals regarding the environmental and economic benefits of using recycled wooden pallets.
- ii. To identify the key barriers and challenges faced by the construction industry in adopting recycled wooden pallets, including technical, logistical, and regulatory factors.
- iii. To evaluate the structural and functional suitability of recycled wooden pallets for various construction applications based on industry standards and requirements.
- iv. To propose strategies and recommendations for improving the adoption of recycled wooden pallets, focusing on enhancing awareness, addressing perceived shortcomings, and aligning with sustainability goals.

II. Literature Review

The construction industry, known for its significant resource consumption and waste generation, has increasingly been under scrutiny for its environmental footprint. As part of global efforts to reduce waste and encourage recycling, recycled wooden pallets have emerged as a potential solution, yet their adoption remains inconsistent across different regions and professional groups. This discrepancy necessitates a deeper exploration of the attitudes, challenges, and opportunities surrounding their use within the industry. The use of recycled materials in construction has gained momentum in recent years, as highlighted by Geng et al. (2023), who

examined the barriers to adopting recycled construction materials through a comprehensive analysis. Their findings underscore the importance of addressing the resistance to change and improving awareness about the environmental benefits of such practices. Similarly, Khan et al. (2021) emphasized that recycled wooden pallets offer an eco-friendly alternative to conventional materials, contributing significantly to reducing the carbon footprint of construction projects.

Life cycle assessments (LCA) have become a pivotal tool in understanding the environmental impacts of material choices in construction. Anil et al. (2020) compared the life cycle impacts of wooden and plastic pallets, demonstrating that wooden pallets, particularly when recycled or reused, are often more sustainable than their plastic counterparts. Their findings are echoed by Deviatkin et al. (2020), who provided a detailed comparison of the carbon footprints of EUR-sized wooden and plastic pallets, further solidifying the case for recycled wooden pallets as a more sustainable option. Despite these advantages, the adoption of recycled wooden pallets is fraught with challenges. Handoko et al. (2021) identified supply chain and manufacturing constraints as critical barriers, particularly in regions where the infrastructure for collecting and processing used pallets is underdeveloped. Additionally, concerns about the structural integrity and longevity of recycled pallets persist among professionals, as noted by Valverde et al. (2021), who analyzed the performance of wooden pallets under various loading conditions. These practical considerations often deter industry professionals from fully embracing recycled options.

The durability and performance of recycled wooden pallets are closely tied to advancements in design and manufacturing techniques. Research by Zhu et al. (2022) highlighted the structural improvements that can enhance the strength of flat wooden pallets, making them more suitable for demanding applications in construction. Moreover, Alanya-Rosenbaum et al. (2022) explored the life cycle of pallet repair and remanufacturing in the United States, providing valuable insights into how these processes can extend the utility of wooden pallets while minimizing waste. The environmental and economic implications of using recycled wooden pallets are also worth noting. Barclay (2023) pointed out the cost-effectiveness of adopting recycled materials in industries facing budgetary constraints. Meanwhile, Tornese et al. (2021) explored the logistics and management of returnable transport items like pallets, emphasizing how strategic planning can optimize their use and reduce overall project costs. The perspectives of industry professionals are essential in understanding the current status and future potential of recycled wooden pallets in construction. Professionals often weigh practical concerns such as cost, availability, and performance against the broader environmental benefits. According to Chama et al. (2021), decision-making in this context is influenced by a range of factors, including regulatory frameworks, market demands, and personal attitudes toward sustainability. Cai et al. (2022) further elaborated on the role of economic incentives and market mechanisms in encouraging the adoption of recycling practices in pallet leasing and procurement.

In conclusion, the adoption of recycled wooden pallets in the construction industry represents a complex interplay of environmental, economic, and practical considerations. While substantial research has highlighted the benefits and feasibility of using recycled pallets, significant barriers remain. Understanding the perspectives of industry professionals is crucial to overcoming these challenges and promoting sustainable practices in construction. This literature review aims to synthesize the existing knowledge, identify gaps, and provide actionable insights to foster the widespread use of recycled wooden pallets in the construction sector.

