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Project Stakeholders' Perceptions of Green Building Implementation in Public Market Buildings

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ABSTRACT

Green building implementation in public facilities is essential to support sustainable development, particularly in public market buildings that require adequate environmental quality, accessibility, sanitation, and user comfort. However, the success of green building implementation is not only determined by technical design and regulatory compliance, but also by project stakeholders' awareness, supporting drivers, and perceived barriers. This study aims to analyze project stakeholders' perceptions of awareness, drivers, and barriers in green building implementation using the Pasar Godean public market project in Sleman Regency, Indonesia, as a case study. A quantitative descriptive approach was applied through a structured questionnaire distributed to stakeholders involved in planning, construction, supervision, and building management. A total of 24 valid responses were obtained from five stakeholder groups and analyzed using descriptive statistics and non-parametric inferential tests with IBM SPSS Statistics version 26. The novelty of this study lies in its specific focus on stakeholder perceptions in a public market green building project under the Indonesian Bangunan Gedung Hijau (BGH) regulatory context. The results show that stakeholders had relatively good awareness, particularly regarding technical aspects of public market buildings, although formal training and certification remained limited. Financial, non-financial, and recognition-based incentives were perceived as complementary drivers. The main barriers were related to awareness and social aspects, human resources and technology, and financial-economic constraints. Therefore, green building implementation in public market projects requires not only regulatory and technical compliance, but also stronger stakeholder readiness, technical training, expert assistance, promotion, and integrated incentive schemes.

Keywords: green building, public market, project stakeholder, awareness, drivers, barriers.

INTRODUCTION

The building and construction sector has become one of the major contributors to global energy consumption, resource use, and carbon emissions, making green building implementation an important strategy for supporting sustainable development. In Indonesia, the green building concept has been institutionalized through the Bangunan Gedung Hijau (BGH) policy framework, particularly Permen PUPR No. 21 Tahun 2021 and SE Menteri PUPR No. 1 Tahun 2022, which regulate green building performance assessment across the building life cycle. The relevance of this concept is not limited to commercial and residential buildings, but also extends to public buildings such as public markets. Public markets play an important socio-economic role, yet they often face challenges related to environmental quality, sanitation, accessibility, and user comfort. Therefore, implementing green building principles in public market projects is expected not only to improve environmental performance, but also to support healthier, more comfortable, and more sustainable public facilities [1], [2], [3].

Previous studies have shown that the success of green building implementation is not determined solely by technical design or certification requirements, but also by the readiness and perception of project stakeholders. Awareness has been identified as an important factor influencing green building adoption, since limited understanding of green building concepts, technical requirements, and long-term benefits may hinder its implementation [4], [5], [6]. Studies on construction professionals and project stakeholders have found that although general awareness of green building

may exist, practical understanding of certification systems, technical features, and regulatory requirements can still vary across stakeholder groups [7], [8]. In addition, drivers such as government incentives, financial support, technical assistance, training, recognition, energy savings, environmental benefits, and improved building performance have been reported as important factors that encourage green building implementation [9], [10], [11]. On the other hand, barriers are commonly associated with high initial cost, limited funding access, certification cost, regulatory complexity, lack of incentives, limited expertise, lack of training, weak coordination among stakeholders, low market demand, and insufficient awareness [12], [13], [14].

Several studies in Indonesia have evaluated green building implementation using rating tools or regulatory-based assessment systems, including studies on public buildings, educational facilities, health facilities, office buildings, and public markets. However, many of these studies primarily focused on technical performance assessment, operational performance, or green construction evaluation. Studies on public markets have also mostly examined the implementation of green building or green construction aspects, while the specific perception of project stakeholders regarding awareness, drivers, and barriers remains limited. This indicates a research gap in understanding how project stakeholders perceive the factors that support or hinder green building implementation in public market projects, particularly in projects that have adopted the national BGH framework during the technical planning stage. This gap is important because public market projects involve multiple stakeholders, including owners, planners, contractors, construction management consultants, and local government or building managers, whose perceptions may influence implementation consistency and future improvement strategies.

