Exploring Traditional Building Materials for Urban Housing in Sri Lanka: Benefits, Obstacles, and a Path Forward amid Economic Challenges

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Abstract

This study examines the abundance of traditional building materials in Sri Lanka, considering material properties. It evaluates local materials like adobe, bamboo, thatch, stone, timber, coconut trees, and grasses, highlighting their cost-effectiveness compared to imports. The research aims to analyze advantages, challenges, and solutions related to using these materials for affordable housing amidst economic difficulties. The study finds benefits such as cultural preservation, material affordability, energy efficiency, reusability, and biodegradability. Challenges include acceptability, durability, deforestation, limited strength, and maintenance. Recommendations focus on adopting and improving local materials for resilient housing. This research contributes insights to traditional building materials in the Sri Lankan context, with implications for the broader region.

Keywords: Affordable Housing, Economic Challenges, Indigenous Resources, Sri Lanka, Traditional Building Materials

Introduction

In Sri Lanka, the stark reality emerges where a significant segment of the urban population endures substandard housing conditions, while those with access to average housing grapple with exorbitant costs (Fernando, 2018). Comparable to many countries, including Sri Lanka, the concept of homeownership carries pronounced significance, often overshadowing education and healthcare priorities (Jameel, 2020). This positioning underscores homeownership as a symbol of stability and prosperity in Sri Lanka, accentuating the vulnerability of those without a home (Perera et al., 2019). For sustainable construction, a reassessment of current practices, techniques, and raw material sources is paramount (Silva, 2017). Escalating construction costs have become a worldwide concern, particularly in Asian countries, where a substantial portion of expenses can be attributed to building materials (Ranasinghe, 2021). In the context of Sri Lanka, the shortage of affordable housing can be attributed to inflated costs of conventionally processed construction materials such as cement and imported steel (Ratnayake, 2019). This demand for imported materials negatively impacts local resources, diluting their value and rendering them seemingly inadequate (Fernando & Perera, 2020). Ideally, economical housing materials should be derived from locally available, renewable resources (Fernando, 2016). Over-reliance on foreign building materials and the challenges of urban-rural transportation contribute to ongoing increases in building costs, compounded by external factors such as fuel scarcity (Fernando & Ranasinghe, 2018).

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The housing challenge in Sri Lanka presents a multi-faceted dilemma, manifesting both quantitatively and qualitatively (Perera, 2012). While poverty isn't the sole driver, the absence of effective administrative coordination to harness the nation's resources for housing and urban development perpetuates the crisis. The effectiveness of public housing agencies also influences the success of housing policies and initiatives. The provision of housing remains a contentious issue of significance, drawing attention from stakeholders across Sri Lanka. Urban migration, coupled with population growth and inadequate government response, exacerbates the housing situation within the country. The challenges described have become increasingly pronounced in Sri Lankan cities, marked by substantial deficits in housing supply, deteriorated housing conditions, elevated housing costs, and the proliferation of slums and informal settlements. Consequently, a significant proportion of urban residents, particularly those belonging to the low-income bracket—comprising approximately 20% of Sri Lanka's population—are compelled to reside in conditions that undermine human dignity.

The economic crisis has further exacerbated the housing sector in Sri Lanka, intensifying issues related to affordability, accessibility, and housing quality (Silva & Perera, 2022). In numerous developing nations, including Sri Lanka, the housing crisis continues to intensify, despite the implementation of various new policies, programs, and strategies by both public and private sectors to address this issue (Fernando et al., 2020). Governments acknowledge that a substantial number of individuals in need of housing, particularly in the low-income segment, necessitate specialized housing initiatives to secure decent living conditions (Ranasinghe & Gunawardana, 2019). Given the limitations of market-based solutions and funds for accommodating this demographic and recognizing the pivotal role of housing in a nation's socioeconomic and political development, governments have consistently engaged in public housing provision (Jayasinghe, 2018). However, similar to India, the progress of public housing in Sri Lanka has struggled to keep pace with the housing demand, with a significant portion of the housing supply being contributed by the informal sector (Fernando & Liyanage, 2017).

Figure 01: Low income urban housing in Sri Lanka

The paper conducts a comprehensive evaluation of key local building materials accessible in Sri Lanka, incorporating an in-depth analysis of Straw/Thatch Architecture, Adobe Architecture, Coconut Timber, Polished Clay tiles, Kabook, and compressed earth blocks. This examination delves into the inherent advantages, challenges, and potential opportunities associated with these traditional building materials, with a particular focus on how they can contribute to the availability and affordability of low-cost housing solutions.

