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Impact of Green Building Certifications on Sustainable Practices in Construction Supply Chains in India.

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Abstract

The construction industry in India significantly impacts the environment through extensive resource use, energy consumption, and waste generation. In response, green building certifications such as LEED, IGBC, and GRIHA have emerged as frameworks that promote sustainable practices. This study aims to assess the role of these certifications in advancing sustainability within the Indian construction supply chain. By focusing on certified projects across metropolitan areas, the research investigates the extent to which green certifications influence material sourcing, waste management, energy efficiency, and stakeholderengagement. A quantitative approach was adopted, employing statistical analysis to evaluate data from 121 certified project participants. Findings reveal that while green certifications drive significant improvements in sustainable practices, the adoption rate is hindered by high initial costs, awareness deficits, and regulatory fragmentation. These insights have implications for both policymakers and industry stakeholders, offering evidence-based recommendations tofoster broader adoption of green certifications and strengthen sustainable practices withinIndia's construction sector.

Keywords:*Green Marketing, Green Building certifications, Sustainable practices, Construction industry, Supply chain,*

1. Introduction-

The construction sector is globally recognized as one of the largest contributors to environmental degradation, due to its high levels of resource consumption, energy usage, and waste production. In India, this challenge is amplified by rapid urbanization, which has led to increased demand for infrastructure and construction projects, resulting in further strain on natural resources. Consequently, there is a growing need for sustainable practices within the industry, and green building certifications such as LEED (Leadership in Energy and Environmental Design), IGBC (Indian Green Building Council), and GRIHA (Green Rating for Integrated Habitat Assessment) have

emerged as critical frameworks to address these issues. These certifications provide standardized guidelines to ensure that construction projects meet environmental benchmarks related to energy efficiency, water conservation, waste management, and sustainable material sourcing.

Despite their potential to transform the construction industry, the integration of green building certifications within India's construction supply chain remains limited. This research examines how certifications influence sustainable practices and identifies barriers that hinder their adoption, including high initial costs, a lack of awareness, and inconsistent regulatory support. This study also explores the role of government policies in shaping certification uptake and sustainable practices. Through an in-depth analysis of data from certified projects, this research offers insights into the practical application of certifications in India's unique socio-economic landscape and provides recommendations to enhance the adoption of green certifications. By focusing on the Indian context, this study contributes to the global discourse on sustainable construction, highlighting challenges and opportunities for implementing environmentally responsible practices in developing countries.

2. Background of the Study-

While India persistently witnesses an unmatched level of urbanization and industrial evolution, the critical part that the construction sector plays in both enhancing economic progress and impacting environmental health has become notably significant and is receiving thorough examination within scholarly and policy-making environments. The building sector in India is a major factor in resource depletion, immense energy consumption, and significant waste creation, raising urgent issues about the sustainability of these approaches for long-term ecological health. In response to the negative environmental effects, various international and national campaigns have been set in motion to push for and advance sustainable building approaches that seek to diminish these detrimental results. Certifications associated with sustainable architecture, like LEED (Leadership in Energy and Environmental Design), IGBC (Indian Green Building Council), and GRIHA (Green Rating for Integrated Habitat Assessment), act as crucial measures for determining sustainability, given that they offer an in- depth array of criteria that shape and direct the activities of planning, constructing, and supervising buildings to minimize their ecological effects.

3. Problem Statement-

The construction industry in India is a significant contributor to environmental challenges, with high levels of energy consumption, resource depletion, and waste production. Although green building certifications—such as LEED (Leadership in Energy and Environmental Design), IGBC (Indian Green Building Council), and GRIHA (Green Rating for Integrated Habitat Assessment)—offer structured approaches to address these sustainability issues, their adoption in India's construction sector faces notable challenges. High initial costs, regulatory inconsistencies, and limited awareness among industry stakeholders are key barriers that hinder widespread adoption of these certifications. This study focuses on sustainability as the primary outcome of green building certifications, assessing

how these certifications influence sustainable practices across the construction supply chain. Key factors, including government policies, stakeholder engagement, material sourcing, waste management, and energy efficiency, are considered as independent variables that collectively impact sustainability in certified projects. The research aims to explore the overall effect of these certifications on sustainability within India's construction industry, providing insights into the potential and limitations of green building standards.

4. Research Questions-

This research is guided by the following questions:

1. How do green building certifications influence the sourcing of sustainable materials in the construction supply chain?
2. What are the impacts of green building certifications on energy efficiency and water conservation practices?
3. How do green building certifications affect waste management practices in the construction industry?

