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Sustainable Reconstruction in Yemen: Evaluating Indigenous and Recycled Materials for Post-Conflict Infrastructure

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ABSTRACT

The protracted conflict in Yemen, ongoing since early 2015, has culminated in catastrophic damage to civil infrastructure and a near-collapse of the national economy. More than 2,900 schools have been damaged or repurposed, nearly 1,000 health facilities have been attacked, and roughly 40% of residential housing units have been affected. This report critically examines a strategic framework for sustainable post-conflict reconstruction that departs from conventional, import-dependent approaches. Central to the analysis is the proposition that resilient recovery in Yemen must be anchored in the adoption of low-cost, locally available materials, guided by the principles of the "Build Back Better" (BBB) framework. The study evaluates traditional earthen construction and recycled concrete aggregate (RCA) derived from war rubble. Findings reveal that while these materials present significant environmental and economic benefits, their effective deployment remains hindered by shortages of skilled labour, dominance of informal practices, and the absence of standardised building regulations. To address these barriers, the study proposes a comprehensive strategy built on three interdependent pillars: material innovation, capacity development, and policy reform. Together, these measures provide a pathway toward a reconstruction model that not only restores physical assets but also strengthens long-term resilience, self-reliance, and socio-economic stability in Yemen.

1. Background of the Study

Yemen's protracted civil conflict, which has persisted since 2015, has not only devastated its social fabric but has also precipitated one of the most severe humanitarian and economic crises in recent history. Even before the outbreak of war, Yemen was already the poorest country in the Middle East and North Africa (MENA) region; however, the conflict has dramatically intensified this fragility, resulting in a 58% decline in real GDP per capita and pushing the vast majority of its citizens below the poverty line [1] . The ramifications of this economic collapse have been dire: more than 17 million people are facing acute food insecurity, while approximately 18 million lack reliable access to

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safe drinking water and sanitation services [2]. Moreover, the destruction of critical infrastructure has created cascading social impacts, compelling families to adopt harmful coping mechanisms such as withdrawing children from school or engaging in precarious forms of labour. In fact, *an estimated 2,916 schools—at least one in every four—have been destroyed, partially damaged, or converted to non-educational use, illustrated in* figure 1, as a result of the conflict [3].

Fig. 1. Destroyed school buildings where classes continue amid rubble, highlighting the severe impact of conflict on education infrastructure: Children studying in a destroyed schools in Taiz, Yemen. Extracted from [4] and [5].

These dynamics not only erode human capital but also weaken the foundation for long-term recovery and development [6]. Against this backdrop, it becomes evident that reconstructing Yemen's civil infrastructure is not merely a technical necessity but a foundational requirement for humanitarian relief, socio-economic stabilisation, and eventual national recovery.

Nevertheless, conventional reconstruction strategies that depend heavily on costly imported materials have proven unsustainable in contexts characterised by extreme economic fragility. Such approaches often exacerbate dependency, inflate project costs, and fail to address the systemic vulnerabilities that render communities highly susceptible to future shocks [7]. Therefore, there is a pressing need to embrace an alternative paradigm that aligns more closely with Yemen's realities one that leverages local capacities, reduces economic burdens, and fosters long-term resilience. Sustainable reconstruction offers such a pathway by prioritising the use of low-cost, locally available materials, which can reduce overall project costs by 20–30% while also lowering environmental impacts associated with transportation and embodied energy [8]. In doing so, reconstruction efforts move beyond the mere replacement of lost assets to serve as catalysts for creating self-reliant, climate-sensitive, and economically viable communities [9].

Guiding this vision is the "Build Back Better" (BBB) framework, which provides a holistic theoretical foundation for post-disaster and post-conflict recovery. The central tenet of BBB is that reconstruction should not simply restore systems to their pre-disaster state but should instead seize the opportunity to address structural vulnerabilities, enhance resilience, and promote long-term regeneration [10], [11]. Significantly, BBB extends beyond physical rebuilding to encompass social, economic, and environmental dimensions of recovery. Within the sphere of infrastructure, this framework calls for strengthening building codes, adopting context-sensitive technologies, and ensuring that restored systems are better equipped to withstand future disruptions. In addition, it emphasises livelihood restoration and economic revitalisation, thereby situating reconstruction as both a humanitarian imperative and a strategic opportunity for transformative development [9]. For

Yemen, where conflict has simultaneously eroded infrastructure, livelihoods, and institutional capacities, the BBB framework presents a particularly relevant and robust approach.