Therefore, this study aims to analyze project stakeholders' perceptions of awareness, drivers, and barriers in green building implementation using the Pasar Godean public market project in Sleman Regency, Indonesia, as a case study. The study focuses on stakeholders involved in the planning, construction, supervision, and management of the project. The novelty of this study lies in its specific focus on stakeholder perception in a public market green building project under the Indonesian BGH regulatory context. The results are expected to provide insights for government agencies, project owners, construction service providers, and public market managers in strengthening stakeholder readiness and improving future green building implementation in public market development.

RESEARCH METHODS

Research Design and Case Study

This study employed a case study approach with a quantitative descriptive design to analyze project stakeholders' perceptions of green building implementation. The case study was conducted at Pasar Godean, a public market located in Sleman Regency, Special Region of Yogyakarta, Indonesia. This market was selected because it represents a public facility project that had adopted the green building concept during the technical planning stage and obtained the BGH Madya certification in 2023. The market was completed in 2024 and consists of three floors, with a total floor area of 14,988 m², a site area of 12,359 m², and a total trader capacity of 1,837 traders.

The scope of this paper is limited to three main perception variables: awareness, drivers, and barriers. These variables were selected because green building implementation in public market projects is not only influenced by technical assessment results, but also by the understanding, supporting factors, and constraints perceived by the stakeholders involved in the project. Therefore, the technical green building evaluation of Pasar Godean is used as a contextual basis to interpret stakeholder perceptions and to discuss their relationship with the implementation conditions found in the case study. The overall research flow for the stakeholder perception analysis is illustrated in Figure 1.

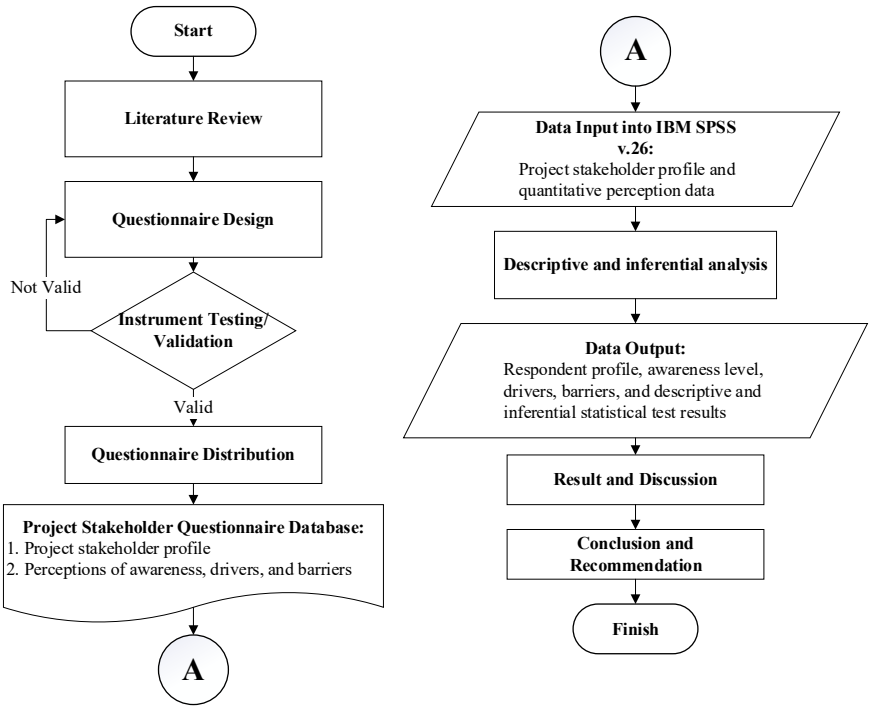


Figure 1. Research flow chart

Respondents and Data Collection

The respondents in this study were project stakeholders involved in the planning, construction, supervision, and management of the Pasar Godean project. Respondents were selected using purposive sampling, in which participants were intentionally chosen based on their direct involvement and relevance to green building implementation in the case study project. The stakeholder groups consisted of the owner, Design Consultant, contractor, Construction Management Consultant, and Building Manager/Local Government. The initial target consisted of 26 key personnel considered relevant to the implementation of green building in the project. However, 24 valid responses were obtained and analyzed in this study.