5. Research Objectives-

4. To analyze how green building certifications influence the sourcing of sustainable materials.
5. To evaluate the impact of green certifications on energy efficiency and water conservation practices.
6. To assess waste management strategies implemented as a result of green building certifications.

7. Hypotheses-

The following hypotheses guide this research. In accordance with standard hypothesis testing, the null hypotheses (H0) assume no significant effect, and the alternative hypotheses (H1) are accepted if the analysis provides sufficient evidence (p-value < 0.05) to reject H0.

- H0: Green building certifications do not significantly influence the sourcing of sustainable materials in the construction supply chain.
- H0: There is no significant relationship between the adoption of green certifications and improvements in energy efficiency and water conservation.
- H0: Green building certifications do not lead to more effective waste management practices in certified projects.

6. Scope and Limitations:

This academic research endeavor is predominantly centered around the intricate and comprehensive examination of various Green Building Certifications, which encompass, but are not limited to, widely recognized frameworks such as GRIHA, LEED, and IGBC, and seeks to conduct a thorough analysis of their substantial influence on the promotion and implementation of sustainable construction practices within the multifaceted context of India. In pursuit of achieving this overarching objective, the study will diligently and meticulously gather, as well as analyse, a diverse array of qualitative and quantitative data from a multitude of stakeholders who are actively engaged in projects that have successfully obtained certification, with a particular emphasis placed on urban and semi-urban locales where the adoption and integration of Green Building Certifications are notably more widespread and prevalent in comparison to other regions. It is of utmost importance to acknowledge that this

investigation will intentionally exclude rural territories from its analytical purview, as the integration of these Green Building Certifications may be significantly hampered by a multitude of socio-economic dynamics and infrastructural obstacles that are characteristically prevalent in those locales.

8. Literature Review:

Green Building Certifications: An Overview-

Green building certifications, including IGBC, LEED, and GRIHA, play a fundamental role in promoting sustainable construction practices globally and within India. These certifications are designed to guide construction projects in adopting environmentally responsible practices by providing standards for energy efficiency, waste management, and sustainable material sourcing. LEED and IGBC, for instance, are recognized globally and promote sustainable strategies across various domains, including site development, energy efficiency, and water use. GRIHA, developed in collaboration with India's Ministry of New and Renewable Energy, is tailored to the Indian context and emphasizes sustainable resource use and minimal environmental impact in urban and semi-urban settings (GRIHA, 2017). The certifications have been linked to tangible benefits, such as improved building performance, reduced perational costs, and decreased environmental footprints. However, Naik & Dhilip (2022) and Srivastava & Gaur (2015) identify significant challenges, particularly for small-scale developers, due to financial constraints and limited access to certified sustainable materials.

Material Sourcing and Sustainable Practices-

Green building certifications place a strong emphasis on sourcing materials that are locally produced, recycled, or renewable to reduce the environmental impact of construction activities. Certifications like IGBC and LEED mandate that a portion of materials used in certified projects must be sourced from within a specific distance to decrease transportation emissions, support local industries, and reduce embodied energy (Desai & Raj, 2020). However, constraints in the availability of locally sourced sustainable materials and a lack of awareness among stakeholders pose challenges for comprehensive adoption of sustainable sourcing practices in India, especially in rural and semi-urban areas (Mudigonda Naik & Dhilip, 2022). The literature emphasizes the need for a coordinated approach, where local policies and incentives can support the availability of certified materials and drive demand for sustainable sourcing within the supply chain

Waste Management in Green-Certified Projects-

Waste management serves as an essential and critical area of focus within the comprehensive framework of certifications pertaining to green building practices, underscoring its significance in the pursuit of sustainability. The initiatives that attain certification from prominent organizations such as GRIHA, LEED, and IGBC are mandated to adopt and implement stringent protocols for waste management, which include, but are not limited to, the meticulous segregation of various types of waste at the construction site, as well as the systematic recycling and innovative repurposing of building materials that would otherwise contribute to environmental degradation. As Tinkov and his team (2023) highlight, constructions that achieve certification yield a markedly diminished volume of waste relative to

those without certification, which is primarily linked to their effective recycling strategies and the intentional reuse of materials. Moreover, the certifications in question necessitate the development and articulation of a comprehensive construction waste management strategy, which explicitly mandates that a specified percentage of waste be diverted from landfills through methods of recycling or repurposing (Mojumder & Singh, 2021). Such methodologies are critical in aiding the decrease of the ecological footprint that comes with construction activities and simultaneously advocate for the intelligent use of available resources, nurturing a more sustainable building approach. Nonetheless, as delineated by Koul, Ghatak, and Sinha (2023), the successful implementation of effective waste management strategies is often hindered by a notable lack of technical expertise and proficiency among construction practitioners and contractors, particularly those operating within smaller enterprises, which can impede progress towards more sustainable construction practices.