Against this conceptual and practical backdrop, the present study examines the feasibility of employing locally sourced, low-cost materials in rebuilding Yemen's war-torn civil infrastructure. Specifically, it focuses on essential sectors such as roads, water supply systems, and housing, which have suffered extensive damage and are crucial to restoring socio-economic stability. The study first contextualises the scale of destruction and critically reviews existing scholarship on sustainable reconstruction. It then evaluates potential material alternatives from technical, economic, and socio-cultural perspectives, while also interrogating the socio-economic barriers that may hinder their widespread adoption. Finally, the study proposes strategic recommendations that integrate material innovation, capacity building, and policy reforms into a cohesive framework for sustainable and resilient reconstruction. Through this comprehensive approach, the research not only contributes to academic discourse on post-conflict rebuilding but also offers practical pathways for fostering long-term resilience and self-reliance in Yemen.

2. Literature Review

2.1 The Extent of Civil Infrastructure Damage in Post-Conflict Zones

The targeting of civil infrastructure has become a pervasive characteristic of modern warfare, and Yemen's conflict is a tragic case in point . Reports indicate that warring parties have carried out unlawful attacks against civilian objects, including homes, hospitals, schools, and bridges [11]. A confidential report from 2016 provided an early, though partial, assessment, estimating the cost of damage to Yemen's infrastructure and economy at over $14 billion, a figure that has undoubtedly escalated due to the conflict's continuation [12]. Specific sectors have been disproportionately affected. For instance, a survey by Yemen's education ministry noted that of 1,671 damaged schools, 287 required major reconstruction, while 544 were being used as shelters for internally displaced persons [13]. Similarly, the Ministry of Public Health and Population reported in 2016 that half of the public hospitals in Taiz, Yemen's third-largest city, were damaged or inaccessible, leading to a surge in civilian morbidity and mortality [14]. According to a global study by Yousuf et al. (2021) [15], Yemen experienced 978 attacks on health facilities between 2016 and 2020, alongside more than 4,000 attacks or threats against healthcare systems, resulting in hundreds of healthcare worker casualties and kidnappings. Thus, the deliberate targeting of these facilities underscores a pattern of conflict that extends beyond military objectives to undermine the very foundations of civilian life.

Fig. 2. The hospital in the northern town of Abs was badly damaged during the conflict [16]

2.2 Theoretical Approaches to Sustainable Post-Conflict Recovery

The reconstruction of civil infrastructure in conflict-affected regions demands a nuanced theoretical approach that extends beyond simple rebuilding. The Building Back Better (BBB) framework, which gained prominence following large-scale disasters such as the 2004 Indian Ocean Tsunami, provides a powerful conceptual lens for this endeavour [9]. The approach advocates for integrating disaster risk reduction measures into all recovery activities, such as by improving structural designs and enforcing updated building codes to enhance the resilience of physical assets [14]. Furthermore, the BBB philosophy emphasises that reconstruction offers a unique opportunity to address a community's pre-existing vulnerabilities across physical, social, economic, and environmental domains [9]. For example, recovery can be used as a chance to modernise telecommunications equipment or "right-size" public infrastructure to meet community needs better [17]. Fundamentally, BBB is not about restoring a status quo but about using the reconstruction period to create a new, more resilient state of normalcy [9].

2.3 An Overview of Sustainable, Low-Carbon Building Materials

In an era of increasing environmental awareness, the global construction industry is shifting towards materials with a lower carbon footprint and reduced environmental impact [17], [18] . Research indicates that local materials, such as earthen aggregates, offer a higher potential for lower environmental impacts and costs, whereas global materials may possess superior technical performance. Sustainable building materials are often characterised by their low embodied energy, the energy consumed throughout their life cycle from extraction to disposal [7]. For instance, unfired earthen materials require virtually no heat or fuel for their production, in stark contrast to conventional cement, which contributes at least 8% of global CO2 emissions [19]. Other innovative materials include recycled concrete aggregates and a range of bio-based materials like date palm fibres, which are being explored for their potential to reduce the reliance on conventional, high-carbon materials. However, it is important to note that many of these materials are still in the research and development phase and have not yet reached widespread implementation [18].

