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Review Article

Green Construction and Local Wisdom Integration for Sustainability: A Systematic Literature Review

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Abstract

The construction industry's environmental impact necessitates a sustainable shift to mitigate resource depletion, emissions, and biodiversity loss. Integrating local wisdom offers innovative, adaptive solutions grounded in deep environmental understanding, potentially transforming construction practices toward sustainability. This study aims to identify aspects, challenges, impacts, and strategies in green construction practices integrated with local wisdom. The PRISMA framework methodology was used to conduct a comprehensive systematic review with qualitative analysis using NVivo software. Nine aspects of green construction integrated with local wisdom were identified, with cultural heritage preservation the dominant aspect. Eleven challenges were uncovered, with balancing tradition and innovation as the main challenges. Seven impacts on the economy, society, and environment were identified, with construction cost efficiency, improvement of community quality of life, and promotion of a circular economy and sustainable waste management as the dominant impacts. Thirteen strategies were identified, with active engagement of local communities in the construction process as the main strategy. The novelty of this research is a comprehensive review of the integration of green construction with local wisdom, which can be used as a guide in sustainable construction practices responsive to local environmental and social conditions and promote economically, socially, and environmentally sustainable development.

Keywords: Green Construction; Local Wisdom; Sustainability; Systematic Literature Review.

1. Introduction

One of the most dominant and risky industrial sectors is construction, which plays a key role in any country's social, economic, and environmental integrity [1]. Major global ecological problems have been identified during the development of the construction industry [2, 3]. The construction industry also contributes to the depletion of natural resources, climate change, and land, water, and air pollution [4]. The construction industry is globally recognized as a major contributor to 5.7 billion tons of greenhouse gas emissions [5], and building units consume approximately 40% of global energy [6]. On average, results from construction activities emit 30% of CO_2 emissions leading to climate change, use 17% of clean water, consume 25% of wood and other raw materials at 40-50%, and use energy at 20-40% [7-9]. The negative effects associated with construction processes and activities involve using over 30% natural

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resources for raw materials that go into the construction process itself, 25% clean water, and generating 30% global waste [10, 11]. Project implementation, including the procurement phase, mobilization, or deployment stage construction, can be a source of GHG emissions [12]. Carbon emissions during different construction phases indicate that the global construction industry and related fields contribute to approximately 70% of the greenhouse effect produced by building material production through construction and building occupancy [13].

The concept of green construction has recently gained prominence due to the growing adoption of sustainable building practices. This new paradigm is motivated by reducing the waste of natural resources and energy and minimizing the negative environmental impacts [14]. The growing popularity of this concept indicates that not all stakeholders in the construction industry possess a comprehensive understanding of green construction. One bottleneck is that contractors may not have sufficient knowledge, especially regarding green construction; thus, effective implementation is complex [15]. Furthermore, the accomplishment of green construction faces many challenges, including a lack of awareness and knowledge of these emerging methodologies, regulatory and policy roadblocks concerning conventional practices, and technical limitations coupled with social barriers [16-20]. Overall, green construction has become increasingly important in the construction industry and is associated with efforts aimed at integrating sustainable practices at every stage of a project's lifecycle. Hence, initiatives are required at the contractor's level to fully realize the minimal benefits of green construction. Awareness and knowledge need to be developed among professionals, along with appropriate policies and standards that can overcome these barriers [21].

Local wisdom, as a heritage of knowledge developed through human interaction with the environment, provides sustainable solutions that are adaptive to addressing regional environmental issues. The richness and diversity of traditional knowledge on green building make local wisdom central in achieving the sustainability of the built environment [22, 23]. However, the integration of local wisdom into modern construction practices faces challenges, especially as the construction industry's focus on technological innovation and green material supply chains tends to ignore local knowledge [24]. Although local wisdom has a deep understanding of ecological balance and sustainability, the current emphasis on technology and innovation has not fully utilized this wealth of traditional knowledge [22, 23]. Therefore, a bridge is needed to enable traditional and modern practices to work together, ensuring the effective preservation and utilization of local wisdom [25]. Thus, holistic sustainability in the built environment can be achieved by integrating local wisdom and modern construction techniques, creating an approach that values cultural heritage and technological advances in achieving sustainable development.

Based on a systematic review of previous research, some significant key findings exist in the green construction domain. The bibliometric review revealed the findings of four main research streams identified, namely alternative materials for sustainable construction, sustainable construction management, recycling and waste reduction, and social sustainability in construction management, with the results of social sustainability as the weakest dimension and alternative materials as the forefront of research. This means that most of the research in sustainable construction focuses more on innovation and development of more environmentally friendly and sustainable construction materials, indicating that the research focus requires further research, particularly in understanding and integrating the social dimension in sustainable construction practices [26].

Another systematic review on green construction revealed several findings; the aspects of construction management identified include supply chain management, time management, cost management, risk management, and non-conventional construction paradigms such as off-site construction [27]. The main challenges in green construction practices include high initial costs, lack of green technology suppliers, and limited information. Green construction's impact on sustainability includes reducing greenhouse gas emissions, energy efficiency, and waste reduction. Strategies identified include Building Information Modelling (BIM), Internet of Things (IoT), and 3D printing. It was found that developed countries focus more on technology development and risk management. In contrast, developing countries face greater challenges in terms of cost and regulation and a lack of support for green technology adoption.

An analysis of responsible procurement in the UK architecture, civil engineering, and green construction sectors identified key opportunities for stakeholder value, improved supply chain performance, and competitive advantage [28]. Challenges were also reviewed, including high start-up costs, resistance to change, and lack of knowledge. This research focused on the UK context as a developed country but also touched on the differences in challenges between developed and developing countries, with developing countries facing greater demand and government support barriers.

Another study showed that a contractor's green construction capability significantly influences construction's environmental, social, and economic aspects [19]. A review of the main barriers to implementation includes financial pressure, lack of access to green technologies, and organizational resistance. Impacts include reduced energy consumption and waste, improved worker safety, and increased company competitiveness. Strategies involved government support, stakeholder collaboration, and the development of internal contractor capabilities. The research identified that the adoption and implementation rate of green construction is more prevalent in developed countries than in developing ones, as developed countries have greater access to advanced technologies and environmentally friendly materials. In contrast, high implementation costs, lack of regulatory support, and limited access to green technologies and materials are the main barriers in developing countries.

Meanwhile, there is research analyzing the main barriers to implementing sustainable construction in developing countries through a systematic review of the literature using the PRISMA method [29]. The main findings revealed four barrier themes: training and education of construction professionals, client attitudes and awareness, construction industry culture and capacity, and government regulations, policies, and economics. Specific barriers identified include lack of training and education among construction professionals, weak application of sustainability ethics, unsupportive public attitudes, low awareness and understanding, lack of accurate data and integrated studies, and inappropriate prioritization of sustainability.

A previous study examined green supply chain management practices in the construction industry through a systematic literature review and the development of a performance evaluation model using the Fuzzy Analytical Hierarchy Process (FAHP), where the main findings identified five categories of green design, green purchasing, green transport, green construction, and end-of-life management [30]. The four main performance evaluation criteria identified were environmental, organizational, economic, and social sustainability. Meanwhile, another study related to green supply chain management proposed a future research agenda that emphasizes the need for an end-to-end perspective in the construction supply chain, more in-depth engagement with the unique nature of the industry, focus on the ultimate goal of environmental sustainability, development of more comprehensive practical guidance, utilization of insights from relevant theoretical perspectives such as innovation theory and resource-based views, and expansion of the research scope to include critical viewpoints on the concept of green supply chain management in construction [31].

Another study presents a systematic review of green construction using Building Information Modeling (BIM). The analysis revealed a key focus on four aspects, including project quality improvement, lifecycle data storage and management, collaboration optimization, and schedule planning and management [16]. BIM was shown to make important contributions in the green pre-construction, construction, and post-construction phases. This research also identified several implementation challenges, such as non-uniformity of data formats, insufficient interactivity, and hesitancy to adopt new technologies. There is a previous systematic review of the integration between lean construction, Building Information Modelling (BIM), and sustainability in the construction industry [32]. This analysis revealed strong synergies between the three concepts, especially at the design and construction stages. Key findings show that the integration improves project efficiency, reduces environmental impact, and optimizes resource use.

A systematic review of the literature on sustainability in construction projects revealed three main research streams, including sustainability evaluation, project management for sustainability, and drivers of sustainable construction [33]. The analysis revealed that the construction industry lacks a comprehensive, standardized sustainability evaluation system. It was found that the drivers of sustainable construction include regulations, stakeholder demands, technological innovation, and organizational capabilities. The findings emphasize the need to develop an integrated evaluation framework, better understand stakeholder motivations, and integrate sustainability into existing project management standards. The main findings of another systematic literature review study revealed eight critical success factors for sustainable construction consisting of energy efficiency, use of recycled materials, construction waste management, effective legal and policy frameworks, environmentally friendly and economical design, long-term costs, awareness, and efficient use of resources [34]. Key challenges include a lack of awareness, high initial costs, and limited expertise.

Although these studies provide valuable insights into green and sustainable construction, such as construction management aspects, challenges, barriers, impacts, strategies, and performance evaluation, there are significant gaps in the existing literature. No previous research describes a comprehensive overview of green construction integrated with local wisdom. Specifically, there has been a lack of in-depth exploration into how the aspects, challenges, impacts, and strategies of green construction practices can be influenced and enriched by incorporating local wisdom. The present study aims to address this research gap by conducting a systematic literature review on integrating green construction and local wisdom for sustainability. The primary objectives of this review are to identify aspects of green construction that are integrated with local wisdom, identify the challenges encountered in this integration, identify the economic, social, and environmental impacts of such integrated approaches, and explore effective strategies for implementing green construction practices that incorporate local wisdom. By synthesizing findings from diverse studies, this review provides a comprehensive understanding of how the synergy between modern green construction techniques and traditional knowledge can contribute to more sustainable and culturally appropriate built environments.

This research is divided into seven sections: section 1 discusses the background and reviews previous research related to green and sustainable construction, section 2 explains the related literature review, section 3 discusses the research methodology, including the explanation of the four questions and SLR steps, section 4 explains the research results about overview, aspects, challenges, impacts, and strategies, section 5 contains a discussion about the results obtained, section 6 explains the conclusions, section 7 explains the limitations and recommendations for future research.