Primary data were collected using a structured questionnaire distributed online through Google Forms. This online distribution method was selected because the Pasar Godean construction project had been completed in 2024, meaning that project stakeholders were no longer mobilized at the project site on a regular basis. Therefore, online distribution was considered more practical for reaching respondents from different stakeholder groups who were already assigned to different offices, institutions, or subsequent projects. The questionnaire was distributed through the coordinator of each stakeholder group and, in some cases, directly to individual respondents. The questionnaire was designed to obtain respondent profiles and measure stakeholders' perceptions of awareness, drivers, and barriers in green building implementation.

Questionnaire Variables

The questionnaire was developed based on previous studies, green building implementation concepts, and the context of public market development. It was structured to measure three main variables: awareness, drivers, and barriers. The awareness variable was designed by adapting the structure of previous green building awareness studies, which commonly measured prior knowledge, project exposure, training participation, professional certification, understanding of green building concepts, and familiarity with rating systems or regulations [7], [8]. Previous studies also assessed awareness through stakeholders' understanding of technical green building features, perceived benefits, and implementation practices [5], [6]. In this study, the awareness indicators were adjusted to the public market context by including awareness of public market regulations, technical aspects

of market buildings, implementation stages across the project life cycle, and the perceived relevance of green building implementation. The awareness variable and indicators are summarized in Table 2.

Table 1. Awareness variable and indicators

Code	Awareness Aspect	Measured Indicators
A1 – A6	Initial awareness and exposure	Prior knowledge of green building/BGH, involvement in green building projects, participation in training/seminars, professional certification, knowledge of BGH regulations, and knowledge of public market-related regulations
A7 – A8	Basic understanding	Understanding of green building principles and public market standards/regulations
A9	Technical awareness of public market buildings	User-oriented design, natural ventilation and daylighting, temperature, odor, cleanliness and noise control, open space, accessibility, and market zoning
A10 – A11	Functional perception and control indicators	Circulation, air movement, fire mitigation, zoning, natural lighting, ventilation, and waste management
A12	Project life-cycle awareness	Green building implementation at programming, technical planning, construction, operation and maintenance, and demolition stages
A13	Relevance of green building implementation	Carbon emission reduction, energy reduction, improved user quality of life, and positive impacts on climate and natural ecosystems

A five-point Likert scale was used to quantify stakeholder perceptions. The scale was adjusted according to the type of question, including level of understanding, importance, relevance, influence, and agreement. In general, the score ranged from 1, representing the lowest perception level, to 5, representing the highest perception level. The driver variable consisted of three indicators covering financial incentives, non-financial incentives, and recognition-based incentives. These indicators were developed based on previous studies emphasizing the role of financial, non-financial, and recognition-based incentives in encouraging green building implementation [9] – [11], [15] – [18]. Meanwhile, the barriers variable consisted of five categories and 19 indicators, covering financial and economic, regulatory and policy, project management and organizational, human resources and technology, and awareness and social barriers. These indicators were synthesized from previous studies that identified financial, regulatory, managerial, human resource, technological, awareness, and social constraints as common obstacles in green building implementation [12] – [14], [19] – [21]. The driver and barrier indicators are presented in Table 3 and Table 4, respectively.