3. Methodology

This study employed a systematic literature review (SLR) guided by the PRISMA 2020 (Figure 3) protocol to ensure transparency, rigour, and reproducibility. A formal review protocol was established in advance, detailing the research questions, inclusion and exclusion criteria, search strategy, and data extraction procedures. This framework reduced potential researcher bias while enhancing the reliability of findings. The search strategy was multifaceted, encompassing both peer-reviewed publications and grey literature to capture the technical, socio-economic, and policy dimensions of sustainable reconstruction in conflict-affected contexts. Systematic searches were conducted across major academic databases such as Scopus, Web of Science, ScienceDirect, and Google Scholar using carefully constructed search strings that combined terms related to “post-conflict reconstruction,” “sustainable reconstruction,” “low-cost materials,” and “civil infrastructure.” To enrich the analysis with practical insights, supplementary searches were performed in grey literature sources, including reports from the World Bank, UN-Habitat, and the United Nations Development Programme (UNDP).

The screening process followed a structured, multi-stage approach consistent with PRISMA guidelines. Initially, all titles and abstracts were assessed for relevance, after which eligible full texts were retrieved and evaluated against the predefined criteria. Studies were included if they were peer-reviewed, published in English between 2000 and 2025, addressed material performance in reconstruction, and were situated in post-conflict or disaster environments. Exclusions applied to military or irrelevant geographic studies and those outside civilian reconstruction. Data extraction was conducted systematically, capturing details such as authorship, year, material type, performance metrics (e.g., cost, durability, and sustainability), test methods, and geographical context. A narrative synthesis, supported by thematic coding and tabular summaries, was used to organise the findings. At the same time, the quality of studies was evaluated using an adapted version of the Multidimensional Measurement Tool (MMAT). This ensured that the final dataset was both contextually relevant and methodologically robust, providing a reliable evidence base for assessing sustainable material options in Yemen's reconstruction.