9. Research Gap-

Despite the increasing scholarly focus on green building certifications, significant research gaps remain. Most notably, there is a lack of comprehensive studies on the economic benefits of certified buildings in the Indian context, as well as the impact of certifications on long-term operational performance. Additionally, limited research exists on the unique challenges faced by rural and semi-urban regions, where green certification adoption is particularly low. Addressing these gaps is essential to understand and address the barriers to sustainable construction practices in India.

10. RESEARCH METHODOLOGY

Research Design-

This study employs a quantitative research design to analyze the impact of green building certifications on sustainable practices within the Indian construction supply chain. A structured questionnaire was used to collect data from industry professionals actively involved in certified construction projects. The questionnaire was designed to capture insights on material sourcing, waste management, energy efficiency, water conservation, and stakeholder perceptions of green certifications.

Sampling Data-

Target Population-

The demographic focus of this investigation encompasses professionals actively participating in environmentally certified construction initiatives within the Indian context. This cohort includes developers, contractors, suppliers, architects, and end-users. These stakeholders are directly involved in initiatives that comply with recognized certifications such as GRIHA, LEED, and IGBC (Mojumder & Singh, 2021).

Sampling Frame-

The sampling framework encompasses professionals hailing from prominent metropolitan areas including Delhi NCR, Mumbai, Bangalore, Chennai, and Pune. These urban locales were chosen due to their significant rates of green building certification adoption and their recognition as construction epicentres featuring certified initiatives (Indian Green Building Council, 2021). Concentrating on urban centers guarantees that the sample consists of informed participants capable of offering pertinent insights regarding the adoption and ramifications of green certifications.

Sampling Technique-
A purposive sampling methodology was employed to identify respondents possessing direct experience in certified green building initiatives. This approach guarantees that the research encompasses participants who are knowledgeable about the intricacies and advantages associated with green building certifications and can provide pertinent data (Koul et al., 2023).

Sampling Size-
A comprehensive total of 121responses were procured through the administration of an online survey, with the conclusive target sample size established at 100 respondents. This designated sample size is adequate for conducting statistical analyses, thereby yielding dependable insights into the perspectives of stakeholders and the implications of certifications (Mojumder & Singh, 2021; Khan et al., 2024).

Sampling Elements-
The sampling constituents encompass pivotal stakeholders within the construction supply chain who are actively engaged in the execution of sustainable building practices. These constituents are:

- **Contractors:** Individuals who oversee and implement projects that have attained green certification.
- **Suppliers:** Enterprises that furnish environmentally friendly and sustainable materials for buildings that have received certification.
- **Architects/Project Managers:** Specialists tasked with the design of projects to comply with green certification standards.
- **End-users:** Individuals or entities occupying or owning buildings that derive advantages from the sustainability initiatives incorporated within certified structures (Mojumder & Singh, 2021).

Data Collection Method- Primary Data-
Primary data was meticulously gathered through the implementation of an online questionnaire that was disseminated utilizing the widely recognized platform of Google Forms, which facilitated ease of access for respondents. The questionnaire specifically aimed at engaging professionals who are actively involved in the intricate processes of green- certified construction projects and was methodically constructed to facilitate the collection of quantitative data that could be statistically analyzed. It incorporated a series of closed-ended questions meticulously designed to extract comprehensive information regarding the degree to which sustainable practices are adopted in key areas such as material sourcing, energy efficiency, and waste management, in addition to assessing the perceived advantages and obstacles encountered in relation to the attainment of green certifications.

Questionnaire Design-
The questionnaire was structured into three main sections to ensure the collection of relevant data:
Sustainable Practices: This section focused on understanding the extent of sustainable practices in certified projects, including material sourcing, energy efficiency measures, and waste management strategies. Questions were designed to quantify these practices, such as asking respondents to indicate the percentage of materials used that are sustainable.

Perceptions and Challenges: The third section gathered insights into stakeholder perceptions of the benefits and challenges

associated with green certifications. Closed- ended questions measured perceptions on a Likert scale (from 1 to 5), assessing aspects such as cost-effectiveness, marketability, and long-term environmental impact.