Table 2. Driver variable and indicators

Code	Indicator	References
D1	Financial incentives, such as tax reduction, permit-related fee reduction, or retribution reduction	[9] – [11], [15] – [17]
D2	Non-financial incentives, such as faster permitting process, technical assistance, and consultation	[9] – [11], [15], [16]
D3	Recognition-based incentives, such as promotion, public recognition, or awards	[9] – [11], [15], [18]

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Table 3. Barrier variable and indicators

Category	Code	Indicator	References
Financial and economic	B1 – B4	High initial cost of green products, materials, and technologies; limited funding access; additional certification cost; and uncertainty of investment return	[12] – [14], [16], [17]
Regulatory and policy	B5 – B8	Complexity of green building regulations and standards; conflicts in certification or credit selection; lack of government incentives; and absence of strategic policy for green building implementation	[12], [14], [19], [21]
Project management and organizational	B9 – B12	Lack of coordination and collaboration among stakeholders; overly ambitious green building targets; limited time for implementing green construction practices; and resistance of the construction industry to changes from conventional methods	[12], [20]
Human resources and technology	B13 – B16	Limited green building experts; low client and market demand for green building; lack of education and technical training for workers; and lack of information and benchmarking data related to green building technology	[12], [14], [19] – [21]
Awareness and social	B17 – B19	Low understanding and awareness of green building; misconception that green building always requires high initial cost; and lack of green building promotion	[13], [14], [15], [21]

Data Analysis

The questionnaire data were analyzed using IBM SPSS Statistics version 26. Before analysis, the data were coded, cleaned, and tested for instrument feasibility. Likert-scale responses were coded from 1 to 5, while categorical responses were coded numerically. Instrument feasibility was examined through content validity using expert judgement, construct validity using Corrected Item-Total Correlation (CITC), reliability using Cronbach's Alpha, and normality using the Shapiro–Wilk test because the number of stakeholder respondents was less than 50.

Descriptive statistics were used to analyze stakeholder profiles and perception patterns through frequency, percentage, mean, standard deviation, and ranking. The mean score was used to determine the tendency of stakeholder perceptions toward awareness, drivers, and barriers, while the standard deviation was used to observe the variation of responses among stakeholders. Since the data were ordinal and not all variables met the normality assumption, non-parametric inferential statistics were applied. Fisher's Exact Test was used to examine the relationship between selected categorical awareness indicators. Kendall's W was used to assess the level of agreement among stakeholder groups in ranking awareness-related indicators. Kruskal–Wallis test was used to examine whether there were significant differences in awareness levels among stakeholder groups and respondent background characteristics. The statistical tests were interpreted using a significance level of 0.05.

RESULT AND DISCUSSION

Respondent Profile and Instrument Feasibility

The survey obtained 24 valid responses from 26 targeted project stakeholders, resulting in a response rate of 92.31%. The respondents represented five groups involved in the Pasar Godean project, namely Owner, Design Consultant, Contractor, Construction Management Consultant, and Building Manager/Local Government, as shown in Figure 2. Most respondents had relevant professional backgrounds, with 45.8% holding postgraduate qualifications, 41.7% having 8–15 years of building

project experience, and 83.3% commonly handling non-simple building projects. This indicates that the collected perceptions were provided by respondents with sufficient experience and relevance to green building implementation.