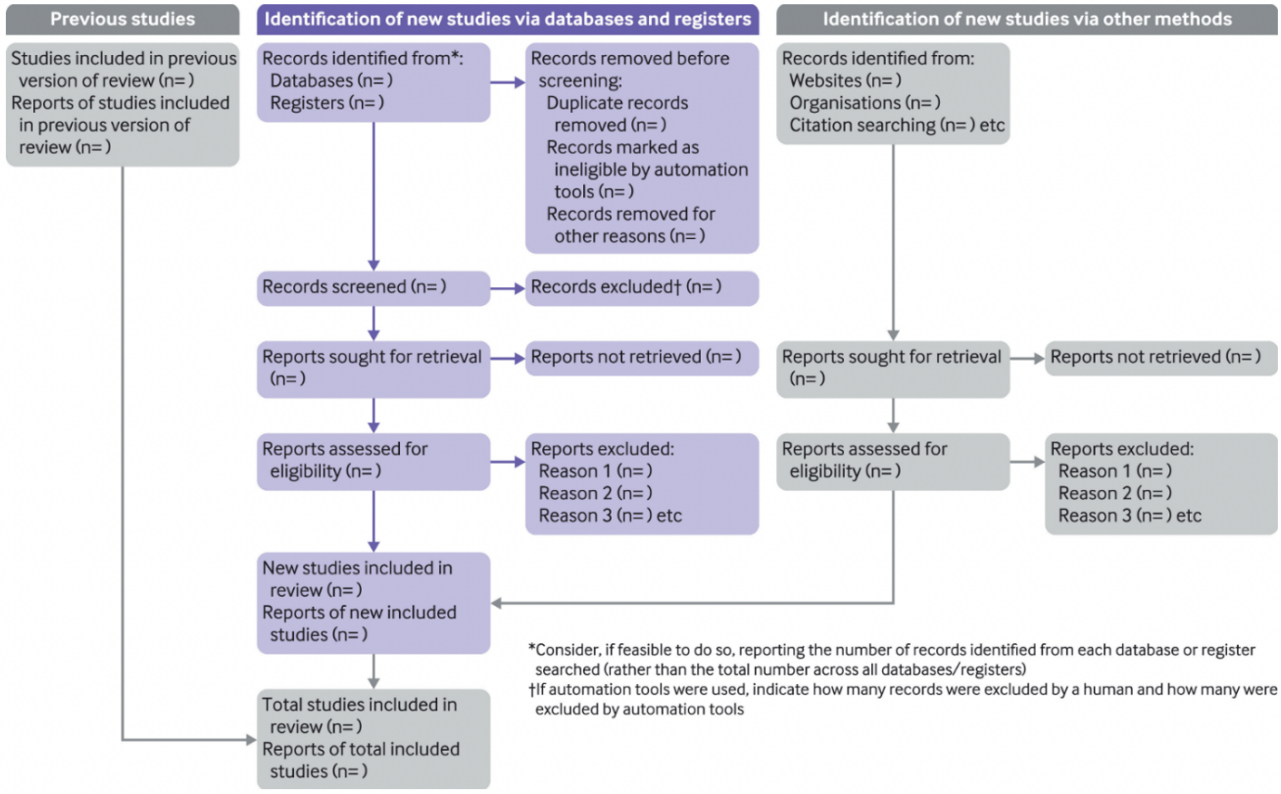

Fig. 3. PRISMA 2020 flow diagram template for systematic reviews [20]

4. Results

4.1 The State of Civil Infrastructure in Yemen

Analysis of War-Related Damage to Roads and Transport Networks

Yemen's road and transport networks have suffered extensive damage, severely impeding the flow of goods, services, and humanitarian aid. The Yemen Integrated Urban Services Emergency Project (YIUSEP), for instance, has undertaken the rehabilitation of hundreds of kilometers of urban and rural roads, while also improving drainage systems and constructing bridges to restore mobility and connectivity [19]. However, the crisis is not solely a function of physical destruction from airstrikes. The deliberate weaponization of critical transport routes by warring parties has compounded the humanitarian crisis. Since 2015, access to Taizz, Yemen's third-largest city, has been

severely restricted, with major roads closed, limiting the movement of civilians and the delivery of essential goods and medicine [21]. This intentionality of destruction demonstrates that a reconstruction plan must not only address the physical damage but also acknowledge the profound political and security dimensions of the conflict.

Fig. 4. Cars and trucks wait in line to pass over a bridge that was hit by an airstrike in 2016. This road is one of four roads linking Hodeida (Al Hudayda) with the rest of the country **[22]**

The Crisis of Water and Sanitation Systems

The lack of access to safe drinking water and sanitation is a pervasive crisis in Yemen, affecting 18 million people [21]. While the conflict has directly damaged water infrastructure, the crisis is also a result of long-term environmental vulnerabilities and the strategic weaponization of resources [23]. This strategy of using water as a weapon of war has had especially harmful impacts on children, with many having to drop out of school to travel and queue for water for their families. Furthermore, the crisis precedes the conflict, as Yemen's groundwater levels have been dropping for decades, with some areas experiencing declines of up to 7 meters per year [14]. This multifaceted crisis necessitates a reconstruction approach that addresses both the immediate, conflict-related damage and the long-term, pre-existing environmental challenges.

The Impact on Housing and Community Facilities

The conflict has inflicted severe damage on civilian housing and essential community facilities, often as a result of unlawful and indiscriminate attacks [24] . A confidential report indicated that an assessment in just four cities (Sanaa, Aden, Taiz, and Zinjibar) found an estimated $3.6 billion in residential damage [24]. The report also provided a stark picture of the impact on community facilities, with 1,671 schools suffering damage and 900 of 3,652 vaccination facilities not operating in early 2016, placing 2.6 million children at risk [14]. Moreover, environmental reconstruction analyses suggest that approximately 40% of residential housing units across Yemen have been either partially or completely destroyed due to cumulative conflict impacts [25]. These figures, while partial, underscore the widespread destruction of the social infrastructure that is critical for community health, education, and stability.