Secondary Data-

In union with the detailed pursuit of primary data collection, a rich assortment of secondary data was diligently extracted from a plethora of reputable academic sources, thorough industry reports, trustworthy government publications, and significant data shared by leading green certification bodies, including but not limited to the Green Rating for Integrated Habitat Assessment (GRIHA), the Indian Green Building Council (IGBC), and the Leadership in Energy and Environmental Design (LEED). This extensive corpus of data not only furnished essential contextual insights but also significantly bolstered the analytical examination of prevailing trends within the realm of green certifications, the intricate regulatory frameworks that govern them, and the multifaceted sustainability metrics that are increasingly becoming central to contemporary environmental discourse.

Data Analysis-

This section presents the findings on the influence of green building certifications and related factors on sustainability as the main outcome. The collected data was analyzed using quantitative statistical methods. Descriptive statistics (e.g., means, percentages, and frequencies) were used to summarize the data, while inferential statistics such as chi-square tests and t-tests were employed to test the hypotheses. A significance level of 0.05 (p-value < 0.05) was used to determine whether to reject the null hypotheses (H0). This approach ensures that the conclusions drawn from the data are statistically valid and evidence-based, providing meaningful insights into the role of green building certifications in sustainable construction practices (Mojumder & Singh, 2021; Tinkov et al., 2023).

11. DATA ANALYSIS

Impact of Green Certifications on Sustainable Practices-

Material Sourcing-

Green building certifications significantly influence material sourcing decisions, with 55% of respondents using recycled materials and 35% sourcing locally. However, local material sourcing remains lower than expected.

Green building certifications were found to significantly influence material sourcing decisions, as shown below:

Figure4.1: Influence of green certifications on sustainable material sourcing decisions.

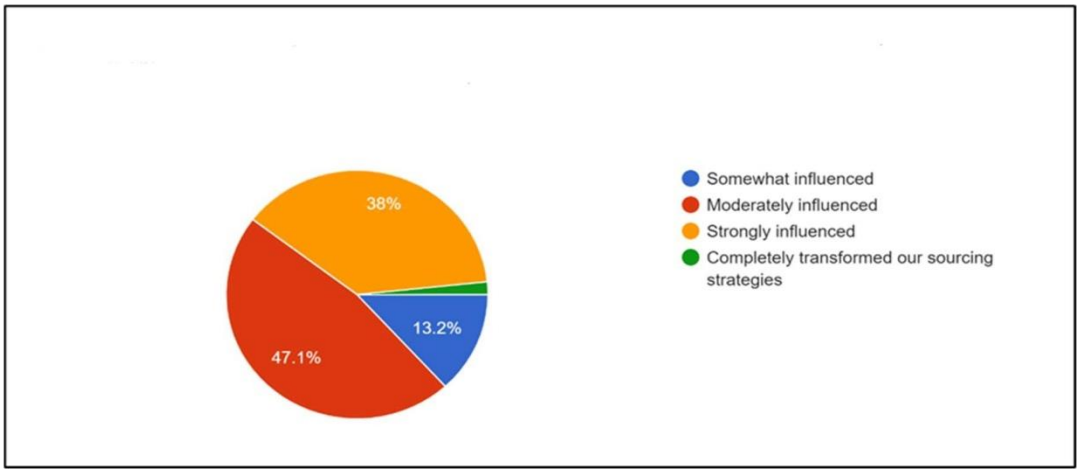


Figure4.2:Types of sustainable materials prioritized in certified projects.

