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Drivers and Barriers to the Use of Nature-Based Construction Materials in the Hindu Kush Himalaya Region



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Executive Summary

The Hindu Kush Himalaya (HKH) region extending 3500 km over all or part of the eight countries (Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan), is home to four global biodiversity hotspots and the source of 10 major Asian river systems that benefit some 270 million people in the HKH and over 2 billion people in the river basins downstream, a fourth of the world's population.

The region faces growing pressure to meet rising housing and infrastructure demand under conditions of climate and disaster risk, rapid urbanisation, and constrained resources. Construction practices across the region are increasingly dominated by cement, steel, and fired brick; materials that are energy-intensive and often poorly suited to mountainous and environmentally fragile contexts. At the same time, the HKH has a long history of rich culture and traditions embedded in contextualized nature-based construction using earth, timber, bamboo, and stone—systems that have evolved in response to globalization, seismic risks, development aspirations of mountain people and material availability through market linkages.

This report provides a regional snapshot of the current state of nature-based construction across the HKH. It draws on scoping review, a regional online survey of 102 stakeholders, and direct interviews with practitioners working across eight countries. The aim is to identify patterns, constraints, and emerging opportunities that can inform future policy, investment, and research.

The analysis shows that nature-based materials remain widely used in rural and low-income contexts and continue to play a vital role in heritage conservation and post-disaster reconstruction. In several HKH countries, these systems have demonstrated resilience in the face of earthquakes, floods, and extreme climatic conditions. However, their use in mainstream housing and infrastructure remains limited.

Five cross-cutting barriers consistently emerged across the countries and stakeholder groups.

First, raw material supply chains for bamboo, timber, and earth are fragmented and largely informal, limiting reliability and scalability.

Second, technical infrastructure including testing facilities, certification systems, and product standards is underdeveloped, leaving many nature-based systems unable to gain regulatory approval or market confidence.

Third, market awareness and perceptions strongly favour industrial materials, which are widely associated with modernity, social status and durability, while natural materials are often stigmatised as informal or outdated.

Fourth, skills and labour constraints are growing, as traditional construction knowledge erodes and training pathways for vernacular systems remain limited.

Finally, policy and regulatory frameworks, while increasingly recognising nature-based materials, are weakly enforced and poorly integrated with finance, procurement, and inspection systems.

Despite these constraints, the report identifies important areas of momentum. Demonstration projects in countries such as Bangladesh, Nepal, and Bhutan show how nature-based systems can be adapted to meet contemporary performance requirements. Post-disaster reconstruction programmes have created policy and institutional footholds for vernacular systems, while hybrid approaches—such as compressed stabilised earth blocks and reinforced bamboo—illustrate pathways for modernising traditional materials. Across the region, practitioners expressed interest in strengthening validation, training, and certification to support wider uptake.

A key finding is that the primary challenge facing nature-based construction in the HKH is not technical feasibility, but systemic alignment. Progress depends on coordinated action across policy, markets, skills development, and institutional capacity, rather than isolated pilot projects or technical fixes. There is also a risk that without timely intervention, skills, knowledge systems, and local value chains associated with nature-based construction will continue to decline, making future transition efforts more difficult and costly.

The report concludes that nature-based construction remains a viable but underutilised component in the current construction practices across the HKH's built environment.

Advancing its role will require targeted measures to strengthen supply chains, build technical and institutional capacity, improve market confidence, and enable regional learning and capacity sharing. The recommendations that follow outline practical steps to address these challenges and support a more resilient, locally grounded construction sector in the region.



1. Introduction and Methodology

1.1 Context

The Hindu Kush Himalaya (HKH) is one of the most critical and fragile mountain systems in the world. Stretching across Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan, it provides food, water, and energy security to 270 million residents directly and over two billion people downstream (ICIMOD, 2025). Yet the region is acutely vulnerable to the combined pressures of climate change, biodiversity loss, rapid population growth, and unplanned urbanisation.