The Continuing Threat of Landmines and Unexploded Ordnance

Beyond the visible destruction, a far more insidious and persistent threat to reconstruction is the widespread use of landmines and unexploded ordnance (UXO). These deadly remnants of war continue to be a leading cause of civilian casualties, with a notable increase in child casualties even during periods of relative calm [26]. This creates a critical and often insurmountable barrier to reconstruction and recovery. Without extensive and well-funded mine-clearing operations, areas with objects critical for survival—such as farmland and water sources—remain dangerous and inaccessible, which has directly exacerbated the humanitarian crisis and contributed to the starvation of civilians [26]. The presence of these devices makes any physical reconstruction effort unsafe and ineffective, as communities cannot safely return to or rebuild in contaminated areas. Thus, mine clearance is not merely a security concern but a foundational prerequisite for any meaningful reconstruction to begin.

4.2 Evaluation of Low-Cost, Locally Available Materials
Traditional Earthen and Stone Construction

Yemen possesses a rich and ancient tradition of earthen and stone architecture, exemplified by the Old Walled City of Shibam, a UNESCO World Heritage site known for its towering mudbrick structures [27][28]. This historical precedence demonstrates the durability and ingenuity of these materials. Earthen materials are exceptionally sustainable, possessing extremely low embodied energy due to their minimal processing requirements and their local abundance [29]. They are also fully recyclable, with structures being easily disassembled and returned to the earth at the end of their lifespan. From a performance perspective, mudbrick and stone structures can be quickly erected, offer good insulation for both heat and sound, and have a natural resistance to fire and insects [14]. However, despite their proven historical and environmental credentials, there exists a significant disconnect between the cultural value of these materials and their modern-day perception. While the soaring mudbrick buildings of Shibam are celebrated, earthen homes are often associated with poverty and lack of modernity [30]. This social stigma presents a considerable barrier to their widespread adoption in modern reconstruction efforts. A successful strategy must, therefore, not only address technical challenges, such as strengthening earthen materials against water and seismic activity, but also undertake a campaign to reframe these traditional materials as symbols of resilience and cultural heritage rather than as relics of a bygone era [18].

4.3 Recycled Concrete Aggregate (RCA) from War Rubble

The immense quantity of concrete rubble left behind by the conflict in Yemen can be viewed not as a liability but as a valuable and abundant resource for reconstruction. The innovative use of Recycled Concrete Aggregate (RCA) from this rubble offers a promising and sustainable path forward.

Fig. 5. Natural and recycled aggregates used in the study [31]

Technical Performance and Durability Enhancements

Groundbreaking research from the University of Sheffield, in collaboration with Syrian academics, has demonstrated that RCA from war rubble can be used to replace up to 50% of the raw materials in new concrete without significantly compromising its performance [30]. However, the use of RCA presents a key technical challenge: concrete with RCA (RAC) generally exhibits weaker durability and reduced mechanical properties compared to concrete made with natural aggregates. Fortunately, these shortcomings can be effectively mitigated through the addition of mineral admixtures, such as fly ash (FA) and silica fume, which enhance the concrete's workability, compressive strength, and resistance to carbonation and chloride-ion diffusion [32]. This research highlights that while RCA has inherent limitations, they are surmountable with a strategic approach to material science.

Cost and Environmental Life Cycle Analysis

From a cost perspective, the utilization of RCA offers substantial economic benefits for a country like Yemen. By reducing the need to import raw materials, the cost of reconstruction is made significantly quicker and cheaper [30]. Furthermore, a life-cycle cost analysis has shown that buildings constructed with a mix of RCA, FA, and structural fibers can achieve up to 21% in cost savings over a 50-year lifespan, with the most significant savings coming from a 76% reduction in maintenance costs. Environmentally, the benefits are equally compelling. The recycling of rubble drastically reduces the volume of landfill waste and lowers the embodied energy of the final product, contributing to a circular economy model and a more sustainable rebuilding process [18], [32].

4.4 Other Indigenous and Waste Materials

In addition to earthen materials and concrete rubble, other indigenous and waste materials offer potential for sustainable reconstruction. Research has shown the potential of bio-based materials, such as date palm fibers, which are abundant in the region, to serve as reinforcement or as partial replacements for cement and aggregates [18]. The use of these natural fibers can lead to lightweight materials with high tensile behavior, which could be particularly valuable for structures in seismically active areas [30]. However, it is important to acknowledge that many of these materials are still in the research and development phase and require further investigation and testing to ensure their viability and performance under real-world conditions before they can be widely adopted for civil infrastructure [18].