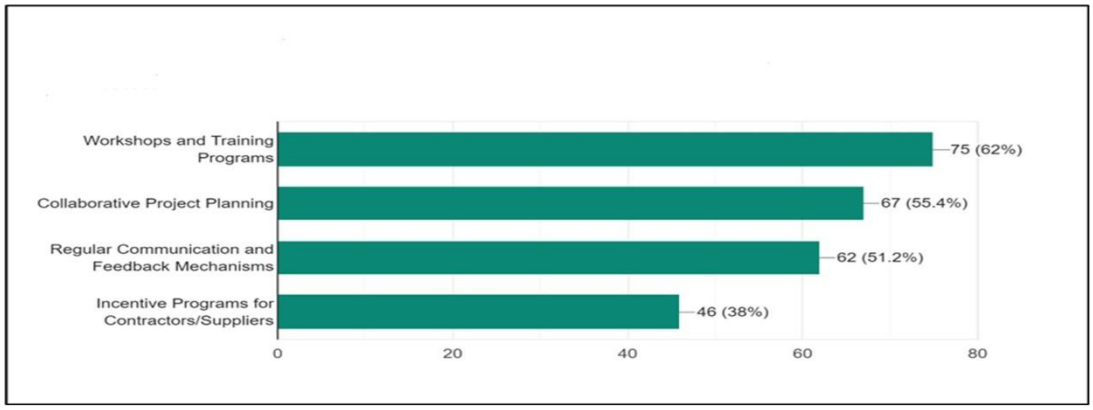
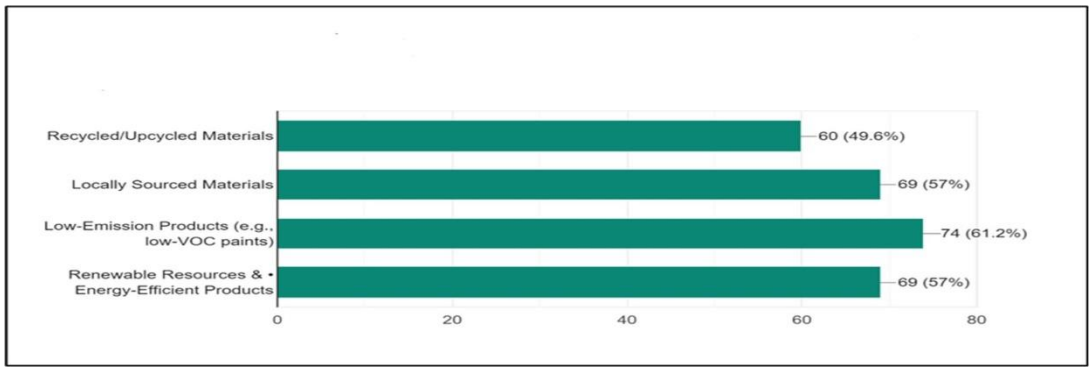


Figure4.3: Strategies organizations use to engage stakeholders in green certifications.



Waste Management Practices-

60% of certified projects implemented recycling measures, and 50% achieved a reduction in waste. On-site material reuse remains lower at 40%, indicating that further innovation in waste management practices is needed.Respondents reported improvements in waste management practices due to certification adoption

Figure4.4:Wastemanagementstrategiesingreen-certifiedorganizations.