The built environment lies at the heart of this challenge. Housing demand is rising sharply, driven by demographic change and urban expansion. Current trajectories suggest that this demand will be met primarily through energy-intensive materials such as cement, steel, and fired brick. While these materials are widely perceived as symbols of social status, progress and modernity, they carry heavy environmental costs. Cement production alone is a major driver of global carbon emissions, while brick kilns in South Asia are linked to severe air pollution.

At the same time, the region possesses a rich heritage of vernacular construction using earth, timber, stone, and bamboo. These systems have evolved over centuries, finely tuned to local climates and hazards. Timber-laced masonry has proven resilience against earthquakes in Nepal and Pakistan; bamboo structures in Bangladesh provide flexible, affordable housing in flood-prone areas; and rammed earth in Bhutan offers thermal comfort in mountainous climates. These materials are renewable, locally sourced, and often far less carbon-intensive than industrial alternatives.

Yet despite these strengths, nature-based construction is in decline. Traditional methods are increasingly stigmatised as “backward” or “temporary,” skills are eroding, and policies either neglect them or enforce them only weakly. The HKH now faces some important choices: whether to continue with high-carbon, resource-intensive materials that strain the ecosystems, or to revitalise and modernise its own heritage of sustainable construction.

This report explores the state of nature-based construction across the HKH, identifying key trends, barriers, and opportunities for scaling locally available materials. It draws on regional scoping review, over 100 online survey responses, and targeted interviews with architects, builders, policymakers, and civil society actors across all eight countries. While not exhaustive, this study aims to map the landscape, highlight promising cases, and inform future action by governments, practitioners, and investors.

The report begins with a regional overview of construction practices and policy trends, followed by country-level snapshots, a thematic analysis of cross-cutting barriers and opportunities, and a set of practical recommendations. The scope of the study is region-wide but recognises the diversity of practices and contexts across the HKH. Rather than providing exhaustive national inventories, the report identifies patterns, contrasts, and illustrative cases that speak to the opportunities and barriers across the system.

1.2 Methodology

The report draws on two primary sources of evidence: a scoping review of literature and policy documents, and a regional online survey and interviews of stakeholders across the HKH.

The scoping review covered all eight HKH countries, drawing on national building codes, housing and construction policies, academic and grey literature, and case studies from NGOs, research institutions, and international development agencies. It aimed to identify where nature-based materials are in use, how they are reflected in policy, and what systemic factors influence their uptake.