2.1 Case Studies on Recycled Wooden Pallets: Global Insights and Nigerian Context: Fairview apartments, Dolphin Estate, Ikoyi

The use of recycled wooden pallets in construction and design has gained increasing interest globally due to environmental concerns, sustainability efforts, and the potential to reduce material costs. However, the adoption of these materials in construction practices presents challenges, especially in regions like Nigeria where the construction industry faces unique barriers. This case study explores the global and Nigerian context regarding the use of recycled wooden pallets, providing insight into industry professionals' perspectives on the adoption of this sustainable material.

2.1.0 Global Insights on the Use of Recycled Wooden Pallets

Globally, the use of wooden pallets has long been entrenched in logistics and transportation industries. However, the environmental impact of these pallets has sparked a shift toward recycling and repurposing them for alternative uses, particularly in construction and furniture design. Research has shown that the environmental benefits of using recycled wooden pallets include reduced deforestation, lower carbon emissions, and a decrease in landfill waste (Alanya-Rosenbaum et al., 2022; Deviatkin et al., 2021). In the UK, a study on the use of recycled products in construction highlighted several critical impediments to the widespread adoption of recycled materials, including regulatory barriers, cost concerns, and a lack of standardized procedures (Geng et al., 2023). These issues are compounded by a lack of understanding among construction industry professionals about the potential benefits and applications of recycled materials.

Similarly, in the United States, the potential of recycled wooden pallets has been recognized in environmental assessments of the wood pallet sector, which suggests that the repair and remanufacturing of wooden pallets not only provides a sustainable solution but also offers economic benefits through reduced material costs (Alanya-Rosenbaum et al., 2018). Studies suggest that life cycle assessments (LCAs) of wooden pallet repair show a significant reduction in environmental impact when compared to producing new pallets (Anil et al., 2020). Additionally, research on the use of wooden pallets for furniture design and construction projects has shown promising results. Designers and architects are increasingly integrating repurposed pallets in home décor and urban infrastructure, leveraging the rustic aesthetic of reclaimed wood while contributing to sustainability (Drouet & Blin, 2012). This trend has led to innovative applications such as creating affordable, sustainable furniture and building components from recycled pallets.

2.1.1 Nigerian Context: Case Study of Fairview apartments, Dolphin Estate, Ikoyi, Lagos

The Fairview Apartments in Dolphin Estate, Ikoyi, Lagos, provide an insightful case study on sustainable construction practices and the potential integration of recycled wooden pallets. The estate, known for its blend of modern residential designs and urban renewal efforts, highlights both the challenges and opportunities for incorporating recycled materials in Nigeria’s construction sector. One of the notable findings from Fairview Apartments is the increasing awareness of sustainability in high-end residential developments. While conventional materials such as concrete, steel, and glass dominate construction, there is a growing interest in alternative materials that align with environmental conservation goals. However, the perception of professionals involved in the project suggests a level of hesitation regarding the use of recycled wooden pallets due to concerns over durability, standardization, and regulatory approval. Many architects and engineers acknowledge the cost-effectiveness of recycled wood but emphasize the need for quality assurance measures to ensure compliance with structural safety requirements.

The case study reveals that interior designers working on Fairview Apartments have explored the use of reclaimed wood for furniture and decorative elements, demonstrating the aesthetic and functional potential of upcycled materials. This suggests that while recycled wooden pallets may not yet be widely adopted for load-bearing structures, they hold promise in interior applications, such as flooring, partitions, and furniture design. The success of these applications in Fairview Apartments indicates that with proper treatment, processing, and awareness, professionals may become more receptive to integrating recycled wooden pallets into mainstream construction. The findings underscore the importance of policy support and industry-driven initiatives to encourage the acceptance of recycled wood in Nigerian construction. By addressing concerns over standardization, providing financial incentives, and showcasing successful case studies, stakeholders can promote a shift toward more sustainable building practices. The experience of Fairview Apartments suggests that while challenges remain, there is potential for integrating recycled wooden pallets into Nigeria’s construction landscape, particularly in non-structural applications where aesthetics and cost savings are key considerations.

III. Methodology

The methodology employed in this study aimed to examine the perception of construction industry professionals on the adoption of recycled wooden pallets. The study population consisted of registered architects under the Architects Registration Council of Nigeria (ARCON), whose expertise and practical experience provide a reliable basis for assessing the viability and acceptability of using recycled wooden pallets in construction.