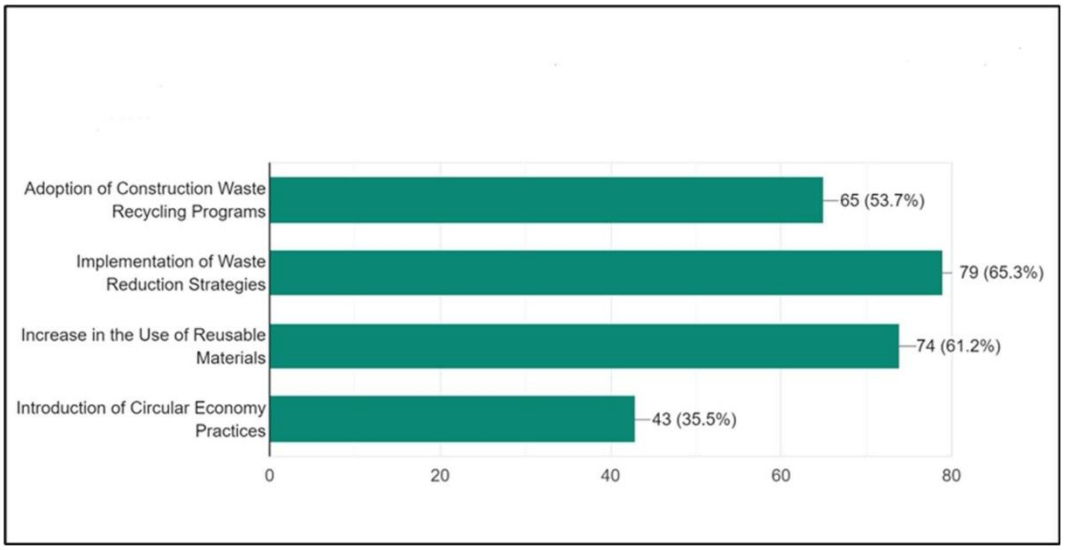


Figure4.5:Impactofgreencertificationsonwastemanagementpractices

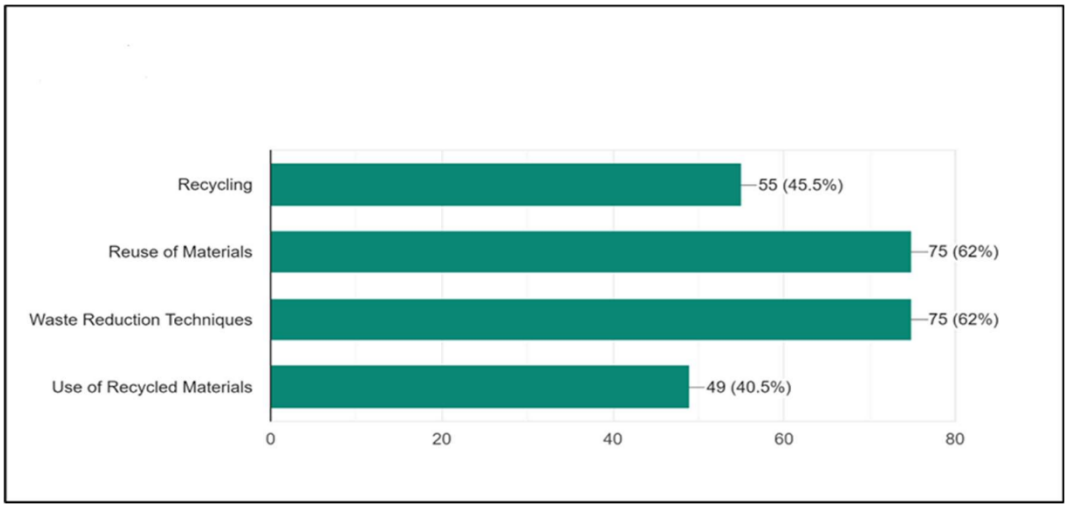
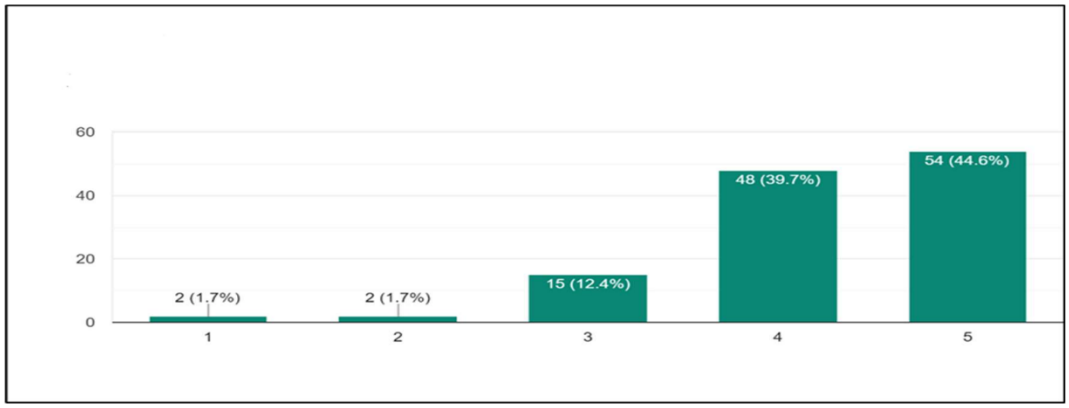


Figure4.6:Effectivenessofwastemanagementstrategiesincertifiedprojects.



HypothesisTestingwithANOVA-

The hypotheses were tested using ANOVA to compare the mean differences between green- certified and non-certified projects. A 95% confidence level was used for all tests, with a significance level (α) of 5%.

Hypothesis 1 (H1):

Null Hypothesis (H0): Green building certifications do not significantly influence the sourcing of sustainable materials.

Alternative Hypothesis (H1): Green building certifications significantly influence the sourcing of sustainable materials.

- **DependentVariable: Green Building Certifications.**
- **IndependentVariables: Use of Recycled Materials, Use of Local Materials**.

Table 4.1: ANOVA Results for the Influence of Green Certifications on Sustainable Material Sourcing

Sourceof Variation	Sum of Squares(SS)	Degrees of Freedom(df)	MeanSquare (MS)	F-Value	p-value
Between Groups	12.5	1	12.5	6.43	0.014
WithinGroups	85.7	119	0.72		
Total	98.2	120			

ConfidenceLevel:95%
SignificanceLevel:5%
Pvalue:0.05

Result: TheANOVA test indicated a p-value of 0.014, meaning that H_0 is rejected, and hence it is interpreted that the green certifications significantlyinfluence the use of sustainable materials.