Additionally, the research considers imported alternatives for these local materials. In the context of Straw/Thatch Architecture, alternatives may include synthetic thatch materials or imported roofing solutions. Adobe Architecture could be substituted with imported mud bricks or alternative sustainable earth-based construction materials. Coconut Timber might be replaced with imported hardwoods or engineered wood products. Polished Clay tiles could face

competition from imported ceramic or concrete tiles. Kabook might be substituted with imported hardwoods or engineered wood products. Lastly, compressed earth blocks could face alternatives in the form of imported stabilized earth blocks or alternative compressed earth building systems.

Literature Review

In Sri Lanka, a mindful utilization of natural resources has defined its architectural heritage, spanning from humble villages and urban centres to temples, memorials, and religious structures (Amaratunga & Balasooriya, 2019). Earth, mud, and adobe have emerged as pivotal building materials, often harmonized with locally sourced timber (primarily from palm trunks), palm and coconut thatch, and straw bales, offering abundant resources for construction needs (Bandara et al., 2021). The traditional architectural ethos of Sri Lanka ensures that resource consumption remains sustainable, preserving both their availability and the delicate ecological equilibrium critical to its agrarian society (Ratnayake & Silva, 2020).

Figure 02: Ancient Sri Lankan urban decent housing (source by "lankapura.com")

The advent of modern technologies, notably concrete blocks, and slabs during the industrial era, led to the marginalization of traditional building components and techniques (Fernando et al., 2022). There emerged a fervent drive among residents of wattle-and-daub houses to embrace this contemporary trend, despite the undeniable reality that these modern materials, such as concrete blocks, didn't deliver the same level of thermal comfort (see Figure 2) (Silva & Perera, 2021). This shift resulted in the replacement of the previously comfortable, cost-effective, and eco-friendly dwellings shown in Figure 2 with their modern counterparts, often chosen for their perceived modernity, advancement, and social prestige. In recent times, a growing awareness of the unsustainability of these practices has sparked renewed interest in earth construction as a viable alternative. This architectural approach holds the promise of affordability while concurrently catering to contemporary demands, providing a balance between modernity and environmental consciousness (Fernando & Jayasooriya, 2020).

Methods

This study employs a qualitative research methodology to explore the utilization of traditional building materials in the context of Sri Lanka. The research design involves a comprehensive literature review to gather insights from existing studies, reports, and scholarly articles related to traditional architecture, building materials, and housing in Sri Lanka. Primary focus will be placed on sources that specifically discuss the use of locally available materials, their advantages, challenges, and potential solutions.

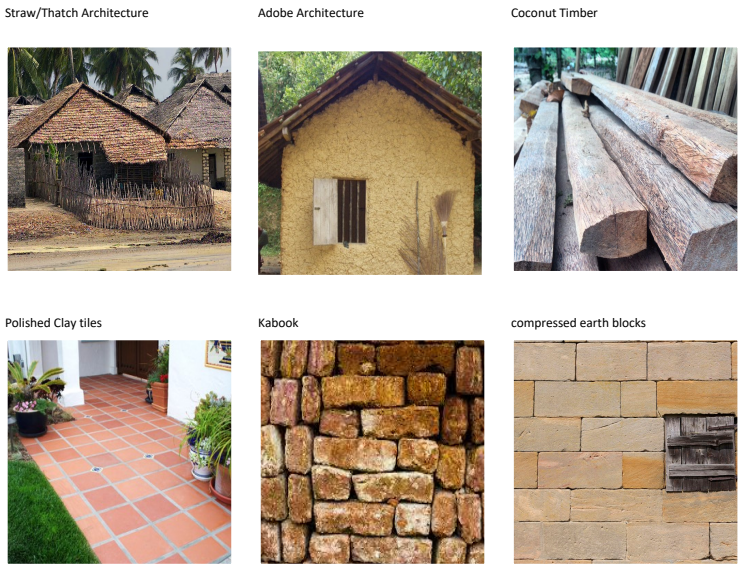
Data collection will also involve interviews and surveys conducted with local experts, architects, engineers, and individuals with expertise in traditional building practices. These interviews will provide firsthand insights into the practical aspects of using traditional materials, their relevance in modern construction, and their potential to address housing affordability and sustainability challenges in Sri Lanka.