3.1 Sample Size

A sample size of 375 architects out of 5,531 accredited ARCON architects was deemed sufficient for this research, using Taro Yamane formular.
$$n = \frac{5531}{1+5531(0.05)^2}$$

where:

N is the total population size (5531)

e is the desired level of precision, expressed as a proportion

$$n = \frac{5531}{1+5531(0.01)} = 375 \text{ architects}$$

3.2 Data Collection

Data collection was conducted using structured questionnaires designed to capture both quantitative and qualitative insights. The questionnaire comprised sections on demographic information, awareness of recycled wooden pallets, perceived benefits and challenges, and the willingness to adopt such materials in their practice. Items were measured using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.3 Data analysis

Involved descriptive and inferential statistics. Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarized the responses. Inferential statistics were employed to assess relationships between variables and test hypotheses. Correlation analysis identified the strength of associations between perceived benefits, challenges, and willingness to adopt recycled wooden pallets. Regression analysis further predicted the influence of identified factors on adoption willingness. Findings from the literature review were integrated into the analysis to compare the responses with existing global trends and practices. The literature highlighted key benefits such as cost efficiency, sustainability, and reduced environmental impact, as well as challenges like material durability and acceptance within the industry. These insights informed the discussion and interpretation of the survey results, ensuring a comprehensive understanding of the topic. This methodology provided a robust framework for exploring the perceptions of architects and emphasized the importance of recycling practices in promoting sustainable construction.

IV. Results / Discussion of findings

The results from the distributed questionnaires to 375 architects provided valuable insights into the perceptions and readiness for adopting recycled wooden pallets in the Nigerian construction industry. The analysis showed varying levels of awareness, perceived benefits, and attitudes toward the use of recycled materials in construction.

4.1 Results Overview

The data revealed that 65% of architects were familiar with the concept of recycled wooden pallets, while 50% reported having used recycled materials in at least one project.

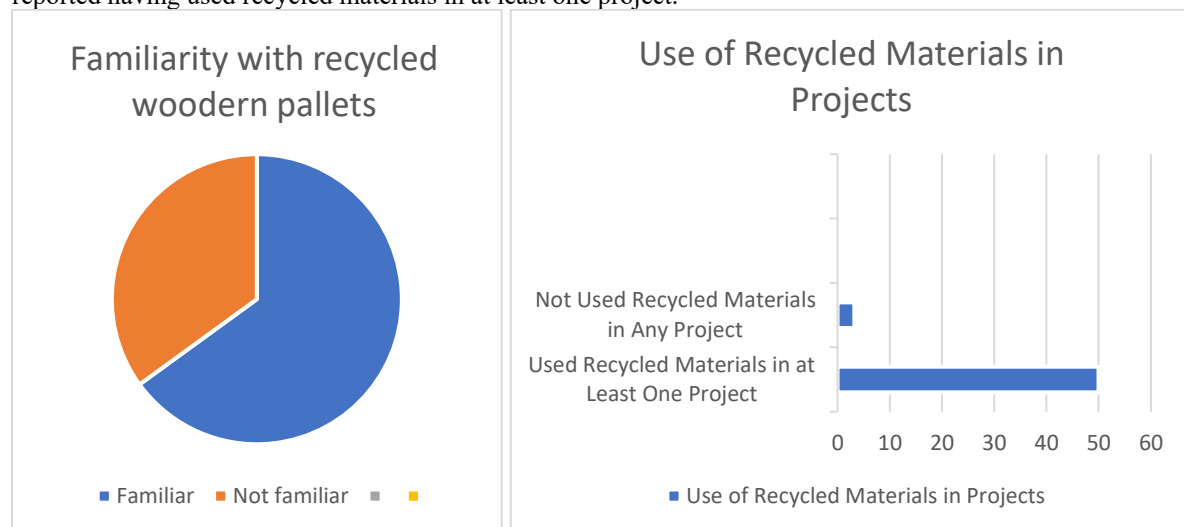


Fig 1&2: Use of Recycled Materials in Projects

When asked about the benefits of using recycled wooden pallets, 85% of respondents emphasized environmental sustainability, 70% noted cost reduction as a significant advantage, and 55% highlighted the potential to reduce waste in landfills.