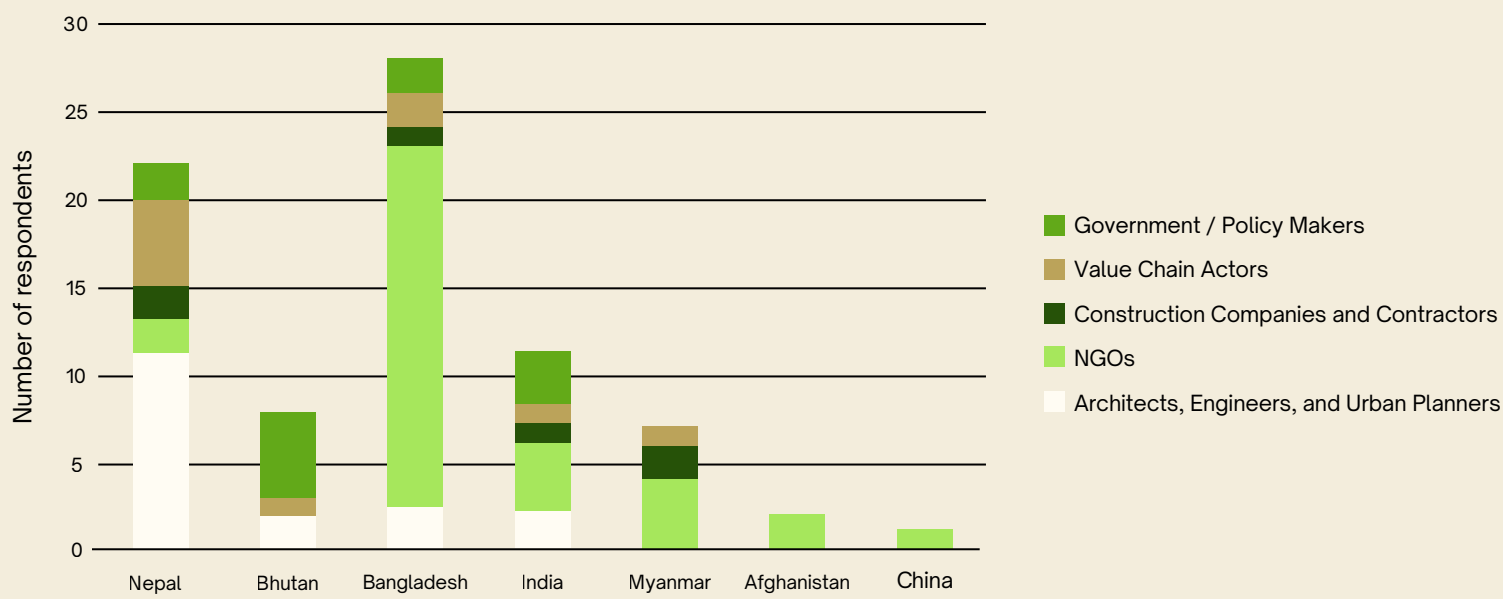
To complement this, an open online survey was conducted between April and July 2025 using Kobo Toolbox. A total of 102 responses were received, unevenly distributed across countries. The highest response rates came from Bangladesh (28), Nepal (22), and Pakistan (20), with smaller numbers from India (11), Bhutan (8), Myanmar (7), China (4), and Afghanistan (2).

Respondents represented a range of stakeholder groups: NGOs and civil society organisations (42), architects and engineers (24), building contractors (12), value chain actors (12), and policymakers (12). The survey gathered perspectives on the use of natural materials, barriers to adoption, policy effectiveness, and opportunities for innovation.