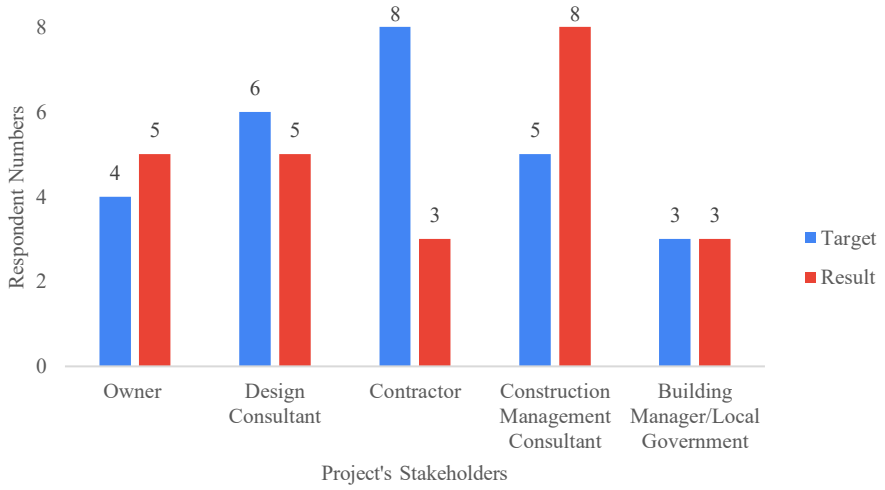


Figure 2. Distribution of project stakeholder respondents

The questionnaire was considered feasible for further analysis. The awareness, drivers, and barriers variables showed acceptable validity, with CITC values of 0.377–0.831, 0.560–0.716, and 0.177–0.685, respectively. The reliability results also indicated good internal consistency, with Cronbach's Alpha values of 0.936, 0.861, and 0.893. Since the data were based on Likert-scale responses and involved a limited number of stakeholders, non-parametric tests were used in the subsequent inferential analysis.

Project Stakeholders' Awareness of Green Building Implementation

Overall, project stakeholders showed a relatively high initial awareness of green building implementation in the Pasar Godean project. As shown in Table 4, most respondents had heard of the green building or BGH concept and had been directly involved in projects applying the concept. However, this awareness appears to be shaped more by project experience than by formal capacity development, as participation in green building training and professional certification was still limited.

From the regulatory aspect, most respondents were already familiar with green building and public market-related regulations, although this understanding was stronger among stakeholders involved in decision-making, design, and management than among field implementation actors. This finding is consistent with previous studies indicating that green building awareness is often present among construction stakeholders, but is not always followed by adequate training, certification, or deep understanding of rating systems and regulatory requirements [5], [6].

Table 4. Initial awareness and exposure of project stakeholders

Code	Awareness Indicator	Answer (%)	
		Yes	No
A1	Heard of green building/BGH concept	95.8	4.2
A2	Previously involved in green building/BGH projects	75.0	25.0
A3	Attended green building/BGH training, seminar, or workshop	50.0	50.0
A4	Had green building/BGH professional certification	20.8	79.2
A5	Knew green building/BGH regulations	83.3	16.7
A6	Knew public market-related regulations	79.2	20.8

The basic understanding scores also support this pattern. The mean score for understanding green building concepts was 3.58, while the mean score for understanding related regulations was 3.63,

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indicating that stakeholders were generally in the moderate-to-good understanding category. Beyond this basic understanding, stakeholders showed stronger awareness when green building was linked to practical and visible aspects of public market buildings. As shown in Figure 3, the highest mean score was found in technical aspects of public market buildings, followed by circulation and safety principles, project life-cycle implementation stages, and the relevance of green building implementation. This suggests that stakeholders understood green building most clearly through aspects directly related to market building performance, such as natural ventilation, daylighting, circulation, zoning, accessibility, cleanliness, safety, and environmental quality. Similar findings were also reported in previous studies, where stakeholder awareness tended to be stronger for technical features that were directly observable in buildings, including lighting, ventilation, energy efficiency, accessibility, and indoor or physical environmental quality [7], [8], [14].