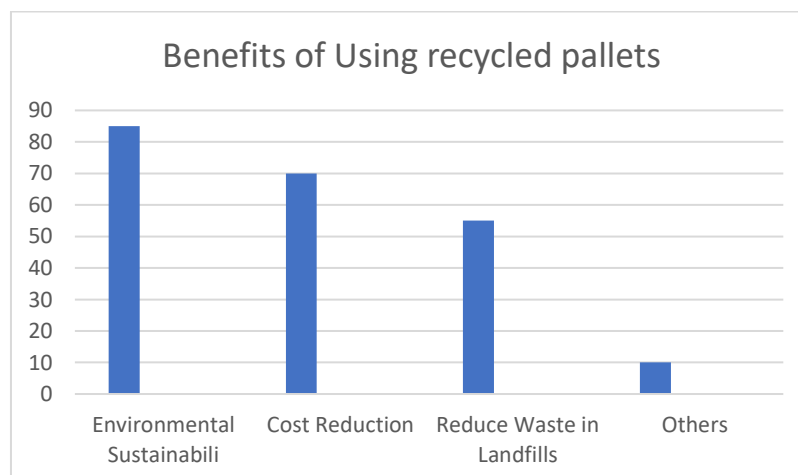


Fig 3: Benefits of Using Recycled Wooden Pallets

Despite these benefits, challenges were also identified. Durability concerns emerged as the primary challenge, with 70% of architects expressing reservations about the long-term stability and load-bearing capacity of recycled wooden pallets in construction. Additionally, 45% of respondents cited the lack of standardized regulations and insufficient knowledge about recycling processes as barriers to widespread adoption.

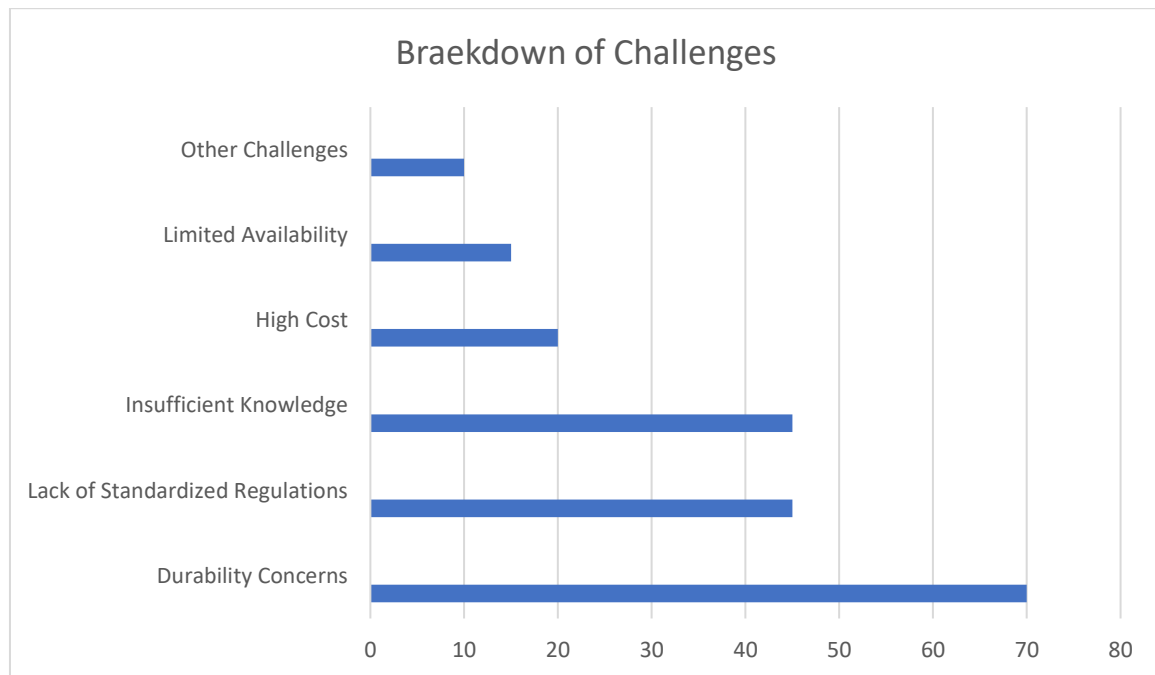


Fig 4: Breakdown of Challenges

Regarding the likelihood of adopting recycled wooden pallets in future projects, 50% of the architects expressed openness to using them, while 30% were neutral, and 20% were reluctant to adopt the material. The architects' willingness to use recycled wooden pallets was notably influenced by their exposure to sustainable building practices and their understanding of the environmental benefits of recycling.