2. Literature Review

2.1. Integration of Green Construction and Local Wisdom for Sustainable Development

Green construction and adaptive local wisdom support the achievement of sustainability. Green construction aims to limit environmental impacts by maximizing energy efficiency, minimizing the use of recycled materials, and improving waste management [35]. On the other hand, different communities have developed local knowledge and practices to interact with their environment using what nature offers. However, this material has been passed down across generations [35]. In this way, adding local wisdom to green construction creates a solution that fits these conditions. The construction industry increasingly recognizes the importance of sustainability standards and certifications (including LEED) that can be used to support environmental considerations [38, 39]. Initiatives such as the Green Construction Site Index (GCSI) offer a set of guidelines that help to rate the environmental performance associated with construction project duties [36-38]; however, preferring eco-friendly materials and sustainable procurement practices is also crucial for advancing the overall success of projects [40-42]. However, local wisdom-based green construction can achieve environmental and cultural sustainability by harmoniously integrating traditional practices with modern technology [35].

2.2. Green Construction Principles

Green construction is guided by several principles meant to limit negative environmental impacts and enhance, or at least not go against, human life quality. These principles include energy efficiency through intelligent building design and energy-saving technologies, using sustainable materials such as recycled or recyclable products with low-carbon footprints, efficient waste management by minimizing construction wastes while maximizing recycling, and water conservation practices using rainwater collection systems [43]. Incorporating these periods, green construction is environmentally friendly and has proven cost-effective in the long run by increasing operational efficiency and reducing building maintenance expenditures [41, 43]. In our demanding world, the building sector has started taking a more holistic approach to environmental issues as eco-certified buildings are becoming mainstream [44, 45]. Construction waste management is one of the main focuses, and various sustainable waste management strategies have been developed to address downstream waste [46, 47]. Additionally, circular economy principles draw attention to low waste generation and reuse, focusing on recycling materials or using them repeatedly as much as possible with a small amount of use for resources [48, 49].

2.3. The Role of Local Wisdom in Green Construction

Local wisdom plays a significant role in creating green constructions by providing solutions to local conditions [50]. Local traditional materials are used to diminish the carbon footprints of material transport, and in many cases, inherited construction techniques have been passed down through generations for centuries, enduring because they remain efficient, resilient, and adaptive to local climatic conditions [50]. Sustainability is also supported by using natural resources wisely, such as bamboo or fast-growing wood [50]. Through integration with local wisdom, green construction is tailored to different regions' needs and practical aspects, making it more contextually relevant and effective in each location by preserving influential traditional culture and knowledge [50]. Local wisdom also ensures safe coping mechanisms against climate change and disaster risks by accessing the adaptation potential of local communities, in which traditional practices enhance their resilience [51]. Local wisdom is the basis for settlement planning to create sustainable built environments while maintaining cultural harmony [52]. Moreover, adaptation to climate change requires a comprehensive and community-driven approach that considers socio-psychological dimensions [53].

2.4. Implementation of Green Construction Integrated with Local Wisdom

Traditional houses that use natural materials are designed to adjust to the local climate, for example, stilt houses in flooded areas or high-roof houses in a hot area for good ventilation. Traditional housing, which utilizes natural materials, is closely tied to its environment but often faces challenges due to the disconnect between stakeholders, planning, labor, and the permanence of the structure amidst societal transition patterns. Traditional techniques and materials, such as rammed earth or clay bricks, are also starting to be used in modern construction projects, whereas conventional elements adapted to green technology can be part of urban design [54]. Environmental consciousness in the construction industry is informed by local wisdom derived from cultural knowledge of sustainable natural resource management. Modern architecture, through construction projects such as these and adopting local wisdom, reinforces environmental sustainability while enriching cultural identity at the same time [55]. In architectural design, the resurgence of local wisdom represents a move towards greater cultural sensitivity among architects as they study traditional styles and look for ways in which ancient patterns can be incorporated into contemporary construction [56]. Moreover, the role of local communities in maintaining and transmitting traditional wisdom significantly contributes to maintaining sustainability as an adaptive option in modern circumstances [57].

2.5. Benefits of Green Construction Integrated with Local Wisdom

Green construction adoption based on local wisdom makes many significant contributions; it utilizes natural materials and friendly environment-building techniques to reduce the negative impacts on ecology; it offers economic benefits both in initial and long-term costs through energy efficiency and an extended building life-cycle, along with social advantages for residents, as eco-friendly buildings promote healthier and more comfortable living environments [58, 59]. They also promote conserving traditional culture and knowledge, enhancing local community development, increasing property value, and reducing dependence on non-renewable resources [60, 61]. Adopting local wisdom practices to mitigate social disputes and promote environmental education has also proven successful through appropriate educational materials [62]. Green construction integrated with local wisdom is the first step toward sustainable and harmonious development.

2.6. New Methods in Green Construction

A significant new method in the field of Green Construction is the Pearl Rating System (PRS), which was developed as part of the Estidama program in Abu Dhabi. PRS is a comprehensive and integrated sustainability rating system that covers environmental, economic, social, and cultural aspects. PRS uses seven main assessment categories: integrated development, natural systems, livable buildings, water conservation, energy efficiency, material management, and innovation. The Urban Planning Council conducts a phased design, construction, and operation review to ensure compliance with Estidama standards. The strength of PRS is its ability to integrate local cultural values and climate conditions into green building standards. The implementation of PRS has successfully driven the transformation of conventional construction practices towards green construction in Abu Dhabi in a short period. This model has the potential to be applied in other developing countries with adjustments to the local context. The key to success is government policy support, stakeholder engagement, and capacity building of local resources [63].

Another new method uses software-based thermal and daylighting performance analyses to evaluate traditional building designs. Technically, this method uses design builder software to simulate the thermal performance of buildings during the hottest and coldest weeks of the year and Revit software for daylighting analysis. The implementation involved modeling building details, including materials, orientation, and space configuration, and then running simulations to obtain temperature and lighting data. The challenge was ensuring input data accuracy on traditional materials and local microclimate conditions. This method could be applied in other developing countries to evaluate and optimize the design of vernacular buildings. The advantage is the ability to quantify the performance of traditional buildings so that sustainable design principles can be identified and adapted to modern buildings. However, customization to the local climatic and cultural context is required. Its application also involves capacity building of local resources using simulation software. Despite these challenges, this approach systematically integrates local wisdom with modern technology to achieve more sustainable construction [64].

3. Research Methodology

3.1. Research Questions

The main goal of this research is to examine how green construction practices are integrated with local wisdom. This research aims to identify aspects of green construction that integrate local wisdom, identify the challenges faced, determine their impacts on the economy, society, and environment, and determine the strategies used in its implementation. This objective is broken down into four research questions (RQs), each with its rationale, as described in Table 1.

Table 1. Research questions

ID	Question	Rationale
RQ1	What are the aspects of green construction integrated with local wisdom?	To explore how traditional practices and local wisdom can be applied in modern sustainable construction, thus uncovering unique ways in which local wisdom can support and enhance the effectiveness of green construction initiatives.
RQ2	What are the challenges in implementing green construction integrated with local wisdom?	To understand the barriers that may arise, whether technical, economic, or social, when synergizing traditional practices with modern construction technologies and methods to offer potential solutions and recommendations for overcoming these barriers to achieve sustainability.
RQ3	How do implementing green construction practices integrated with local wisdom impact economic, social, and environmental sustainability?	To determine the benefits of this approach in the three main dimensions of sustainability, it will help measure its effectiveness and relevance and provide a basis for better policy recommendations.
RQ4	What are the strategies for implementing green construction integrated with local wisdom?	To develop practical guidance that can be used by construction professionals, policymakers, and local communities to apply the approach and contribute significantly to facilitating the broader adoption of locally integrated green construction practices, which in turn can support sustainable development goals.

3.2. Steps for the SLR Methodology

This systematic literature review used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework. The SLR methodology used in this study involves the following four steps:

- ***Search Technique***

The search technique for this systematic literature review involved a comprehensive approach to identifying all relevant studies [65]. A comprehensive literature search will be conducted using various academic databases, such as Scopus, Web of Science, ScienceDirect, Emerald, Proquest, Taylor and Francis. A search string with the following keywords will be used: ("green construction" OR "sustainable construction") AND ("local wisdom" OR "indigenous knowledge") AND ("sustainability" OR "sustainable development"). The database is extended for all queries through, at present, 2024.

- ***Search Criteria***

The PRISMA framework was used as the search criterion [65]. The search criteria for this systematic review were carefully determined to ensure the inclusion of relevant, high-quality studies. The search mainly focused on mapping the published literature on green construction, local wisdom, sustainability, aspects, challenges, and strategies. Articles from irrelevant sources were excluded. This systematic approach helped to narrow the initial search results to the most relevant studies for review. The PRISMA flowchart illustrates this process, showing that of the initial 1,044 records identified, 932 were excluded after filtering based on inclusion criteria, as shown in Figure 1.