Table 1
Comparative Analysis of Low-Cost, Locally Available Construction Materials for Yemen) [18], [32]

Material Type	Cost-Effectiveness	Sustainability /Environmental Impact	Durability & Performance	Socio-Cultural Relevance
Earthen Materials (e.g., Mud Brick)	Highly cost-effective; low initial investment	Extremely low embodied energy; abundant; locally	Varies; requires protection from water; can be vulnerable to seismic activity; low compressive strength	Deeply rooted in cultural heritage (e.g., Shibam); traditional knowledge base exists; associated with poverty
Recycled Concrete Aggregate (RCA)	Reduced material and transport costs; potentially lower life cycle	Reduces landfill waste and reliance on virgin materials; lower	Durability and strength can be weaker than natural aggregate concrete;	Novel application; potential to address massive waste problem;

	cost with proper treatment;	embodied energy than new concrete	performance can be enhanced with admixtures	requires new skills and policy support
aPlant-Based Fibres (e.g., Date Palm)	Very low cost; abundant local resource	Reduces cement and aggregate content; biodegradable and renewable	Improves flexural strength and tensile behavior; decreases compressive strength; adds lightweight properties	Traditional use in some composites; promotes local agriculture and livelihoods

4.5 Socio-Economic Dimensions of Reconstruction

Challenges and Resilience of the Local Construction Sector

Despite the immense challenges posed by the conflict, Yemen's local contracting sector has demonstrated remarkable resilience and adaptability. However, this sector operates within a fragile and deeply flawed ecosystem characterized by pervasive systemic barriers [33]. These include ongoing security issues, ineffective legislation, and widespread corruption, which have forced much of the industry into an informal sector, leading to a decline in quality and standardization. A critical and often overlooked barrier to development is the country's historic loss of skilled labour. For decades, Yemen exported its workforce to Gulf countries, draining its pool of human resources and creating a cycle of dependency [29]. This deficit in skilled labour has directly contributed to the country's heavy reliance on imports, which comprise an astonishing 60-70% of construction costs in the modern sector [34] . This high dependence on foreign materials not only strains the economy but also makes reconstruction prohibitively expensive. Consequently, a sustainable reconstruction plan cannot succeed without simultaneously addressing the underlying issues of human capital, policy, and governance.

The Role of Community Empowerment and Livelihood Generation

Effective post-conflict reconstruction is not a top-down process; it is a collaborative effort driven by the needs and capacities of affected communities. The Building Back Better framework emphasizes using the recovery process as a strategic opportunity to promote resilient livelihoods and empower local populations [9]. Initiatives like "cash-for-work" programs, which are supported by organizations such as the World Bank and UNOPS, offer a dual benefit: they enable the restoration of critical services and infrastructure, such as roads and water systems, while also providing a sustainable source of income for food-insecure households [29]. By investing in local community groups and engaging residents in the rebuilding process, projects not only ensure viable local solutions are developed but also contribute to the economic and psychosocial recovery of the community [9], [29].

4.6 Barriers to Implementation: Policy, Finance, and Skilled Labour

The successful implementation of a sustainable reconstruction strategy faces formidable barriers. From a policy perspective, a lack of approved national building codes, standards, and specifications has resulted in projects that are often either over-designed or inappropriate for local needs [33]. Financially, contractors frequently face a lack of support from institutions, compelling them to undertake projects with their own capital and often leading to cost-cutting measures that

compromise quality [33]. Perhaps most critically, the ongoing challenge of a depleted skilled labour pool remains a foundational problem. Rebuilding the workforce requires extensive vocational training programs and a concerted effort to create a more formal, secure, and regulated construction sector that can attract and retain talent [29].