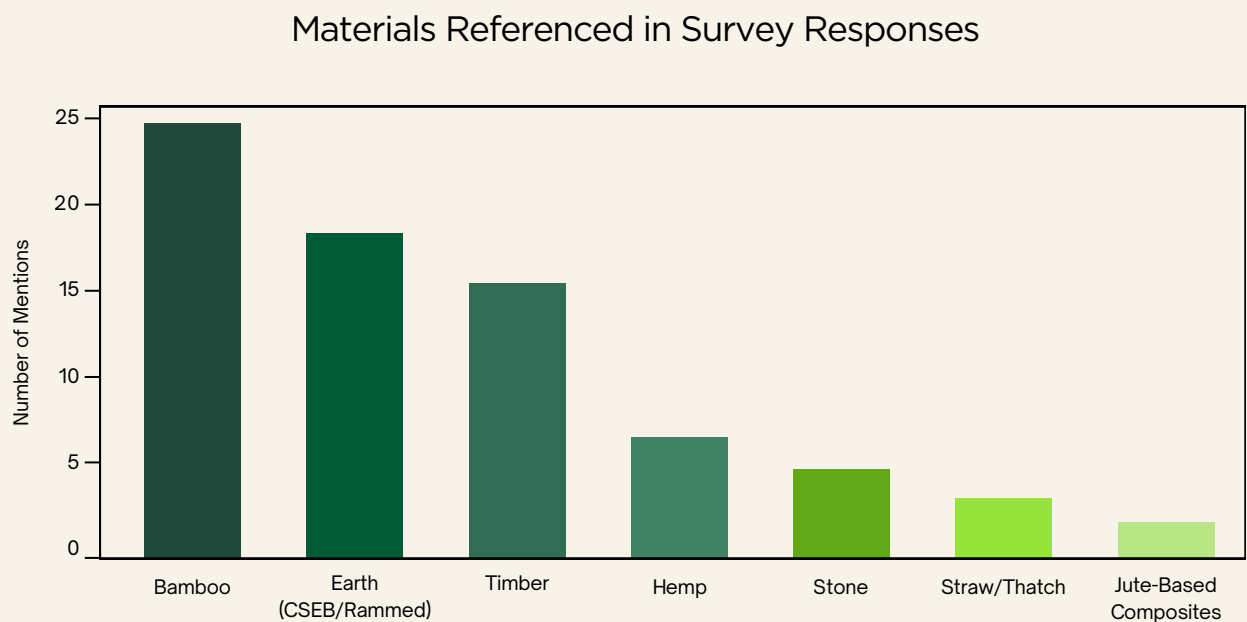


Erica Udas/ICIMOD

Survey Responses



When asked about materials currently in use, respondents most frequently mentioned bamboo, earth, and timber. The figure below shows the frequency with which each material was cited. Trends in less-represented materials such as hemp, stone, straw/thatch, and jute-based composites should be interpreted with caution given the limited number of responses.



While the survey offered valuable insight into stakeholder perceptions—particularly among NGOs and design professionals—the sample was skewed. Government officials, contractors, and material suppliers were underrepresented, and some countries, notably Afghanistan and China, had minimal participation. As such, the survey should be understood as an indicative snapshot rather than a representative dataset.

To deepen the analysis and test emerging themes, semi-structured interviews were conducted with practitioners and experts from across the region. Interviewees included architects, policy specialists, and contractors with direct experience in nature-based construction. The interviews explored consumer perceptions, regulatory enforcement, training gaps, and innovation potential.

The survey has several limitations that should be acknowledged. Responses were concentrated in Bangladesh, Nepal, and Pakistan, with limited representation from Afghanistan, China, and Myanmar. The sample was also skewed toward NGOs and civil society organisations, while contractors, policymakers, and value chain actors were underrepresented. In addition, policies and building codes in several HKH countries are currently under revision, meaning the findings reflect a snapshot in time. Given these limitations, the analysis emphasises areas where multiple evidence streams converge, and notes explicitly where findings rest on thin or uneven data.

2. Regional Context

2.1 Regional overview and drivers

The HKH region faces a dual challenge: it is both highly vulnerable to climate change and undergoing rapid, often unplanned urbanisation.

Traditional building systems that evolved over centuries—using earth, stone, bamboo, and timber—have provided housing adapted to seismic, climatic, and cultural identity. However, these systems are increasingly being displaced by concrete and steel, which are perceived as modern and aspirational (UN-Habitat Afghanistan, 2017; Government of Bhutan, 2020). This shift is not only changing skylines but also increasing embodied carbon in the built environment and eroding locally embedded knowledge.

The decline of vernacular methods is tied to several structural drivers. Policy frameworks have historically neglected nature-based materials, leaving them without the same recognition or legitimacy as industrial alternatives (Government of Bangladesh, 2015; Government of Nepal, 2020). Market competition is another key factor: cement and steel industries benefit from economies of scale, subsidies, and established supply chains, while small-scale producers of natural materials remain fragmented and undercapitalised (Government of Pakistan, 2025). Social perceptions also play a strong role: natural materials are frequently associated with poverty, fragility, or informality, even when evidence shows their resilience and affordability (INTACH, 2019; BRAC University, 2020). Against this backdrop, efforts to reintroduce or update natural building systems are often positioned as niche or experimental rather than mainstream solutions.