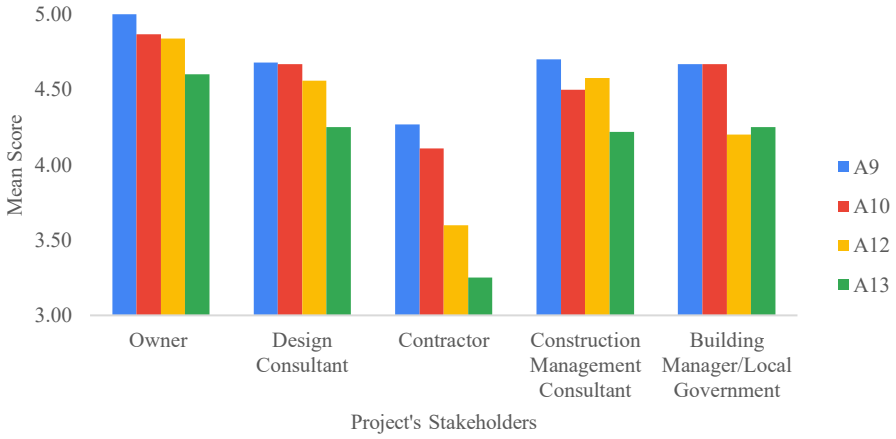


Figure 3. Mean score of stakeholder awareness aspects

The control question results show that stakeholder awareness was strongest when green building principles were linked to practical and operational aspects of public market buildings. As shown in Figure 4, the highest agreement was found in A11c, which refers to the role of natural ventilation in maintaining comfort and air quality, and A11d, which refers to waste sorting from the source, with both items reaching 95.8% agreement. Meanwhile, the lower agreement on A11a and A11b indicates that zoning was still partly perceived as a trading location arrangement, and daylighting or natural ventilation was still partly associated with electricity savings, rather than being fully understood as part of environmental management, user health, and overall building quality.

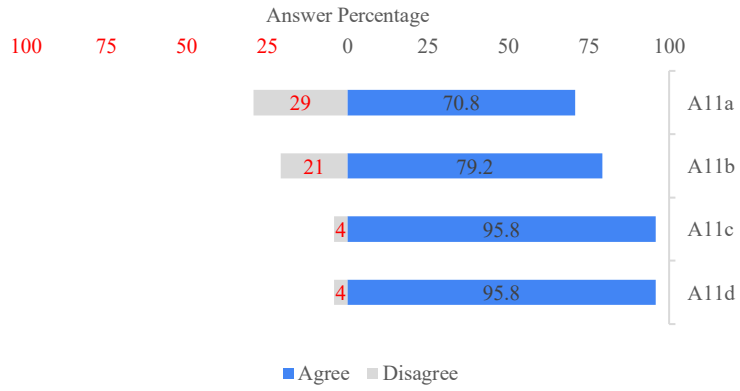


Figure 4. Percentage of responses to control questions

The inferential analysis supports this interpretation. Fisher's Exact Test indicated that respondents who had attended green building-related training, seminars, or workshops had a higher proportion of good understanding than those who had not, at 91.7% compared with 50.0%, although the relationship was not statistically significant at the 5% level ($p = 0.069$). Certification ownership also did not show a meaningful relationship with understanding level ($p = 1.000$), suggesting that awareness was not determined solely by formal certification. Kendall's W results showed significant but weak agreement across awareness indicators, with W values ranging from 0.130 to 0.250 and p-values below 0.05, while the Kruskal–Wallis test showed no significant difference in awareness levels across stakeholder groups ($p = 0.097$). These findings indicate that stakeholder awareness was generally strong and relatively shared across groups, but differences such as the lower contractor scores should be interpreted as descriptive tendencies rather than statistically confirmed differences.

Project's Stakeholders' Perception of Drivers

Project stakeholders generally perceived all forms of incentives as influential drivers for encouraging green building implementation in the Pasar Godean project. As shown in Figure 5, financial incentives and non-financial incentives received the same highest mean score (D1 = 3.96; D2 = 3.96), followed closely by recognition-based incentives (D3 = 3.87). This indicates that stakeholders did not rely on a single dominant incentive, but viewed green building implementation as requiring a combination of economic support, administrative or technical facilitation, and institutional recognition. The mean comparison also shows that Owner, Design Consultant, and Building Manager/Local Government tended to rate financial and non-financial incentives more highly, while Contractor and Construction Management Consultant gave relatively higher emphasis to non-financial and recognition-based incentives.