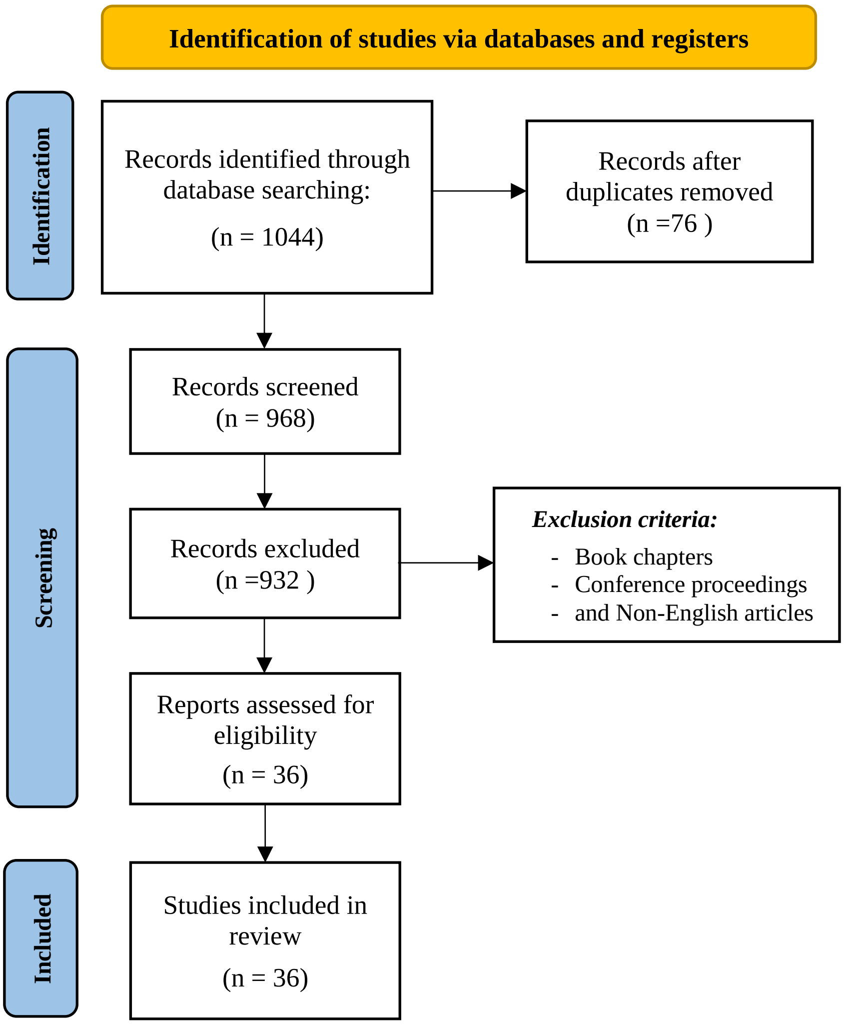

Figure 1. PRISMA Flow Diagram

- ***Quality Assessment***

The methodological quality of the included studies was assessed using a quality assessment checklist. This evaluation will look at the clarity of research objectives, appropriateness, and validity of the methodology for answering those questions, as well as integrity in data collection/analysis, to name a few. It aims to prevent the omission of any given study and guarantees that only high-quality studies are included in the final synthesis. This is an important step in preserving the trustworthiness and transferability of the results provided by systematic reviews. By implementing this quality assessment process, we aim to generate high-quality evidence that can guide future research and practices in green construction integrated with local wisdom for sustainability. The inclusion criteria will include research articles in English, whereas the exclusion criteria will include book chapters, conference proceedings and non-English articles. The search results were then filtered based on predefined criteria, including a review of titles, abstracts, and full texts. The detailed data selection process is illustrated in Figure 1.

- ***Data Extraction***

Data extraction information was systematically collected from the studies (methods, results, and conclusions) using NVivo software to facilitate systematic extraction and coding [66]. In the process, a set of codes representing the main ideas and topics of the subject matter on which the research was based was obtained. The codes were grouped into a hierarchy to facilitate detailed thematic analysis. Data were extracted from the articles and analyzed using quantitative or qualitative methods. As the codification framework was designed, these in-depth analyses revealed patterns and relationships that led to substantial findings in the research area. The literature collected in this study will be thoroughly examined and synthesized to draw out key themes, trends, and gaps in the literature related to green construction integrating local wisdom toward sustainability. A total number of 36 articles were chosen for this review study. The selected papers come from journal articles; the papers published between 2005 and 2024 are in English and cover various topics, including green construction integrated with local wisdom and sustainability.

The PRISMA flowchart illustrates the structured process for selecting studies for systematic review. Starting with the identification of 1,044 records through various academic databases, i.e., Emerald (186), Proquest (171), ScienceDirect (39), Scopus (264), Taylor & Francis (250), and Web of Science (134), the process continued with the removal of 76 duplicate records, leaving 968 records. After screening based on the inclusion criteria, 932 records were excluded, leaving 36 for further analysis. All 36 recordings were successfully obtained and assessed for feasibility, resulting in 36 studies that met all inclusion criteria and were included in the review. This diagram simplifies the understanding of the selection process and emphasizes the importance of transparency and consistent methodology in conducting systematic reviews.

4. Results

From the initial pool of 1044 studies, the SLR identified 36 papers based on their significant contributions to the subject. In this section, we provide a synthesis of the outcomes and results derived from the analysis of these primary studies.

4.1. Overview

This section provides a comprehensive review of these studies, including an examination of the year of publication, country of study, and the number of publications in each country category in the domain of green construction integrated with local wisdom. The literature review covers key studies published up to 2024, providing a comprehensive picture of green construction integrated with local knowledge. The number of articles varied significantly across the years reviewed, with a relatively low and stable number from 2005 to 2012, followed by fluctuations with no consistent trend between 2013 and 2020, as shown in Figure 2. There is a sharp spike in 2021, with the number of articles peaking in 2023. A spike in 2021 could indicate an increase in interest or publications on the topic under review. Green construction practices are becoming very important for implementation in the construction industry and are supported by local wisdom to increase the effectiveness of construction initiatives and achieve sustainable development.

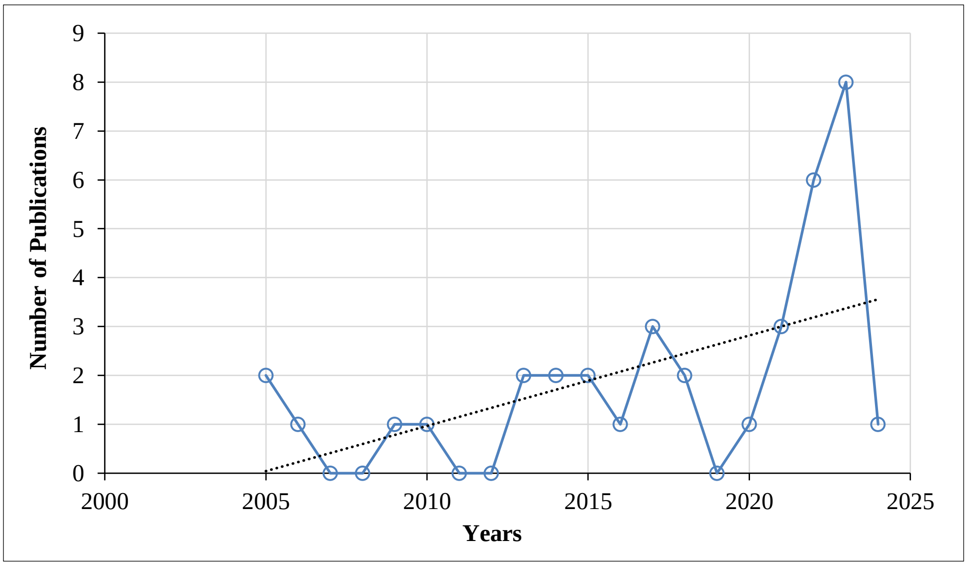

Figure 2. Number of publications per year

The present analysis spans a diverse range of countries. China leads with six reported cases, followed by Indonesia and Saudi Arabia with three instances, and India, Finland, and Egypt with two cases. Other notable cases include Zambia, the United States, Hong Kong, Mozambique, Portugal, New Zealand, Nigeria, United Arab Emirates, Bhutan, Kosovo, Oman, Mexico, Italy, Iran, Kenya, South Korea, Australia, and Jordan, each reporting one case. This diversity underscores integrating green construction with local wisdom in different regions. It emphasizes the importance of local wisdom as an enabler of sustainable development, as shown in Figure 3.

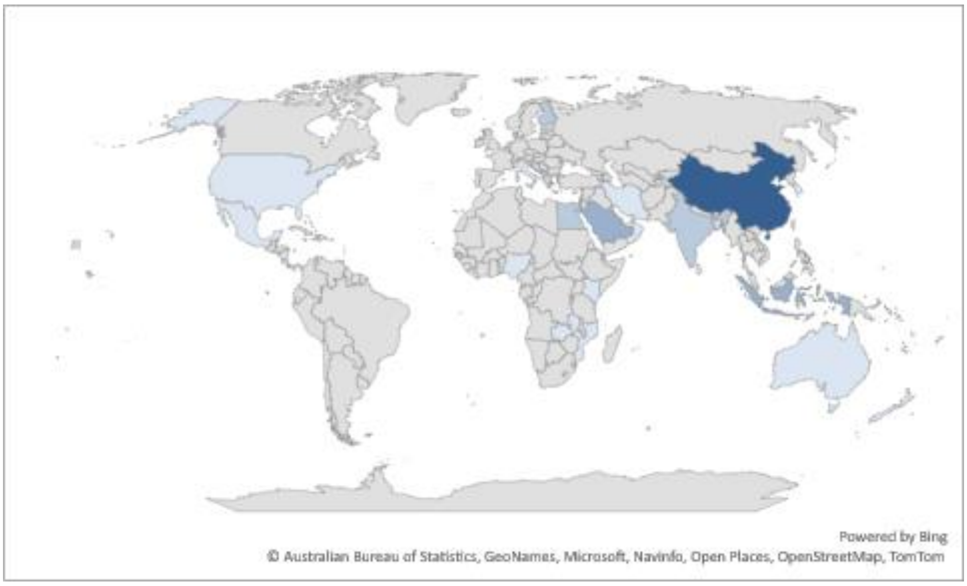

Figure 3. Distribution of papers by country of research location

Publications from 2005-2024 on integrating green construction with local wisdom are dominated by developing countries, with 26 cases, followed by nine cases from developed countries and one case from least developed countries, as shown in Figure 4. Based on this data, it is evident that developing countries face increased environmental and social pressures due to rapid population growth and extensive urbanization. This creates a need for sustainable construction practices that are both eco-friendly and contextually appropriate solutions for regions requiring eco-friendly technologies, which form a significant part of many features found within indigenous cultural legacies creating opportunities with high potential resources for integrating bioregional materials and innovations towards scaling up principles based on green construction practices.