The research will analyze collected data using thematic analysis to identify recurring patterns, advantages, challenges, and potential solutions related to the utilization of traditional building materials in Sri Lankan housing. Comparative analysis will be conducted to juxtapose traditional methods with modern alternatives, highlighting their strengths and limitations in terms of affordability, environmental impact, and societal acceptance.

List selected traditional building

Distinguished from materials with limited renewal potential, straw/thatch emerges as a cultivated resource, derived as a by-product from cultivated plants. In the context of Sri Lanka, significant quantities of straw can be sourced from the immediate vicinity, as local villagers cultivate cereals that yield straw for both food and construction purposes (Fernando, 2009). Straw often combines harmoniously with adobe bricks, masonry walls, or stands alone as a construction material. Remarkably, even today, nomadic communities in Sri Lanka continue to employ this form of construction (Perera, 2015). The essence of straw construction involves weaving or binding straw bales from crops such as wheat, oats, barley, and rice, either as standalone walls or coated with earthen or lime stucco. Traditionally, straw bales were considered waste products, comprising the dry plant materials or stalks remaining in fields after harvest (Silva & De Silva, 2020).

Figure 03: List of selected building materials



Adobe Architecture: A defining facet of Sri Lanka's rural heritage, adobe has unquestionably stood as one of the most prevalent and readily accessible building materials, exerting a profound influence on the sustainability and resilience of the country's villages (Gunawardhana, 2013). Sri Lanka's earth-based technologies have encompassed an array of approaches, ranging from the use of raw earth to refined earth bricks (Jayasena, 2011). Wattle-and-daub earth technology has been a prevailing method, involving the creation of solid wooden post frames filled with adobe balls to shape walls (Wickramaratne, 2005). Typically, Sri Lankan builders construct walls layer by layer, employing mud bricks bonded with an earth slurry mixture as mortar. Upon drying and solidifying into a monolithic structure, a robust mud plaster, enriched with various additives

rooted in local culture (such as cow dung, goat dung, beaten straw, animal hair, and animal skin fat), is applied to enhance durability.

Coconut Timber: The versatile coconut tree, synonymous with Sri Lanka's landscapes, contributes significantly to traditional construction practices. Its timber is widely used in framing and structural components due to its strength, durability, and availability. This sustainable resource provides an eco-friendly alternative to imported materials (Dissanayake, 2010).

Flooring Materials: Traditional Sri Lankan flooring solutions often feature locally available materials such as polished clay tiles or brick pavers, contributing to aesthetic charm and functional resilience. These materials not only align with the architectural character but also exhibit durability over time (Fernando, 2009).

Compressed Earth Blocks (CEBs): offer a promising solution for addressing housing challenges in Sri Lanka. With a history of traditional building practices deeply rooted in the local context, CEBs align with the country's cultural heritage while presenting a modern, sustainable alternative (Ruwanpura and De Silva, 2014). CEBs are created by blending a small amount of cement or lime with natural soil, resulting in blocks that are machine-pressed under high pressure (Ariyawansa et al., 2015). This process enhances their strength, making them suitable for multi-story constructions.

In Sri Lanka, where affordability and ecological considerations are crucial, CEBs demonstrate remarkable potential. Their thermal efficiency offers relief from the island's tropical climate, reducing energy consumption for cooling (Pradhan, 2019). Furthermore, the use of locally available materials minimizes construction costs and supports the national economy (Abeysekara and Meegoda, 2016). CEBs also contribute to addressing environmental concerns by conserving timber resources and reducing carbon footprint (Arachchige and Adhihetty, 2019). As Sri Lanka navigates economic challenges and strives for sustainable development, embracing Compressed Earth Blocks can create a harmonious blend of tradition and innovation, providing durable, energy-efficient, and cost-effective solutions to the country's housing needs.

Kabook: Kabook, a material derived from the kabook tree bark, finds application as a natural insulation material for walls and roofs. With its thermal properties, kabook contributes to the comfort and energy efficiency of traditional Sri Lankan dwellings (Perera, 2015).