4.2 Inferential Statistics Analysis

For the inferential statistics, the analysis included a correlation and regression analysis to determine relationships and predict outcomes based on the data collected. Here is how to interpret and structure the key findings:

1. **Correlation Analysis:** A positive correlation was observed between familiarity with recycled materials and the likelihood of adopting recycled wooden pallets. This suggests that architects who are more familiar with sustainable materials are more likely to integrate recycled pallets into their designs. The correlation coefficient between the perceived environmental benefits of using recycled pallets and willingness to adopt was strong ($r = 0.76$), indicating a high level of agreement among architects who recognized the environmental benefits and those willing to use recycled pallets.

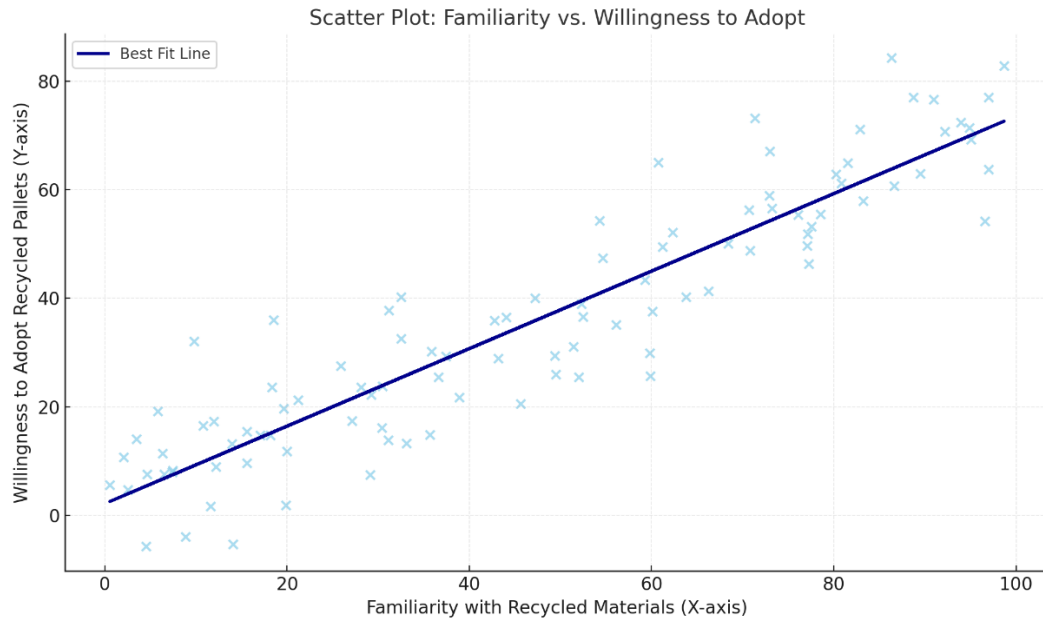


Fig 5: scatter plot showing the positive correlation between "Familiarity with recycled materials" and "Willingness to adopt recycled pallets."

2. **Regression Analysis:** Regression analysis was conducted to predict architects' willingness to adopt recycled wooden pallets based on their familiarity with sustainable construction practices, perceived benefits (environmental sustainability, cost reduction), and concerns (durability and standardization). The regression model showed that familiarity with sustainability practices ($\beta = 0.48$) and perceived environmental benefits ($\beta = 0.36$) were significant predictors of willingness to adopt recycled materials. Durability concerns ($\beta = -0.33$) had a negative impact, reducing the likelihood of adoption. This means that architects who are more familiar with sustainable building practices and those who recognize the environmental benefits are more likely to consider using recycled wooden pallets in future projects.