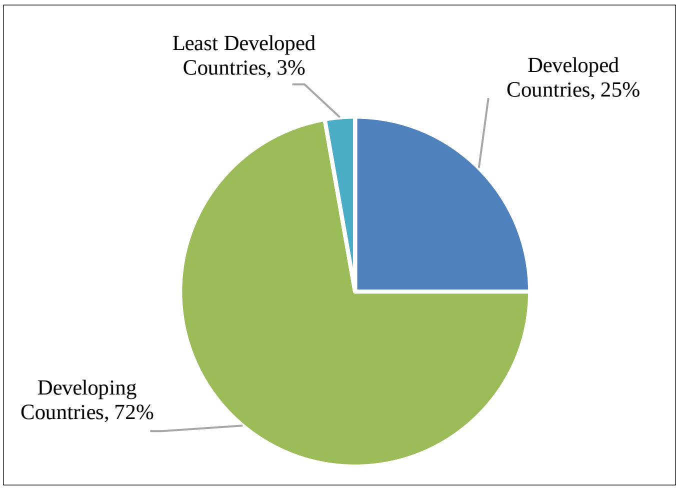

Figure 4. Distribution of papers by country category

4.2. Aspects of Green Construction Integrated with Local Wisdom

This identification was carried out through a detailed literature review and highlighted the synergy between globally relevant green construction principles and traditional knowledge that has been tested for generations. This is important to ensure that the implementation of green construction effectively addresses environmental degradation and responds to local socio-cultural needs. This approach can contribute to preserving local wisdom while increasing the resilience and sustainability of infrastructure in the face of climate change and rapid urbanization challenges. This study identified nine briefly described aspects, providing insights into green construction integrated with local wisdom. This fills a knowledge gap, as the identification of aspects related to this has not been performed in previous studies, as shown in Table 2.

Table 2. Aspects of Green Construction Integrated with Local Wisdom

Aspects	Description	References
Cultural Heritage Preservation	By promoting the importance of cultural values in modern construction, protecting local identity with responsive design, encouraging community participation, and respecting historical sites, we can shape socio-cultural sustainability in the built environment.	[51, 63-64, 67-99]
Energy efficiency & conservation	The synergy of traditional passive design principles with modern technology for energy optimization, adapting local wisdom in building orientation, natural ventilation, and contextual thermal protection.	[51, 63-64, 67 69-90]
Indoor & Outdoor Environment Quality	Applying the traditional concept of balance with nature to create a healthy environment, integrating local elements to improve the comfort and well-being of users in the context of local culture.	[63-64, 74, 77, 79, 81]
Local & eco-friendly materials selection	Using sustainable local materials, traditional processing techniques, and modern innovations improves performance, supports local economies, and minimizes construction's carbon footprint.	[51, 63-64, 67-95]
Local Technology and Resources Utilization	Revives and modernizes traditional technologies for contemporary use, utilizes local resources and techniques, and innovates grounded on Indigenous knowledge systems to make them applicable for sustainable construction.	[63-64, 67-72, 74, 76, 78-79, 81, 83-85, 91-92, 94-98]
Renewable energy utilization	Synergies between renewable energy systems and traditional practices locally suitable for geography, such as using biomass or micro hydro wherever feasible based on the conditions.	[63, 69-70, 74, 76-77, 81, 83, 88-90]
Sustainable land use & development	Indigenous land uses and local ecological values combine with modern requirements for contextual sustainable development in a new approach to land use planning based on traditional settlement policy.	[63-64, 70, 74, 76, 79, 88-89, 99]
Sustainable waste management	Adopting traditional environmentally friendly waste management practices, integrated with modern technology, creates a circular system that minimizes impacts and maximizes the utilization of local resources.	[63-64, 70-72, 74-77, 83-85, 88-90, 92, 96]
Water efficiency and conservation	Revitalizing traditional water management systems, such as rainwater harvesting and ancient irrigation, combines modern technology to optimize the use and conservation of contextual water resources.	[51, 63-64, 67-68, 70-71, 74, 76, 88-90, 97]

Table 2 shows a comprehensive synthesis of the aspects of green construction that are integrated with local wisdom and a holistic approach to realizing the sustainability of the built environment. These studies discuss aspects of cultural heritage preservation that emphasize incorporating cultural values into the design and construction of buildings to preserve and strengthen local cultural identity. In addition, every other essential aspect of green construction explains the synergy between traditional practices and modern innovations in energy efficiency and conservation, indoor and outdoor environment quality, local and eco-friendly materials selection, local technology and resources utilization, renewable energy utilization, sustainable land use and development, sustainable waste management, and water efficiency and conservation. Numerous references for each aspect support this, highlighting the robust research foundation and global relevance of this approach. Overall, this table underscores a green construction paradigm that focuses not only on efficiency, resource conservation, and minimizing impacts on the environment but also on the preservation of cultural identity and empowerment of local communities, creating a comprehensive framework for sustainable development that is responsive to the context of a particular socio-culture.

Figure 5 shows the distribution of the number of publications related to green construction integrated with local wisdom in various least-developed, developing, and developed countries, where most of the publications are dominated by developing countries. The figure shows that developing countries prioritize the preservation of cultural heritage in green construction, followed by the selection of local and eco-friendly materials, reflecting a strong focus on utilizing local resources and minimizing environmental impact through sustainable practices. Developing countries have a wealth of cultural heritage but are threatened by rapid modernization. Therefore, preserving cultural heritage helps maintain national identity amid globalization. In developing countries, local materials are often more accessible and affordable and have lower carbon footprints. Developing countries have limited access to advanced technologies, encouraging adaptive solutions based on local wisdom and local resource-based innovation. Developed countries that implement cultural preservation tend to have many publications in energy efficiency and conservation, focusing on high-tech innovation and more robust environmental policies. Meanwhile, the least developed countries have the fewest publications, pointing to limitations in research and implementation of green construction integrated with local wisdom owing to the focus on basic infrastructure. These results demonstrate the need for developing and supporting research in countries with lower levels of economic development to achieve inclusive and holistic sustainable development.

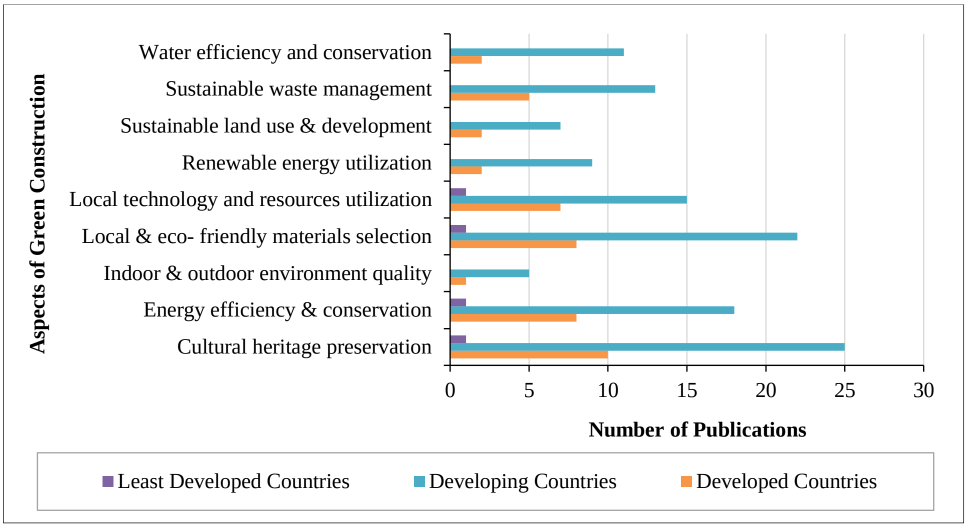

Figure 5. Number of publications within aspects in three country categories

4.3. Challenges of Green Construction Practices Integrated with Local Wisdom

Identifying the challenges in green construction practices integrated with local wisdom aims to develop more effective, targeted, contextual, and sustainable strategies in the global construction industry. This is based on the complexity and significant variation in different countries' social, economic, technological, and cultural conditions. Understanding these challenges will result in policies designed more responsively by stakeholders and create technological innovations adaptive to the locality, resulting in adopting green construction practices that are eco-friendly and economically efficient but also deeply rooted in local values and socioculturally relevant. This includes addressing universal environmental challenges by creating a holistic approach to sustainable development that values diversity.

Table 3 shows the eleven identified challenges that highlight the pressing need for holistic and interdisciplinary green construction strategies that align with global standards while being deeply rooted in local wisdom, ensuring culturally relevant and environmentally effective sustainability. The challenge that dominates many references is balancing tradition and innovation, reflecting its complexity and urgency in the context of green construction integrated with local wisdom. This suggests that this is a critical area that requires further attention in the development of sustainable construction practices.

Table 3. Challenges in Green Construction Practices Integrated with Local Wisdom

Challenges	Description	References
Balancing tradition and innovation	Modern technological innovations are balanced with traditional practices and local wisdom, which are integrated into sustainable design or construction by considering the efficiency or performance of buildings in contemporary contexts.	[51, 64, 67-68, 74-75, 78-79, 80-81, 83, 89-90, 92-94, 96-99]
Extreme local climates	Green construction technologies and designs are adapted to local extreme climatic conditions; innovative solutions are needed by combining traditional knowledge and modern energy resilience and efficiency approaches.	[63, 75]
High dependency on fossil fuels	Develop sustainable alternatives that use local resources and green technologies to reduce the construction industry's high dependence on fossil fuels.	[51, 64]
Insufficient research and sustainable approaches	The existence of limited research and contextual sustainable approaches are obstacles to the development of green construction solutions integrated with local wisdom and specific regional needs.	[67, 71-72, 86-87]
Lack of comprehensive regulations	The lack of a comprehensive regulatory framework in supporting and implementing green construction practices that integrate local wisdom requires the development of responsive policies.	[51, 72, 74, 87, 92, 95]
Limited local resources	The existence of problems with the limitations of local resources in the implementation of green construction requires innovation in the use of alternative materials and the optimal use of traditional techniques that are adaptive to these limitations.	[64, 68, 71, 74-75, 79, 81-83, 85-86, 93, 95, 98]
Limited professional knowledge and skills	The lack of professional education, knowledge, and skills in implementing green construction integrated with local wisdom requires capacity building and special training.	[51, 67, 70-72, 74, 87-90, 93, 96]
Local cultural values in design and construction	Local cultural values are integrated into the design and construction process, making sustainability holistic regarding the environment, culture, and society.	[51, 63, 71, 76-77, 83]
Low stakeholder awareness	Low awareness from stakeholders about the importance of green construction that integrates local wisdom requires effective education and socialization to increase support and knowledge.	[68, 71, 73-74, 84, 86, 88-90, 92]
Maintaining local cultural identity	Defending local cultural identity in the context of modernization and globalization of construction, balancing innovation and preservation of cultural heritage.	[68, 71, 74, 76, 80, 85, 96, 99]
Scarcity of localized sustainability assessment tools	The scarcity of local sustainability assessment tools sensitive to the local cultural context requires the development of assessment metrics and indicators that contain local values and priorities.	[67, 70, 86, 87]

Figure 6 shows that the predominant challenge in all categories is balancing tradition and innovation, demonstrating the universal complexity of integrating modern practices with local wisdom. Green construction practices that integrate local wisdom into various categories of countries face different challenges. Developing countries face the significant challenges of balancing tradition and innovation, limited resources, lack of professional knowledge, and low awareness. The challenge in developed countries, in addition to balancing tradition and innovation, focuses more on maintaining the integrity of local culture in globalization and standardization of construction practices. However, they are more advanced in terms of technology and resources. Meanwhile, the least-developed countries are concerned about resource limitations because they are still focused on meeting basic needs, thus ignoring long-term sustainability aspects. Therefore, a different approach is needed to solve the challenge of green construction by paying attention to the socio-economic context, technological capacity, and urgency of cultural preservation in each country category while still focusing on the goal of sustainable development.