5. Discussion and Strategic Recommendations

The analysis presented in this report reveals that the challenges facing Yemen's reconstruction are deeply interconnected and cannot be solved with a purely technical or material-based approach. The full potential of low-cost, locally available materials can only be realized through a convergence of material innovation, economic policy, and social acceptance. A comprehensive and resilient reconstruction strategy for Yemen must be founded on three interdependent pillars:

i. **Material Innovation:** Actively promote and invest in the use of both traditional earthen construction and the innovative application of recycled concrete aggregate from war rubble. This requires further research to develop context-specific standards and techniques that enhance durability and performance.

ii. **Capacity Building:** Prioritize the development of a skilled local workforce through targeted vocational training programs, apprenticeships, and "cash-for-work" initiatives. This will not only address the critical shortage of labour but will also stimulate the local economy and reduce the dependence on costly foreign expertise and imports.

iii. **Enabling Environment:** Advocate for and support policy and legislative reforms that formalize the construction sector, establish and enforce standardized national building codes for both traditional and novel materials, and improve access to financial support for local contractors and communities.

Furthermore, the success of any one pillar is contingent upon the others. For example, the widespread adoption of Recycled Concrete Aggregate (RCA) from war rubble, while technically and environmentally sound, is impossible without the establishment of new building codes that recognize and regulate its properties [33]. Similarly, the revival of Yemen's rich tradition of earthen architecture, which is critical for cultural and environmental sustainability, requires not only a technical understanding of its application but also a concerted effort to overcome the negative social perceptions associated with it [8]. The BBB framework provides the ideal conceptual guide for this integration, ensuring that material solutions are aligned with the development of human capital and are supported by a robust legal and governance framework.

Identifying Key Research Gaps and Future Directions

While the conceptual framework for sustainable reconstruction is clear, significant research gaps remain. Future work should focus on context-specific empirical studies on the durability of local materials in Yemen's unique climate, including resistance to floods, wind, and seismic activity [8]. A detailed life-cycle cost analysis of various material options, taking into account transportation, labour, and maintenance costs, is also needed to provide a robust economic justification for their use. Furthermore, research into best practices for training local labour, formalizing the construction sector, and integrating community-led initiatives into larger reconstruction projects is critical to translate these strategic recommendations into tangible, on-the-ground action [18], [33].

Table 2
Key Barriers and Strategic Recommendations for Yemen's Reconstruction

Category of Barrier	Specific Barrier	Evidence from Research	Strategic Recommendation
Humanitarian/Security	Ongoing conflict and deliberate targeting of infrastructure; threat of landmines and UXO.	[29]	Integrate reconstruction with peace-building initiatives and prioritize well-funded mine/UXO clearance operations.
Economic	Plunging GDP and widespread poverty; heavy reliance on costly imports (60-70% of construction costs).	[33]	Implement programs that reduce import dependency and foster local material sourcing and production.
Human Capital	Loss of skilled labour due to emigration; lack of technical expertise in new and traditional methods.	[30]	Invest in comprehensive vocational training and "cash-for-work" programs to rebuild local capacity.
Policy/Governance	Lack of standardized national codes and legislation; corruption and informal activities.	[33]	Advocate for legislative reform, including the development of new building codes and standards for local and recycled materials.
Socio-Cultural	Negative perception of traditional building materials (e.g., earthen homes) associated with poverty.	[35]	Launch education and community engagement campaigns to re-frame traditional architecture as a symbol of cultural heritage and resilience.

6. Conclusion

The ongoing conflict in Yemen has resulted in unprecedented physical and economic devastation. Evidence from this study indicates that dependence on costly, import-dependent construction materials is not only economically unsustainable but also environmentally detrimental. A viable alternative exists in the utilization of locally available resources—particularly recycled concrete aggregate (RCA) from war rubble and traditional earthen materials. Insights from post-conflict regions illustrate the practicability of leveraging indigenous and recycled materials to restore essential infrastructure. Therefore, the adoption of a locally driven reconstruction model is not merely a strategic decision but also an economic, environmental, and social imperative. The study relies on a systematic literature review without primary field testing in Yemen's climate or mine-contaminated areas, limiting empirical validation of material durability. Realising this vision necessitates coordinated efforts among diverse stakeholders: international donors must prioritise support for community-based initiatives; national policymakers should incentivise the use of local materials and offer technical training; and academic institutions must advance empirical, field-based research. By harnessing its own resources and cultural heritage, Yemen can effectively restore its

infrastructure while simultaneously promoting social cohesion, economic self-reliance, and long-term resilience—even amidst the deep scars left on its educational, health, and housing systems.

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