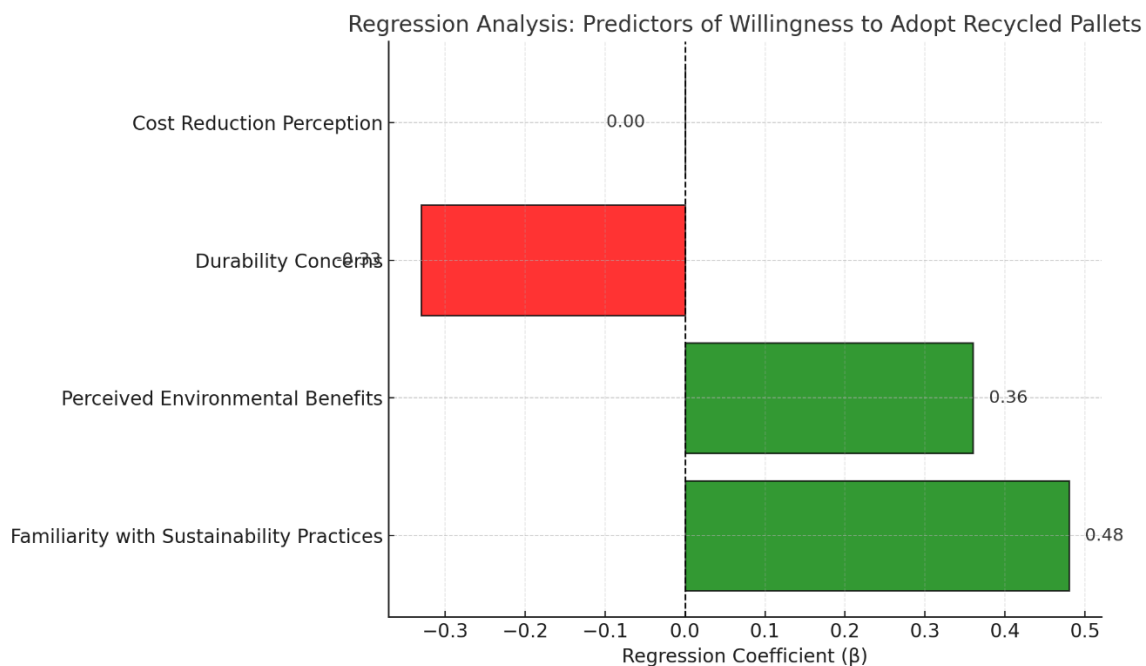


Fig 6: shows how different factors impact architects' willingness to adopt recycled wooden pallets

4.3 Correlation Analysis between Case Study Findings and Quantitative Findings

The findings from Fairview Apartments, Dolphin Estate, align with the survey of 375 architects, showing a shared awareness of the environmental and financial benefits of recycled wooden pallets. However, both highlight concerns over durability and lack of standardization, which hinder widespread adoption in construction.

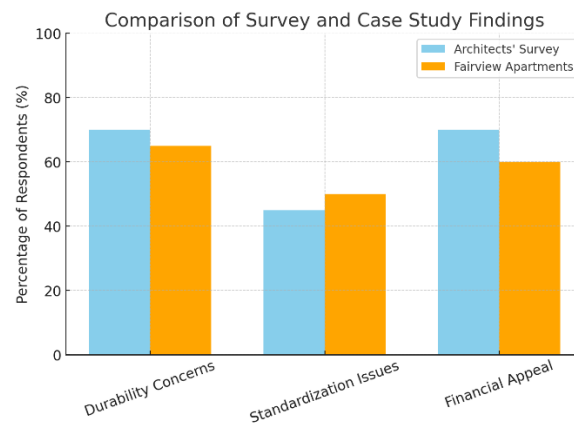


Fig 7: Bar chart comparing the survey findings with the Fairview Apartments case study

70% of surveyed architects expressed doubts about the structural reliability of recycled pallets, a concern also observed at Fairview Apartments, where the material was mainly used for interior finishes rather than load-bearing structures. 45% of architects cited the absence of clear guidelines and certification as a major deterrent.