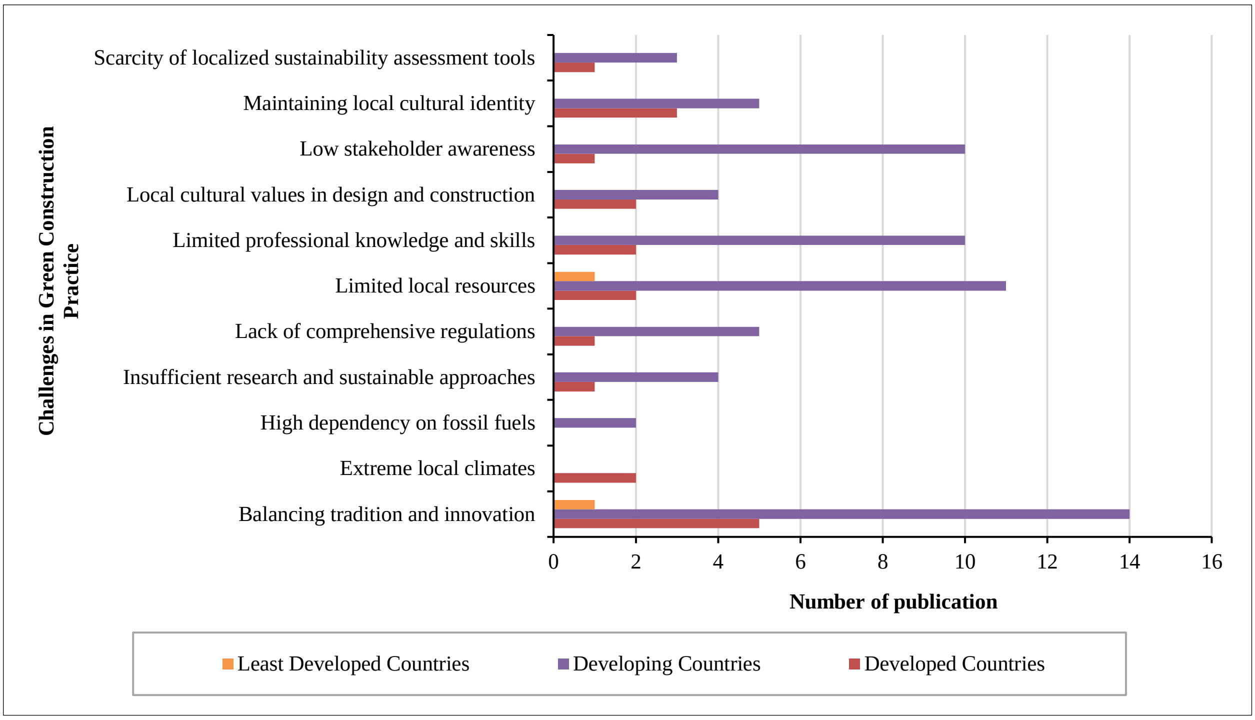

Figure 6. Number of publications within challenges in three country categories

4.4. Impacts of Green Construction Practices Integrated with Local Wisdom on Economic, Social, and Environmental Sustainability

This comprehensive analysis of economic, social, and environmental impacts can provide essential insights for decision-making in the development of more effective policies and strategies to promote green construction integrated with local wisdom, which is relevant for addressing current global challenges and supporting the overall sustainable development goals.

4.4.1. Sustainable Economic Impacts

The economic impact of green construction practices integrated with local wisdom is the change in the economic structure and dynamics resulting from implementing sustainable construction based on traditional knowledge and modern technology. Economic impact analysis aims to comprehensively understand the implementation of these practices' financial and structural consequences. The main objectives are to identify long-term economic benefits, balance investment costs and anticipated returns during the project/build cycle, provide an empirical basis for more informative policy decision-making and implementation strategies, and promote sustainable business models within the construction industry. Table 4 shows that adopting green construction practices integrated with local wisdom had seven economic impacts. These impacts underscore the significant potential of green construction implementation rooted in traditional knowledge to generate culturally relevant, local, and sustainable financial benefits.

Table 4. Economic Impacts of Green Construction Practices Integrated with Local Wisdom

Economic Impacts	Description	References
Construction cost efficiency	Combining traditional and modern techniques, using local resources, and incorporating Indigenous knowledge can reduce the cost of construction, making the development process more economical.	[51, 63-64, 68, 70-72, 74-75, 79, 81, 83-84, 87-89, 92-93, 96-97, 99]
Contribution to regional economic growth	Stimulation of regional economy through the multiplier effect from green construction projects derived from local wisdom, which in turn will foster innovation and entrepreneurship.	[51, 63-64, 67, 69, 85, 89-90, 94-95, 98]
Creation of local employment opportunities	Supporting green construction projects by creating local jobs using traditional expertise and promoting the empowerment of local communities to stimulate inclusive economic growth.	[67-68, 70, 73-75, 78-79, 80-83, 85, 87-88, 90-91, 94-96, 98]
Improve market competitiveness	Competitive in the market by differentiating construction products against both sustainability contents and distinctive local wisdom to create a discriminant value proposition.	[63]
Long-term operational cost savings	Long-term cost savings on operations with efficient use of energy and resources - adopting traditional practices from building management.	[68-70, 72-73, 75-77, 80, 82, 84-89]
Savings in social and environmental costs	Through an environmentally friendly way of building, which does not use negative externalities and also improves community living conditions.	[51, 63-64, 67, 69, 73, 89-90, 98]
Strengthening of local supply chains	Integrating local producers and suppliers into the construction process can enhance or repair the region's supply chains, increasing regional economic resilience and reducing import reliance.	[63-64, 67, 69, 73, 83, 87, 89-90, 98]

Based on several studies that confirm the economic impact of green construction practices integrated with local wisdom, there is significant variation among country categories, as shown in Figure 7. Construction cost efficiency, creation of local employment opportunities, and long-term operational cost savings dominate the economic impacts in developing countries. In developing countries, construction cost efficiency is the main impact due to limited financial resources and the need to optimize infrastructure investment. Integrating local wisdom to promote the use of traditional materials and techniques, which are more affordable and suited to local conditions, also leads to the creation of local jobs. This becomes the second impact because it responds to high unemployment rates and supports community economic empowerment. Thus, implementing this practice also helps preserve traditional skills and encourages inclusive economic growth. In addition, long-term operational savings, while important, are in third place as developing countries often face pressure to meet their short-term needs.

However, the awareness of the long-term benefits of energy and resource efficiency is increasing. This approach reflects the efforts of developing countries to balance urgent development needs with sustainability aspirations while leveraging local wisdom to achieve economic and environmental goals. The economic impacts in developed countries are dominated by the creation of local employment opportunities and long-term operational savings in integrated green construction practices, and local wisdom reflects the complexity and maturity of the construction market. The focus of local job creation highlights efforts to tackle structural economic transformation challenges and revitalize local economies while meeting public demands for more sustainable and inclusive development. Additionally, the emphasis on long-term operational savings demonstrates an awareness of the longer building life cycle and a deep understanding of the value of investment in energy and resource efficiency.

This also reflects the ability of developed countries to allocate substantial resources in the early stages of projects for long-term benefits, supported by more advanced regulatory frameworks and higher environmental awareness. These two impacts demonstrate the strategic approach of developed countries in integrating economic sustainability with social and environmental responsibilities in the construction sector. In least-developed countries, the economic impact of integrating green construction practices with local wisdom remains limited, primarily focused on local job creation, regional economic growth, and social and environmental cost savings, reflecting the socio-economic and infrastructural challenges these regions face. This low intensity can be caused by limited resources, lack of technical expertise, inadequate infrastructure, and development that still focuses on meeting basic needs. In addition, the lack of awareness and regulations related to green construction also contributes to the impact limitations. However, this impact shows the potential for further development, which can be optimized through capacity building, technology transfer, and policies that support green construction practices integrated with local wisdom.