Advantages of traditional Sri Lankan building materials

Abundance of Resources: In the Sri Lankan context, traditional building materials mirror nature's bountiful offerings. Earth, stone, thatch, and coconut fiber are among the ample resources available. For instance, the utilization of laterite and loamy soil, prevalent throughout the island, forms the foundation of earth building technology. The wisdom of our predecessors is evident in their construction of multi-storey buildings solely using earth, a practice that endures through time, with these structures standing resilient.

Affordability: The Sri Lankan housing landscape echoes challenges akin to high costs of imported building materials, driven by importation expenses and inflation. This predicament restricts lower-income individuals from building or renting decent homes. The presence of abundant local materials significantly lowers costs, empowering individuals from the low-income segment to undertake housing projects.

Energy Efficiency: In the global context, the construction sector's energy consumption accounts for more than one-third of total energy usage, contributing to climate change. Traditional Sri Lankan buildings constructed from earth exhibit superior energy efficiency, emitting fewer greenhouse gases and preserving internal thermal comfort despite external solar radiation (Iwuagwu and Azubuine, 2015).

Eco-Friendly Approach: Sri Lanka's built environment influences global warming through greenhouse gas emissions from energy consumption and construction activities. Embracing local building materials presents an avenue for drastically reducing carbon emissions from buildings. These materials align with eco-friendly principles, responding to the climate and serving as organic protective measures that mitigate environmental impact. The thermal insulation and energy efficiency inherent in local materials contribute to minimizing negative environmental consequences. Proximity to resources further curbs pollution by diminishing the need for fuel-intensive transportation.

Reuse Potential: Reusability hinges on a material's durability and lifespan. Enduring materials can enjoy several useful years after decommissioning from one structure, finding purpose in new locations. Items like windows, doors, and even bricks can be effectively repurposed. Reclaimed timber from previous structures has gained traction as a sought-after material in contemporary construction.

Biodegradability: The biodegradability of a material pertains to its natural decomposition ability upon disposal. Organic materials swiftly return to the earth, while others, like steel, exhibit a prolonged degradation process. Equally crucial is whether a material's decomposition produces hazardous substances, either independently or in combination with other elements. Traditional Sri Lankan building materials align with this characteristic, including earth, thatch, bamboo, and timber, showcasing their environmental compatibility and sustainable nature."

Challenges in Utilizing Traditional Sri Lankan Architecture and Indigenous Building Materials

Acceptance and Cultural Relevance: The evolution of Sri Lankan architecture hinges on its alignment with the preferences of its intended inhabitants. The misconception that structures fashioned from traditional materials are subpar poses a significant barrier to nurturing a truly indigenous architectural identity. The challenge of acceptability has, regrettably, led to the erosion of traditional values, replaced by foreign influences that often fail to resonate with the local culture.

Durability and Strength: A pivotal concern surrounding houses constructed from traditional Sri Lankan building materials is their perceived low strength. Comparatively, these local materials exhibit inferior strength when juxtaposed with conventional construction elements such as cement, concrete, and steel. The robustness of a dwelling underpins its longevity and security. Venkatarama and Prasanna (2009) aptly note that the durability of earth as a construction material is intrinsically linked to its compressive strength. Additionally, Riza et al. (2011) highlight that natural soils often lack the requisite strength, stability, and durability for building purposes. This underscores the need for enhancing the strength properties of locally available building materials to bolster user satisfaction.

Limitations on Building Height: The inherent characteristics and strength profiles of traditional Sri Lankan building materials pose limitations on vertical construction. These materials lend

themselves to low-rise structures, which, unfortunately, perpetuates the demand for larger land footprints. The extensive land usage required for spreading buildings necessitates the development of new infrastructure, such as roads, drainage systems, and utility installations, inadvertently leading to habitat disruption, soil erosion, and environmental degradation.

Deforestation Conundrum: In Sri Lanka, the sourcing of building materials has implications for deforestation and its associated environmental repercussions. The procurement of timber for construction often lacks sufficient reforestation efforts, causing an imbalance between consumption and regeneration rates. This challenge exacerbates the ongoing issue of deforestation and ecosystem degradation.

Challenges to Cultural Heritage: Sri Lanka's traditional building practices have long been rooted in the sustainable utilization of local resources, harmoniously integrating buildings with the natural environment. However, the influx of imported building materials and construction methods poses a threat to this culturally resonant and sustainable approach. The shift towards imported materials endangers the time-honoured Sri Lankan architectural ethos.