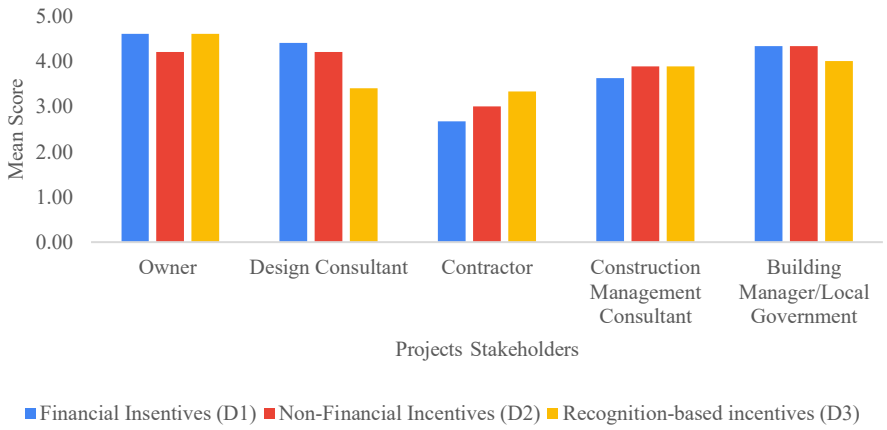


Figure 5. Mean score of perceived drivers among projects stakeholder groups

The inferential results support this interpretation. Spearman correlation showed a very strong and significant positive relationship between awareness and perceived drivers ($\rho = 0.763$; $p < 0.01$), indicating that stakeholders with stronger awareness tended to perceive incentives as more important in supporting green building implementation. However, Kendall's W showed no consistent priority pattern among the three incentive types ($W = 0.014$; $p = 0.717$), and the Kruskal–Wallis test showed no significant difference in drivers' perception among stakeholder groups ($p = 0.071$). These results suggest that financial, non-financial, and recognition-based incentives were perceived as complementary rather than competing drivers. This finding is consistent with previous studies showing that green building adoption requires a combination of incentives, such as tax reduction, faster permitting, technical assistance, promotion, and public recognition, rather than relying only on financial support [9] – [11], [15] – [18].

Project's Stakeholders' Perception of Barriers

The barriers perceived by project stakeholders show that the main challenges in implementing green building in a public market project were related more to stakeholder readiness and the broader

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implementation ecosystem than to internal project management. As shown in Figure 6, the highest barrier category was awareness and social barriers, followed by human resources and technology, and financial and economic barriers. These results indicate that green building implementation was mainly constrained by limited awareness, technical capacity, market readiness, and cost-related concerns. This interpretation is supported by the mean scores of awareness and social barriers (3.67), human resources and technology barriers (3.57), and financial and economic barriers (3.47), while project management and organizational barriers had the lowest mean score (3.03).

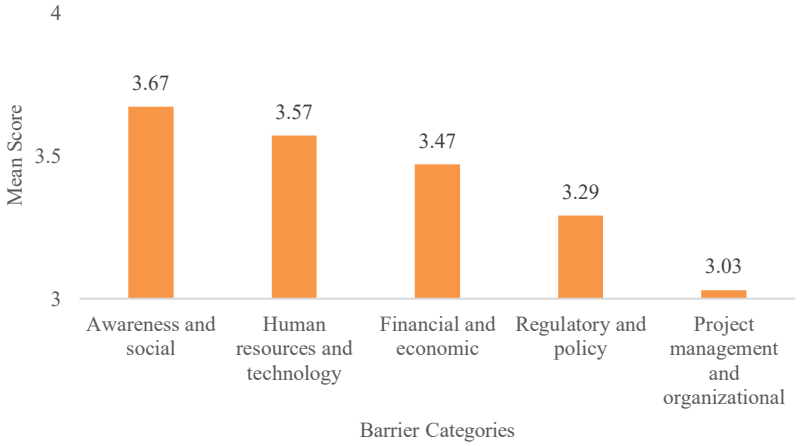


Figure 6. Mean score of barriers categories

At the indicator level, the dominant barriers formed a consistent pattern: high initial cost, limited expertise, lack of training, low market demand, and limited awareness. As summarized in Table 5, the highest-ranked barriers were high initial cost of green products, materials, and technologies (B1 = 3.92), limited green building experts (B13 = 3.83), lack of education and technical training for workers (B15 = 3.75), low client and market demand for green building (B14 = 3.75), and low understanding and awareness of green building (B17 = 3.71). In contrast, the lowest-ranked barriers were lack of coordination and collaboration among stakeholders (B9), overly ambitious green building targets (B10), and limited time for implementing green construction practices (B11). This suggests that stakeholders did not perceive internal coordination or project targets as the main obstacles in this case; instead, the challenges were more strongly associated with cost sensitivity, capacity building, market demand, and awareness.