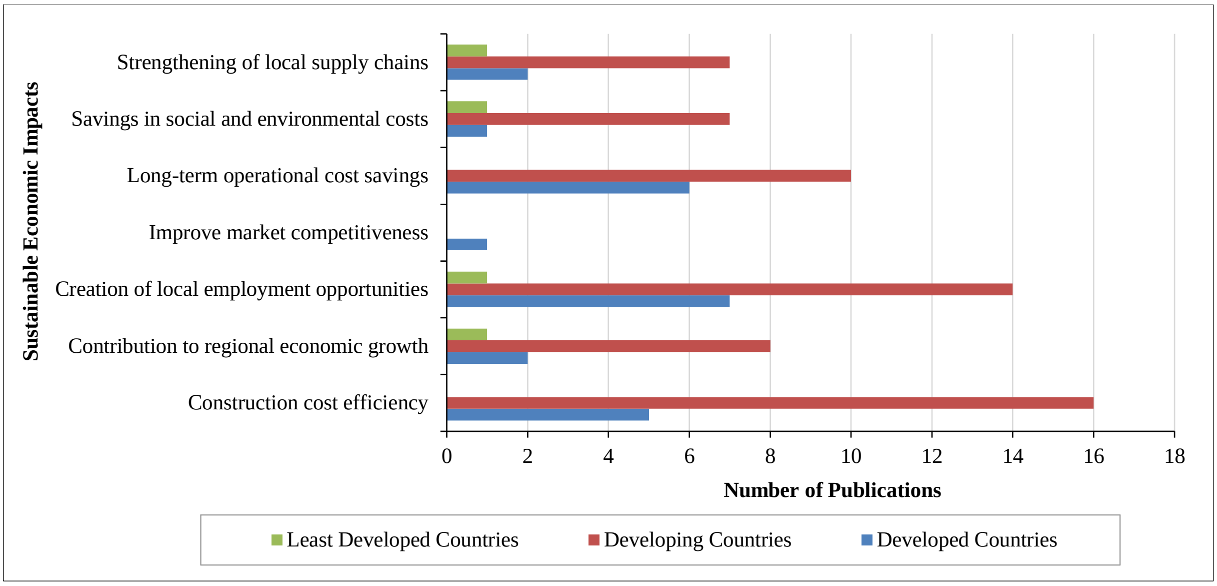

Figure 7. Number of publications within sustainable economic impacts in three country categories

4.4.2. Sustainable Social Impacts

Green construction practices integrated with local wisdom have a social impact, transforming community structures, social dynamics, and community welfare levels. This impact occurs through synergy between modern and traditional innovation. The results of this study are expected to provide a scientific basis for formulating policies and implementation strategies that are more inclusive, responsive to socio-cultural aspects, and support the formation of an ecological, sustainable, and culturally meaningful built environment. Table 5 shows the seven social impacts of implementing green construction integrated with local wisdom. These impacts underscore the substantial capacity of green construction implementations rooted in traditional knowledge to produce inclusive social benefits relevant to local conditions and sustainability.

Table 5. Social Impacts of Green Construction Practices Integrated with Local Wisdom

Social Impacts	Description	References
Community empowerment and inclusive participation	Green construction practices embedded with indigenous and local wisdom embody concepts of community empowerment. The public participates in project planning and execution processes, strengthening the sense of belonging to this environment by creating greater independence and thus adding long-term sustainability.	[51, 67, 74, 83, 90, 95, 96]
Education and skills development	This method creates a teaching atmosphere and skill development by using hands-on experience from traditional practice combined with modern technology to strengthen local capacity, which concerns sustainable construction and preserves indigenous knowledge.	[67, 72, 74-76, 83, 88]
Enhancing socio-cultural resilience	Local wisdom improves socio-cultural resilience at the community level in the face of global change. Preserving traditional value systems and helping local communities adapt to modern sustainable construction practices are essential.	[68, 73-76, 78-79, 81-87, 90-91, 95-96, 98-99]
Improvement of community quality of life	Green construction is based on local wisdom, which can improve the quality of life by creating a healthy, comfortable, and culturally relevant built environment that meets physical and psychosocial needs.	[51, 63, 67, 70-74, 76-82, 84, 86-89, 91-95, 98]
Preservation and reinforcement of local cultural heritage	Such an approach helps conserve and enhance the surrounding local culture, keeps traditional architectural methods alive, and promotes sustainable modern design.	[51, 63-64, 67-68, 71, 73-76, 79-81, 85, 87, 90-91, 93-95, 97-99]
Protection and promotion of health and well-being	Green construction methods also respect local knowledge and promote the health of Indigenous communities through natural materials, responding to climate considerations, and encouraging sitting in spaces conducive to social interaction.	[63-64, 69, 74, 76-77, 87, 89, 92, 95, 98]
Strengthening of community identity and pride	Green construction integrated with local wisdom increases a sense of identity and community pride, as it helps to construct an engaged landscape that responds to regional values and aesthetics, thereby building well-being with themes.	[63, 67, 79]

Several references explaining the social impact of green construction integrated with local wisdom among the three categories of countries are presented in Figure 8. The predominant social impact on developing, developed, and least-developed countries is improving community quality of life, reflecting this approach's universal need and effectiveness. Developing countries provide a healthy and affordable environment, and developed countries use it to address urbanization and alienation, creating more humane and sustainable spaces. Least-developed countries focus on meeting basic needs. Integrating local wisdom provides culturally appropriate solutions, whereas the green aspect ensures sustainability. This improvement in the quality of life of workers and communities also positively affects productivity, public health, and community solidarity, making it a primary focus in developing, developed, and least-developed countries. This impact is easily measurable and directly felt by construction workers and the community, making it a strong indicator of success in implementing green construction practices integrated with local wisdom.

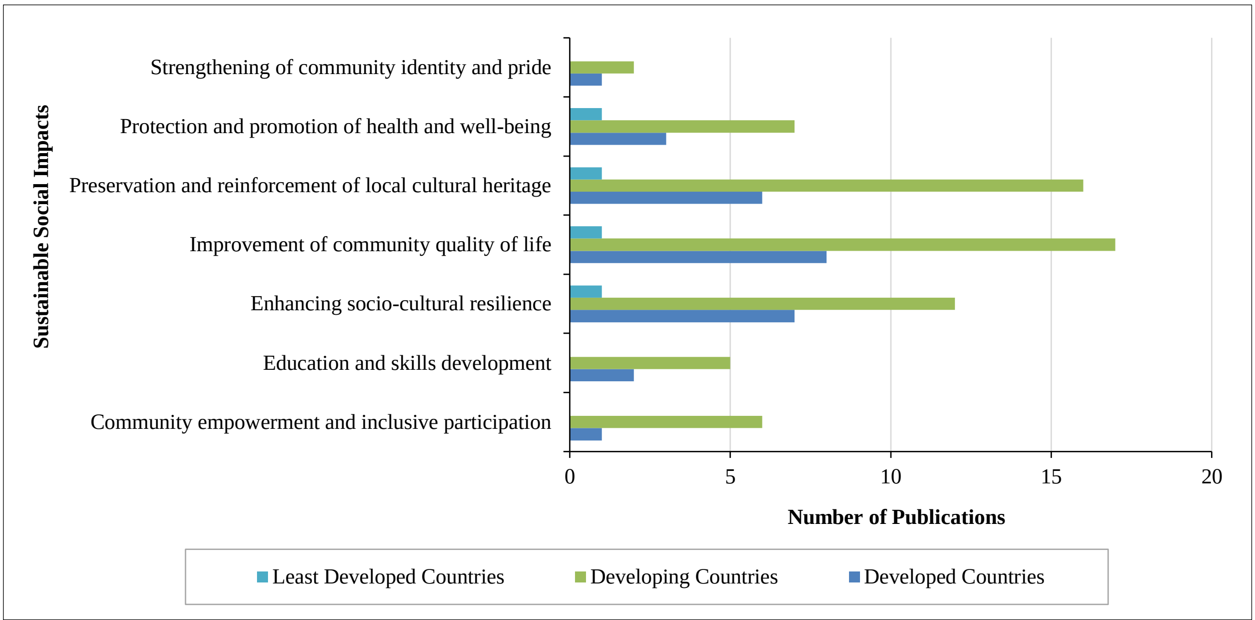

Figure 8. Number of publications within sustainable social impacts in three country categories

4.4.3. Sustainable Environment Impacts

The merger of modern sustainable practices with traditional knowledge results in ecological change and environmental impacts of the integrated green construction of local wisdom. Environmental impact analysis aims to comprehensively understand the ecological consequences of adopting such practices. The results are expected to provide a scientific basis for effective policies and encourage innovation in environment-friendly and locally context-appropriate construction. Table 6 presents the seven environmental impacts of green construction practices integrated with local wisdom, highlighting the significant role these practices play in creating sustainable, locally responsive environmental solutions aligned with regional conditions.

Table 6. Environment Impacts of Green Construction Practices Integrated with Local Wisdom

Environment Impacts	Description	References
Climate change mitigation and reduction of carbon emissions	Green construction integrated with local wisdom reduces carbon emissions using less-energy local materials and passive construction techniques. Properly managing the resources used also involves global climate change mitigation.	[51, 63-64, 67, 69-75, 77-83, 85-87, 89-90, 93, 95, 98-99]
Efficient and sustainable water resource management	The application has retained a long-established and traditional water management method with the help of modern technology, hence enhancing efficiency in resource conservation use to withstand climate variability.	[51, 64, 67, 69, 76, 88, 90, 97]
Improvement of air quality and environmental health	Green construction from local wisdom leads to applying non-toxic natural materials and designs that maximize ventilation, thus creating better clean air in rooms by nature.	[51, 64, 67, 69, 76, 80, 84, 89-90]
Maintaining biodiversity and local ecosystems	These conservation practices benefit biodiversity by incorporating traditional ecological knowledge in landscape planning decisions, planting local species of plants, and minimizing habitat loss.	[51, 63, 67, 75-76, 80, 92-93, 95, 98- 99]
Preservation and revitalization of cultural landscapes	Green construction integrated with local wisdom supports cultural landscape preservation and revitalization, promotes ecological-cultural movement balance between constructed & natural environments, and improves environmental quality.	[68, 73-76, 80-81, 88-91, 93, 95-96, 98-99]
Promotion of circular economy and sustainable waste management	This methodology builds on classic circular economy ideas but fuses them with fresh mechanisms to use available resources most efficiently, reduce waste, and increase recycling in the construction sector.	[51, 64, 67-68, 70- 92, 94-95]
Resilience and adaptation to climate change	Green construction integrated with local wisdom responds to local environmental conditions through adaptive design. It has shown great potential in increasing resilience to climate change while combining traditional mitigation measures and new technologies created to address modern conservation challenges.	[51, 63-64, 69, 73, 83, 90, 95]

The dominant variation in environmental impacts in local wisdom-integrated green construction practices in developed, developing, and least-developed countries reflects their priorities and capacities in facing environmental challenges. Figure 9 illustrates that the most significant environmental impact in both developed and developing countries is the promotion of the circular economy and sustainable waste management. This highlights the importance of addressing construction waste and optimizing resource use, supported by more established infrastructure and greater technological capacity. The following significant impacts are climate change mitigation and carbon emission reduction, demonstrating a global commitment to the issue. Meanwhile, in least-developed countries, environmental impacts on climate change mitigation and carbon emission reduction, maintenance of biodiversity and local ecosystems, and preservation and revitalization of cultural landscapes illustrate vulnerability to the impacts of climate change as well as the richness of biodiversity and cultural heritage that are often threatened by unplanned development. This reflects a greater reliance on natural resources and traditional knowledge in construction practices. The limitations of infrastructure, advanced technology for waste management, and the circular economy are the causes in least-developed countries. These differences underscore the importance of a locality-tailored approach to green construction implementation, allowing each country to leverage local wisdom in addressing the most pressing environmental challenges while developing the capacity for more complex aspects of sustainability.