Maintenance Demands: A prevalent challenge facing traditional Sri Lankan architecture pertains to the maintenance requirements of structures built from local materials, particularly earth-based construction. As highlighted by Rumana (2007), the vulnerability of earthen plinths and walls to inclement weather, especially during the wet season, necessitates regular maintenance. The material's lower inherent strength underscores the need for frequent upkeep to ensure the structural integrity of the building. Neglecting proper maintenance could lead to premature deterioration due to exposure to environmental factors such as rain and storms.

Embracing the Future: Nurturing Sri Lankan Traditional Architecture and Indigenous Building Materialsowards Progress: Fostering a Resilient Architectural Legacy and Sustainable Material Practices

Modernized Techniques for Timeless Tradition: The contemporary demand for building materials prompts the reengineering of traditional methods to meet present needs. An illustration of this innovation is the compressed earth block (CEB), an emerging alternative to adobe and wattle and daub construction. CEBs, an evolution of adobe bricks, incorporate minimal amounts (often less than 10%) of cement or lime during blending. The blend isn't manipulated to attain a plastic state, rather it's combined until cement/lime and soil thoroughly integrate. Machine pressing or hand-operated compacting follows, creating CEBs with remarkable compressive strength suitable for three-floor constructions and potentially extending to five floors [Maini, 1999]. Compared to wattle and daub, CEB construction is notably more durable and refined.

Synergy of Modern and Traditional: The reinforcement of traditional Sri Lankan building materials through integration with conventional elements enhances strength and longevity. In high-rise buildings, CEBs can serve as the walling system regardless of height, while conventional materials support foundations, reinforcement, and other structural components.

Governmental Support: Governments in Sri Lanka should endorse local building materials by incorporating them into public projects across the country. Official building codes in various regions should recognize traditional building materials as viable construction resources. Balancing construction with conservation, initiatives for tree planting and sustainable resource utilization should be paramount. To address the depletion of ozone, escalating energy consumption, and environmental concerns, the paradigm must shift towards appreciating local building materials as high-quality alternatives.

Recommendations

Government Initiatives: Sri Lankan governments should actively promote the use of locally available materials for housing projects, aligning with cultural preservation and boosting tourism for economic growth.

Tackling Housing Deficits: Given the abundant local resources, authorities should incentivize the utilization of traditional building materials to address housing shortages and enhance affordability.

Climate Resilience: Particularly in warm climates like Sri Lanka's, embracing local materials in housing construction can mitigate health risks associated with excessive heat and decrease energy demands for cooling, fostering a sustainable living environment.

Innovating for Durability: Future research endeavors should explore techniques to enhance the mechanical and durability attributes of local materials through synergies with industrial waste or other conventional materials, ensuring long-lasting housing structures.

Nurturing Local Industries: Governments can bolster local building materials industries by streamlining operational procedures, providing tax incentives, and creating an enabling environment for sustainable growth.

Flexible Planning: Regulatory bodies should reconsider stringent policies that limit the use of local building materials in urban areas, encouraging developers to embrace such resources.

Educational Reform: Academic curricula in fields like technology, architecture, and engineering should incorporate the study of locally sourced building materials. Professionals, including government officials, architects, and engineers, should lead by example, advocating for local materials as worthy alternatives to conventional options."

Conclusion

This study embarked on a comprehensive examination of the inherent advantages, prevailing challenges, and prospective avenues associated with traditional building materials in Sri Lanka, focusing on their potential to bolster the supply of cost-effective housing and alleviate affordability concerns amidst the ongoing economic crisis. The findings underscored the pivotal role of these materials in preserving cultural heritage, their easy accessibility and affordability, energy efficiency, reusability, and biodegradability. However, the study also illuminated challenges related to societal acceptance, durability, deforestation, limited strength, and the need for regular maintenance in structures constructed with traditional materials.

To combat the economic crisis and address the pressing housing needs, recommendations are made to embrace and enhance the use of indigenous traditional building resources. By actively adopting these solutions, Sri Lanka can strategically tap into its abundant wealth of local materials and skilled labor force. This approach not only promises to address the immediate housing shortfall and affordability concerns but also stimulates the local economy by generating employment opportunities within the construction sector. Ultimately, the synthesis of traditional building practices with innovative strategies can be a viable and sustainable means to alleviate the strain of the economic crisis, stimulate economic recovery, and create a positive ripple effect on various sectors of Sri Lanka's economy.

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