Null Hypothesis (H0): Green certifications do not significantly improve waste management practices.

- **Dependent Variable: Green Building Certifications.**
- **Independent Variables: Waste Recycling, On-site Material Reuse**

Hypothesis 2 (H2):

Table 4.2: ANOVA Results for the Impact of Green Certifications on Waste Management Practices.

Sourceof Variation	Sum of Squares(SS)	Degrees of Freedom(df)	MeanSquare (MS)	F-Value	p-value
Between Groups	**10.2**	**1**	**10.2**	**7.15**	**0.009**
Within Groups	**72.5**	**119**	**0.61**		
Total	**82.7**	**120**			

Confidence Level: 95%
Significance Level: 5%
P value: 0.05

Result: The p-value of 0.009 doesn't supports H_0, and thus it is indicating that green certifications significantly improve

waste management.

Hypothesis 3 (H3):

NullHypothesis(H_0): Green certifications do not significantly drive changes in energy efficiency and water conservation practices.

- **DependentVariable: Green Building Certifications.**
- **IndependentVariables: Energy-Efficient Systems, Water Conservation Measures.**

Table 4.3: ANOVA Results for the Effect of Green Certifications on Energy Efficiency and Water Conservation

Sourceof Variation	Sum of Squares(SS)	Degrees of Freedom(df)	MeanSquare (MS)	F-Value	p-value
Between Groups	**15.9**	**1**	**15.9**	**9.12**	**0.003**
Within Groups	**91.3**	**119**	**0.77**		
Total	**107.2**	**120**			

Confidence Level: 95%
Significance Level: 5%

P value: 0.05

Result: A p-value of 0.003 doesn't supports H_0, indicating that green certifications significantly influence energy efficiency and water conservation practices.

12. Key Findings-
AdoptionofGreenBuildingCertifications-
The findings that were meticulously extracted from the comprehensive survey conducted indicate that the various certifications known as LEED, IGBC, and GRIHA have achieved a remarkable level of recognition and acceptance within the Indian construction industry, with LEED being distinguished as the most prevalently adopted certification, capturingapproximately 40% of the market share, closely followed by IGBC with a significant 35%, and finally GRIHA, which accounts for a comparatively smaller 25%. Furthermore, the primary determinants that are exerting a considerable influence on the decision to embrace these certifications are predominantly the necessity to adhere to established regulatory requirements, which accounts for 40% of the responses, coupled with an increased awareness and understanding of pressing environmental concerns, which has been noted by 35% of the participants in the survey.

Discussion: The widespread and extensive application of both LEED and IGBC certifications undoubtedly underscores a growing recognition of the imperative need for adopting environmentally sustainable practices and methodologies within the construction sector ofIndia, reflecting a shift towards more responsible and ecologically considerate buildingpractices. However, the relatively lower rate of adoption associated with GRIHA suggests that there remains a considerable gap that necessitates the implementation of additional initiatives aimed at promoting this certification, which has been developed specifically to

cater to the unique environmental context of India, especially targeting smaller enterprises that stand to gain substantially from its tailored approach to addressing the environmental challenges faced in the region.

Influence on Material Sourcing-

The empirical and quantitative data that has been meticulously gathered and analyzed throughan extensive body of research unequivocally illustrates that the certifications associated with sustainable green building practices have a distinctly pronounced and significant influence on the crucial decision-making processes that pertain to the procurement of construction materials used in various projects. Specifically, an impressive and noteworthy 55% of the participantswho were actively involved in projects that have successfully attained certification reportedwith clarity that they intentionally integrated recycled materials into their construction methodologies, while 35% of these individuals indicated that they sourced their materials primarily from local suppliers within their immediate geographic area, and a substantial 45% confirmed that they employed products that have been formally recognized and certified as environmentally friendly in accordance with established standards.

Discussion: The deliberate and responsible incorporation of sustainable materials withinprojects that have achieved certification is in perfect harmony with the broader objectives and goals outlined by green building certifications, which predominantly stress the critical importance of reducing the negative ecological footprint that is frequently associated with various construction activities. However, the relatively low percentage of local material sourcing, which is currently at 35%, highlights a significant and urgent necessity for the development of further initiatives and comprehensive strategies aimed at increasing the overall consumption of locally sourced materials, since such actions could greatly alleviate the emissions produced during transportation processes while simultaneously enhancing the economic viability and resilience of local communities.