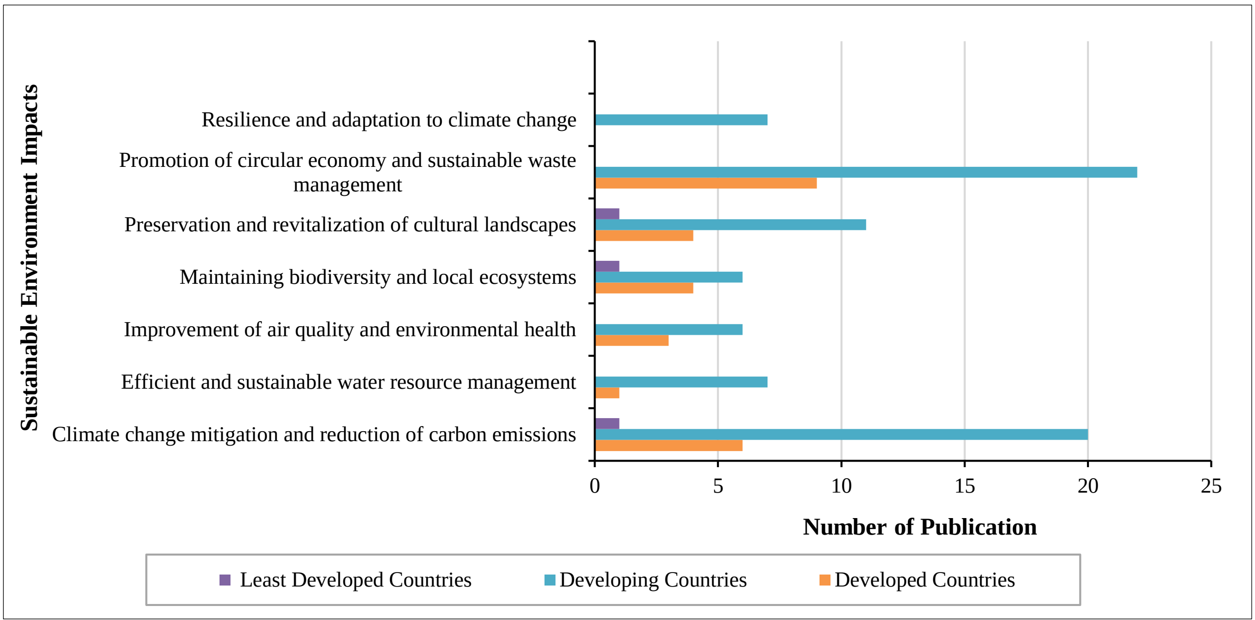

Figure 9. Number of publications within sustainable environment impacts in three country categories

4.5. Number of Publications within Sustainable Environment Impacts in Three Country Categories

The strategy for implementing green construction practices that integrate local wisdom involves a series of systematic and planned approaches to maximize the harmony between modern sustainable construction principles and traditional knowledge deeply rooted in local culture. The objective of this strategy is to accommodate the effective and efficient implementation of green construction practices that are responsive to local socio-cultural and ecological conditions and meet global sustainability standards. Furthermore, this strategy must solve problems such as limited literacy, limited resources, and stakeholder interest variations. Therefore, effective strategy formulation requires cross-disciplinary collaboration considering the relationship between complex technical, social, economic, and ecological factors when implementing integrated green construction with local wisdom.

This approach seeks to create comprehensive and sustainable construction solutions by harmoniously combining modern innovation with traditional values. Based on several references, there are 13 strategies for implementing green construction practices integrated with local wisdom, with the most frequently referenced strategy being the active engagement of local communities in the construction process, as shown in Table 7. The active engagement strategy of local communities in the context of green construction that integrates local wisdom is an approach that prioritizes local communities being actively involved in all stages of the construction process, local communities as active partners in planning, decision-making, and project implementation, and receiving benefits. This approach strengthens the sustainability of the project in the long term, increases the sense of community ownership, and ensures that the implementation of green construction is in line with local socio-cultural conditions, thus significantly contributing to strengthening social ties and preserving local wisdom in the framework of sustainable development.

Table 7. Strategies of Green Construction Practices Integrated with Local Wisdom

Strategies	Description	References
Active engagement of local communities in the construction process	Fully involve local communities in the planning, decision-making, and implementation process of green construction projects by utilizing traditional knowledge as much as possible and ensuring that any development outcomes are socio-culturally relevant.	[67-68, 71-79, 81-87, 89-90, 93, 95-99]
Alignment with government policies and regulations	Aligning green construction practices and local wisdom with government regulations, creating synergies between bottom-up initiatives and top-down directives for sustainability.	[63, 74, 84, 87, 92, 93, 97, 99]
Application of holistic waste management strategies rooted in local practices	Implement holistic waste management strategies rooted in local practices, combining traditional circular economy principles with modern technology to optimize resources.	[67]
Development of context-responsive technological innovations	Creating locality-responsive technological innovations, integrating local wisdom with modern technical solutions to develop adaptive and efficient construction systems.	[63, 67-69, 73-75, 80, 83-84, 88-89, 97-98]
Development of locally-informed sustainability frameworks	Design a sustainability framework based on locality conditions and values, ensuring the relevance and effectiveness of assessment criteria in a specialized context.	[63, 68-69, 73-75, 77, 80-81, 83, 86-87, 90, 92, 94, 96-98]
Enhancement of contextual sustainability and technological literacy	Improving sustainability literacy and contextualized technologies of practitioners and communities, providing understanding and adoption of green construction practices integrated with local wisdom.	[77, 84, 87-89, 99]
Facilitation of multi-stakeholder collaboration and partnerships	Promote cross-sector cooperation and partnerships among various stakeholders, such as governments, companies, academic institutions, and communities, in formulating and implementing integrated green construction solutions.	[68-69, 77, 84, 86-87, 89, 91, 97]
Implementation of adaptive green certification and environmental management systems	Implement an adaptive green certification and environmental management system, accommodating local values while maintaining global standards for sustainability.	[51, 84, 86, 88 92]
Implementation of integrated risk management incorporating local wisdom	Apply integrated risk management using local wisdom by optimally utilizing traditional disaster mitigations and environmental adaptation.	[89]
Integration of sustainability assessment with local cultural values	Integrate sustainability assessments with local cultural values, ensuring that measurements and indicators reflect local communities' perceptions, priorities, and visions.	[63, 67, 74-75, 78, 81, 86, 90-91, 93, 99]
Occupational health and safety	Occupational safety guidelines should combine traditional methodology with current norms while providing a local way to maintain a safer and healthier labor environment.	[51, 67, 75, 85, 88, 93]
Optimization of inclusive cross-disciplinary team collaboration	Maximize the synergy between cross-disciplinary collaboration among members of the inclusive teams who bring technical knowledge and local creativity to achieve integrated contextual construction solutions.	[63, 68, 87, 89]
Utilization of BIM for sustainable design and construction with local considerations	Utilizing Building Information Modeling (BIM) for sustainable design and construction with consideration to local values, integrating local wisdom data and parameters into a digitized form to optimize the project.	[51]

Figure 10 illustrates the strategy of active engagement of local communities, which is the dominant approach to green construction practices integrated with local wisdom in developed, developing, and least-developed countries. This reflects the importance of contextual adjustment and local community participation in sustainable development. Developed countries use this strategy to resolve social isolation and maintain cultural identity amid rapid modernization. Developing countries use it to balance modern and traditional practices and maximize local resources. In least-developed countries, this strategy allows for the use of traditional knowledge that is original but often overlooked. Developing locally informed sustainability frameworks is an important part of ensuring the relevance of criteria and indicators to local conditions. This approach increases project effectiveness and acceptance, encourages community empowerment, and preserves local wisdom. This strategy also helps to overcome resistance to change and the need for solutions responsive to local conditions. These strategies provide a comprehensive approach that aligns global sustainability goals with local needs, making them effective across developed, developing, and least-developed countries.

Different strategies are implemented in each country, considering technological capabilities, socio-cultural backgrounds, and specific development priorities while maintaining sustainability and integration with local wisdom.

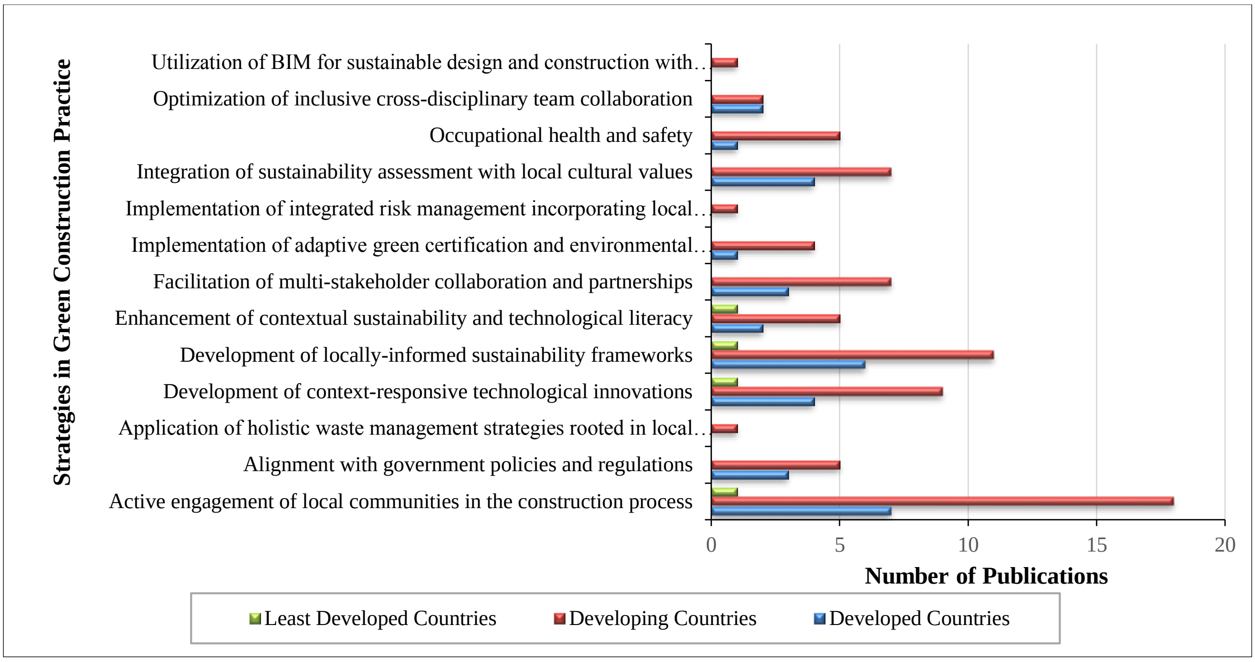

Figure 10. Number of publications within strategies in three country categories

5. Discussion

This research conducted a systematic literature review of 36 selected articles. This identification process underwent in-depth content analysis, involving coding and categorizing the data using NVivo software, which enabled the extraction of consistent patterns and themes from the various studies related to integrating green construction with local wisdom. These themes were then synthesized and categorized into nine different aspects, shown in Table 2. This process was also applied to identify challenges, impacts, and strategies.