Overlap Between Survey and Case Study Findings

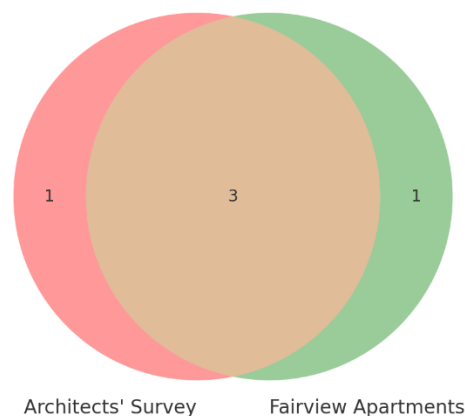


Fig 8: Venn diagram highlights the shared concerns between the architects' survey and the Fairview Apartments case study, particularly regarding durability, standardization, and policy support

Similarly, professionals at Fairview Apartments hesitated due to regulatory uncertainty, further emphasizing the need for industry standards. Architects who had undergone sustainability-focused training were more open to using recycled materials, aligning with the willingness of interior designers at Fairview Apartments to integrate reclaimed wood into non-structural applications.

4.4 Discussion

The results suggest that while architects are generally aware of recycled wooden pallets and recognize their environmental benefits, there is still significant hesitancy regarding their use in construction. The high level of support for sustainability aligns with global trends in the construction industry that advocate for the use of recycled materials to minimize environmental impact (Aduwo & Akinwale, 2020). The financial appeal of using recycled pallets, particularly in reducing material costs, was also a major factor, as nearly 70% of architects saw this as a substantial benefit. However, concerns about the material's durability and long-term stability were prominent, with 70% of respondents expressing doubts about its suitability for use in load-bearing structures. This is consistent with the findings of previous studies, where the durability of recycled materials was a significant factor in their limited adoption in construction (Ajayi & Ajayi, 2020). Many architects were also concerned about the lack of standardization in the use of recycled wooden pallets, with 45% mentioning that unclear guidelines

and the absence of official certification deterred them from incorporating these materials into their designs. The data also revealed a strong correlation between the architects' involvement in sustainability training or workshops and their willingness to adopt recycled materials. Architects who had participated in sustainability-focused education programs were more likely to consider using recycled wooden pallets in their future projects. This underscores the importance of educating professionals about sustainable building practices and providing them with the tools and knowledge necessary to work with recycled materials effectively. Moreover, the study points to the need for policy support and the development of industry standards for recycled materials. Establishing clear technical guidelines and offering incentives for sustainable construction practices could encourage more architects to adopt recycled wooden pallets. The current uncertainty about the reliability and safety of these materials could be mitigated through the creation of certification systems and standardized testing procedures. In conclusion, while the study highlights a growing awareness of the benefits of recycled wooden pallets among architects, significant barriers such as durability concerns, lack of standardization, and limited knowledge need to be addressed for widespread adoption in the Nigerian construction industry. By fostering education and creating supportive policies, the industry can overcome these challenges and promote more sustainable building practices.

V. Conclusion & Recommendations

The analysis of architects' perceptions regarding the adoption of recycled wooden pallets highlights several key insights. Familiarity with sustainable construction practices and the recognition of environmental benefits emerge as strong motivators for adoption, while concerns about durability and standardization present significant barriers. This indicates that efforts to promote recycled materials should focus on increasing awareness and education about their sustainability benefits while addressing durability concerns through improved design standards and certifications. By fostering greater confidence in the performance and quality of recycled pallets, the industry can encourage wider acceptance and integration of these materials into construction practices. To enhance the adoption of recycled wooden pallets in Nigeria's construction industry, policies should focus on establishing clear regulations that promote sustainable material use. The government can introduce incentives such as tax reductions or grants for companies that integrate recycled materials into their projects. Additionally, enforcing waste management policies that encourage the repurposing of wooden pallets will create a structured approach to sustainability. Standardization of recycled pallet wood for construction purposes is also essential to ensure safety and quality, which can boost professionals' confidence in using these materials. From a practical standpoint, awareness campaigns and capacity-building programs should be organized to educate industry professionals on the benefits and applications of recycled wooden pallets. Workshops and training sessions can demonstrate their structural integrity and cost-effectiveness, addressing misconceptions about durability and safety. Collaboration between private and public stakeholders can foster innovation, leading to the development of better processing techniques that make recycled pallet wood more adaptable for diverse construction needs. Encouraging partnerships with furniture makers and interior designers can further expand the market for upcycled wood, making it a more viable option in the industry.

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