Table 5. Overall dominant and lowest perceived barriers indicators

Code	Indicator	Mean Score	Rank
B1	High initial cost of green products, materials, and technologies	3.92	1
B13	Limited green building experts	3.83	2
B15	Lack of education and technical training for workers	3.75	3
B14	Low client and market demand for green building	3.75	4
B17	Low understanding and awareness of green building	3.71	5
B11	Limited time for implementing green construction practices	2.96	17
B10	Overly ambitious green building targets	2.92	18
B9	Lack of coordination and collaboration among stakeholders	2.67	19

The comparison among stakeholder groups also shows that each group emphasized barriers that were closely related to its role in the project. Owner, Design Consultant, and Contractor consistently placed high initial cost (B1) as the main barrier, while the Construction Management Consultant emphasized the lack of technical education and training (B15), and Building Manager/Local Government emphasized the misconception that green building always requires higher initial cost (B18). Nevertheless, the Kruskal–Wallis test showed that the differences among stakeholder groups were not statistically significant for all barrier indicators, as all p-values were above 0.05. Therefore, these variations should be interpreted as descriptive tendencies rather than statistically confirmed differences.

These findings are consistent with previous studies that identified high initial cost, limited green building experts, lack of technical training, low market demand, regulatory complexity, and limited awareness as major barriers to green building implementation [12] – [14], [19], [21]. However, the findings also differ from studies that emphasized poor coordination, weak collaboration, or project management resistance as major obstacles [12], [20]. In the Pasar Godean case, coordination among stakeholders was not perceived as a dominant barrier, suggesting that the main challenge was not the project organization itself, but the readiness of human resources, technical knowledge, market support, and incentive mechanisms required to sustain green building implementation.

Synthesis of Project's Stakeholders Perceptions

The overall findings indicate that project stakeholders had a relatively strong awareness of green building implementation, particularly when the concept was connected to practical and visible aspects of public market buildings. However, this awareness was not fully supported by formal capacity development, as training participation and professional certification remained limited. This condition suggests that stakeholder understanding was formed largely through project exposure and practical experience rather than structured competency development.

The drivers and barriers result further show that improving green building implementation in public market projects requires a combination of support mechanisms. Stakeholders perceived financial, non-financial, and recognition-based incentives as complementary drivers, while the main barriers were related to awareness and social aspects, human resources and technology, and financial-economic constraints. Therefore, strengthening green building implementation should not rely only on regulatory compliance or technical design requirements, but also on capacity building, technical assistance, expert support, promotion, and incentive schemes that can reduce cost-related concerns and improve stakeholder readiness.

CONCLUSION

This study shows that project stakeholders had a relatively good level of awareness and understanding of green building implementation in the Pasar Godean public market project, particularly when the concept was related to technical aspects of public market buildings. However, this awareness was not fully supported by formal capacity development, as training participation and professional certification remained limited. Stakeholders perceived financial, non-financial, and recognition-based incentives as complementary drivers, while the main barriers were related to awareness and social aspects, human resources and technology, and financial-economic constraints, particularly high initial cost, limited green building experts, lack of technical training, low market demand, and limited awareness. Therefore, green building implementation in public market projects should not rely only on regulatory compliance and technical design requirements, but also on strengthening stakeholder readiness through technical training, expert assistance, promotion, and integrated incentive schemes. Since this study was limited to a single case study with a relatively small number of stakeholder respondents and perception-based data collected after project completion, the findings should be interpreted contextually rather than generalized to all green building projects. Future studies may examine broader public market projects and further link stakeholder perceptions with technical implementation performance and building operation outcomes.

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