The integration of traditional knowledge with modern construction practices presents one of the significant challenges in the adaptation of local techniques for large-scale projects. This process requires substantial innovation to meet the demands of urban and industrial development. Resistance from traditional practitioners and scepticism of modern professionals towards the relevance of local knowledge requires careful negotiation and collaborative learning to bridge the paradigm gap, ensuring effective harmonization between local wisdom and contemporary construction technologies [72, 83, 96-97]. The challenges identified in this study consist of 11 challenges, as outlined in Table 3. There are specific challenges in certain areas, such as the Perth region and the south-west of Western Australia, in the application of compacted soil construction [87]. The main challenges include the lack of specific technical standards for mix and structural design, difficulties in post-construction repairs and alterations, and problems with wall-to-floor connections. The extremely hot climate is also a constraint during the construction process. To address this, the local industry has developed innovative solutions, such as using air voids in walls to improve thermal performance and ease of utility installation. In addition, an increased understanding of material properties through continuous research and developing more advanced construction practices has helped overcome some of these challenges. However, standardization and more comprehensive technical guidance remain a priority for further development. Another specific challenge occurred in Mathare informal settlement, Nairobi [91]. The main challenges include limited space for material storage, difficult accessibility of project sites, and ethnic fragmentation within the construction sector. Space limitations led to the preference of using materials such as zinc that are easy to store. Poor accessibility limits the distribution of materials into settlements. While ethnic fragmentation affects the division of roles in the construction supply chain. Approaches to address these challenges include utilizing stakeholder-based supply chain mapping and a comparative analysis of storage space requirements between construction technologies. This study emphasizes the importance of considering socio-technical factors in planning construction interventions in informal settlements.

This study also evaluates the economic, social, and environmental impacts of green construction practices that integrate local wisdom. The impact on the economy was identified as seven, shown in Table 4. The economic impact of local wisdom-integrated green construction practices can be measured through cost-benefit analysis and Life Cycle Cost Analysis (LCCA), used extensively to measure construction cost efficiency and long-term operational savings in various case studies. LCCA was applied to compare construction and operational costs between a green building based on local wisdom and a conventional building. This method allows the evaluation of material efficiency by considering savings and benefits during the operation and maintenance stages against the overall life cycle costs. A cost-benefit analysis was used to compare design alternatives and optimize the relationship between investment and facility management costs. These methods enable a comprehensive evaluation of the cost efficiency and sustainability of construction projects, considering the entire life cycle of the building [77]. Seven social impacts were identified, shown in Table 5. Social impacts were assessed through a comprehensive qualitative approach, combining in-depth interviews, focus group discussions (FGDs) with local communities, and ethnographic methods. In-depth interviews enabled in-depth exploration of individual perceptions and experiences. While FGDs facilitated collective understanding and social dynamics, ethnographic methods offered deep contextual insights into daily practices and social interactions. This methodology enables a holistic evaluation of the improvement of quality of life and strengthening of cultural identity [97]. Seven impacts on the environment were identified, shown in Table 6. Life Cycle Assessment (LCA) measures environmental impacts related to climate change mitigation and carbon emission reduction in various case studies. This method enables a comprehensive evaluation of the carbon footprint of local wisdom-based green buildings compared to conventional buildings. LCA is also used to calculate total CO_2 emissions and determine the ratio between embodied and operational carbon in buildings [77].

The results of this study also determine the strategies implemented in green construction practices that integrate local wisdom. There are as many as 13 strategies, as shown in Table 7. Some of the important factors policymakers need to consider when developing such strategies include recognizing local traditions, understanding local values, beliefs, and practices in resource use and community engagement, which can increase the acceptance and effectiveness of sustainability initiatives [93-94, 96]; ensuring that projects are in line with their needs and cultural identity [73, 83]; knowing the community's level of understanding of green construction, local social structures, potential conflicts of interest, and technical capacity [74, 96]; understanding local socio-economic conditions, availability of local labour and materials [84]. To adapt these strategies to different socio-economic contexts, policymakers can conduct contextual assessments to understand specific socio-economic conditions, cultural values, and community needs with ethnographic surveys and socio-economic mapping [90, 93]; educational initiatives should be designed to reflect the local context, incorporating language, practices, knowledge, and technology to enhance understanding [74, 96]; utilizing local materials and labour in construction projects to promote economic benefits within the community [73]; encouraging local leaders to take an active role in promoting sustainability initiatives, effectively mobilizing community support and participation [94].

Comparative analyses of local wisdom-integrated green construction practices reveal significant variations between developed, developing, and least-developed countries. Developing countries tend to emphasize preserving cultural heritage and selecting local eco-friendly materials, reflecting the richness of tradition and the urgency of sustainable innovation [93]. Developed countries focus more on energy efficiency, indicating more advanced technological capacity. Meanwhile, least-developed countries have a more limited scope of aspects, indicating limited resources. The balance between tradition and innovation is a key challenge across all country categories. However, developing countries face additional challenges regarding limited resources and professional knowledge. Developed countries are more concerned with maintaining local cultural identity amid globalization [84]. The economic impact in developing countries is more pronounced regarding construction cost efficiency, while developed countries emphasize local job creation. Social impact in the form of improving the community's quality of life is dominant in both developing and developed countries. Regarding environmental impact, the main focus is promoting a circular economy and sustainable waste management. A surprising finding is the dominance of strategies for active involvement of local communities in the construction process across all country categories, indicating the importance of community participation and contextual customization regardless of the country's level of development. This variation in findings confirms the importance of locally tailored approaches in integrating green construction with local wisdom.

6. Conclusion

This systematic literature review presents a comprehensive synthesis of green construction integrated with local wisdom, addressing a significant literature gap. The analysis identifies nine key aspects, with cultural heritage preservation as the most predominant, eleven challenges primarily focused on balancing tradition with innovation, and seven distinct impacts spanning economic, social, and environmental dimensions. The most significant impacts are construction cost efficiency, community quality of life improvement, and promotion of circular economy and sustainable waste management. Thirteen implementation strategies were identified, with active community engagement in the construction process emerging as principal. This holistic analysis underscores the potential of integrating local wisdom with green construction practices to create culturally relevant, environmentally sustainable, and economically viable built environments. The findings highlight significant variations across developed, developing, and least-developed countries, reflecting diverse socio-economic contexts and priorities. Developing countries emphasize cultural heritage preservation and eco-friendly material selection, while developed nations focus more on energy efficiency and technological innovation, illustrating the need for context-specific approaches.

The research implications span theoretical and practical domains, contributing to the body of knowledge and providing a robust basis for policymakers and practitioners to develop tailored strategies. This synthesis can drive innovation, promote inclusive sustainable development, and contribute to global efforts in addressing climate change and environmental degradation. The universal prominence of community engagement strategies underscores the importance of contextual adaptation and participatory approaches. The study emphasizes the need for a paradigm shift in construction practices, advocating for an approach that considers environmental sustainability, cultural preservation, and community empowerment. By presenting a comprehensive synthesis of aspects, challenges, impacts, and strategies, this study provides a foundation for developing effective and contextual policies to encourage sustainable construction practices that are both environmentally responsible and culturally relevant.

6.1. Limitations and Recommendations for Future Research

This study has limitations, as the literature review on English articles excluded articles from local non-English sources. The recommendations for future research are as follows:

- To develop metrics and indicators that align with local conditions to make a sustainability assessment of green construction practices integrated with local wisdom.
- Analyzing the mechanism or technical transfer of knowledge between traditional practices and modern technological innovations in the construction industry, especially green construction.
- Analyze the long-term impact of these strategies through longitudinal studies.

Key variables for monitoring include environmental performance (energy efficiency, water use, carbon emissions, and waste management from buildings), building resilience (durability of structures against climate change and natural disasters), life-cycle costs (initial construction costs, operations, maintenance, and recycling), socio-economic impacts (local job creation, skill development, and revitalization of traditional practices), policy and regulatory changes, and cultural preservation (sustainability and evolution of local wisdom practices in a modern context). Longitudinal study designs may include mixed-method approaches, selection of study sites representing various geographical, social, and economic contexts, collaboration with local institutions, and comparative analyses between regions to identify factors that influence successful integration.

- Analyzing behaviour in green construction practices that integrate local wisdom.
- Combining behavioural analysis with green construction and local wisdom creates an interdisciplinary approach that can yield new and innovative insights. Additionally, it suggests that behavior analysis can promote innovative research methods such as ethnography, case studies, or participatory action research approaches in the context of green construction and local wisdom.
- Broaden the focus of research on less developed countries to better understand the challenges and strategies undertaken for sustainability.

7. Declarations

7.1. Author Contributions

Conceptualization, W.S.K.; methodology, W.S.K.; software, W.S.K.; validation, W.S.K.; formal analysis, W.S.K.; writing—original draft preparation, W.S.K.; writing—review and editing, W.S.K. and Y.Z. ; visualization, W.S.K.; supervision, Y.Z., Y.P.D., S., and M.A.W. All authors have read and agreed to the published version of the manuscript.

7.2. Data Availability Statement

Data presented in this study is available in the article.

7.3. Funding

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7.4. Conflicts of Interest

The authors declare no conflict of interest.

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