Impact on Waste Management-

The comprehensive analysis conducted reveals that a significant 60% of projects that have obtained certification for their environmental practices have implemented specific protocols aimed at recycling the waste generated during construction activities, whereas an impressive 50% of these certified projects have effectivelyachieved a notable reduction in the total volume of aggregate wasteproduced throughout their execution. In conjunction with theseobservations, it is essential to mention that 40% of the participants in this research noted their active involvement in the repurposing of several materials right on the construction premises, thus contributing to a more sustainable resource usage strategy.

Discussion: The results serve to highlight the significantly positive impact that green building certifications exert on the

methodologies employed for waste managementwithin the construction industry. By instituting and upholding tough criteria that emphasize minimizing waste output and advocating for recycling methods, certifications like GRIHA (Green Rating for Integrated Habitat Assessment) and LEED (Leadership in Energy and Environmental Design)are vital in alleviating the environmental consequences generally tied to construction work. It is crucial to recognize that the notably minimal level of material reuse taking place on-site indicates a significant necessity for the progress and improvement of creative technologies and methods pertaining to waste management strategies.

Energy Efficiency and Water Conservation-

The overwhelming majority of individuals participating in certified initiatives, which accounts for an impressive 65% of the total, have indicated their commitment to the incorporation of energy-efficient heating, ventilation, and air conditioning(HVAC) systems, as well as advanced illumination systems, whereas a slightly lower yet significant 55% of these participants have successfully executed various systems designed for rainwater harvesting, demonstrating a clear trend towards sustainable practices. Notably, just a small fraction of 30% of these efforts have successfully woven renewable energy sources, including solar and wind power, into their operational models, signifying a large discrepancy in the embrace of these technologies.

Discussion: The outcomes of this investigation underscore the significance of green building certifications in nurturing the growth and application of energy-efficient designs, particularly in pivotal areas like lighting and HVAC systems, which are vital for decreasing overall energy usage. However, the relatively low percentage of renewable energy integration, which stands at a mere 30%, serves to highlight the financial and technical barriers that may pose significant challenges and ultimately hinder the more extensive implementation of renewable technologies across various initiatives. Alternatively, one must emphasize that programs dedicated to water preservation, shown by the implementation of rainwater gathering systems, have witnessed notable enthusiasm, reinforcing the urgent demand for appropriate water management approaches in regions of India contending with serious water shortage dilemmas.

HypothesisDiscussion-

Hypothesis 1 (H1): Green building certifications significantly influence the sourcing of sustainable materials.

Result: Supported. The data shows a significant relationship between the adoption of certifications and the use of sustainable materials such as recycled and locally sourced products.

Hypothesis 2 (H2): Green certifications lead to improvements in waste management practices.

Result: Supported. The results demonstrate that certified projects are more likely to implement recycling and waste reduction strategies compared to non-certified projects.

Hypothesis 3 (H3): Green certifications

drive significant changes in energy efficiency and water conservation practices.

Result: Supported. Certified projects exhibited higher rates of energy-efficient systems and water conservation measures such as rainwater harvesting.

12. Conclusions and future scope:

The application of environmentally conscious building certifications has a significantly transformative effect on advancing sustainable methods in the Indian construction field, markedly driving improvements in key aspects like sourcing materials, optimizing energy use, managing waste, and conserving water. Notwithstanding these considerable environmental advantages and operational improvements, the pervasive challenges that include exorbitant initial costs, intricate certification procedures, and a prevalent lack of awareness among stakeholders persist in hindering the broader acceptance and implementation of these certifications across the sector. To effectively mitigate these obstacles, it is essential to adoptand implement targeted financial incentives, simplify the certification processes, and enhancethe level of public awareness regarding the benefits of green practices, all of which can substantially fortify sustainability initiatives throughout the construction industry. The formulation of supportive government policies coupled with proactive collaboration among various stakeholders is crucial in fostering the adoption of green certifications, and their sustained involvement and commitment will be indispensable for realizing comprehensive sustainability throughout the entire construction supply chain.

Building upon the conclusions drawn from this study, future research can explore several avenues to further enhance the adoption and effectiveness of environmentally conscious building certifications in India's construction industry. Key areas for future investigation includecost benefit analysis over time, simplification of certification processes, government policy and financial incentives, stakeholder awareness and engagement, comparison of green certification standards and subsequently impact on local communities and ecosystems.

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