Historically, the HKH region has demonstrated remarkable diversity in construction techniques, each adapted to local geographies. Rammed earth and stone construction dominate in Bhutan, Afghanistan, and high-altitude areas of India and Nepal, providing thermal mass and durability (Government of Bhutan, 2020; UNDP Afghanistan, 2013). Bamboo has been integral in Bangladesh, Myanmar, and northeast India, offering flexibility, renewability, and cultural familiarity (BRAC University, 2020; UN-Habitat Myanmar, 2020). Timber-laced masonry, such as the Dhajji Dewari system in Pakistan and similar methods in Nepal, is widely recognised for its seismic performance (Government of Pakistan, 2007; Government of Nepal, 2020). Hybrid systems that combine earth and bamboo have gained traction in Nepal, supported by organisations like Adobe and Bamboo Research Institute (ABARI).

Today, however, the prominence of these practices is shrinking. Migration, changing housing aspirations, and rising incomes have encouraged households to seek concrete and steel solutions, even in regions where local resources are abundant (UN-Habitat Myanmar, 2020). Skills shortages further exacerbate the decline, as fewer young builders are trained in vernacular methods (INTACH, 2019). Despite this, pockets of innovation persist. ABARI's hybrid bamboo-earth projects, Bangladesh Rural Advancement Committee's (BRAC) modular flood-resilient bamboo housing, and conservation efforts in Bhutan show that nature-based approaches can meet modern needs for safety, durability, and cultural continuity (BRAC University, 2020; Government of Bhutan, 2020).



2.2 Material availability and value chains

The value chains for natural building materials across the HKH are highly localised and uneven. Supplies of bamboo, timber, and earth are often seasonal and tied to community-managed resources or small-scale artisanal producers (Practical Action Bangladesh, 2018). While these materials are abundant in some contexts, their extraction, processing, and transport are constrained by weak infrastructure and lack of investment. This creates a patchwork of availability that hampers scale-up.

Demand is also segmented. In rural and lower-income communities, natural materials continue to play a major role due to affordability and accessibility. In contrast, urban and peri-urban areas are dominated by industrial materials, reflecting both consumer preference for “modern” housing and the marketing strength of established industries (Government of Pakistan, 2025). Construction finance mechanisms typically favour conventional materials, reinforcing the dominance of cement and steel (Government of India, 2016).

Another feature of the value chain is fragmentation. The chain from resource extraction to finished construction is rarely integrated. For example, bamboo producers may lack links to formal markets, and earthen block makers often work informally without certification systems (Housing and Building Research Institute [HBRI], 2018). Without standards, certification, or supportive procurement policies, these actors cannot compete with industrial material suppliers. This fragmentation not only limits economies of scale but also undermines trust among consumers and regulators, who often question the quality and safety of natural materials.

Yet there are positive signs. Pilot initiatives have shown how organised cooperatives, NGO partnerships, and targeted procurement can strengthen the supply chain for natural materials. For example, BRAC’s bamboo housing projects created structured demand that linked artisans with communities, demonstrating a model for scaling (BRAC University, 2020). Similarly, heritage conservation efforts in Bhutan and India have created specialised markets for skilled masons and carpenters, sustaining vernacular practices in specific contexts (INTACH, 2019; Government of Bhutan, 2019).

2.3 Policies, standards, and incentives.

The policy environment across the HKH region is fragmented and often inconsistent. While national governments have introduced building codes and housing policies that make reference to nature-based construction, these references are typically partial, non-binding, or poorly enforced.

In Afghanistan, for example, the National Building Code (2013) includes structural provisions but offers little guidance for mudbrick or timber, despite their prevalence in rural construction (Government of Afghanistan, 2013). Bangladesh's National Building Code (2015; revised 2020) includes bamboo, timber, and clay, but without clear mechanisms for enforcement or quality control (Government of Bangladesh, 2015). In Bhutan, the National Construction Industry Policy (2020) and National Housing Policy (2020) both encourage the use of local materials and traditional techniques, but implementation is limited by compliance costs and lack of incentives for private sector adoption (Government of Bhutan, 2020).

China's Green Building Evaluation Standards (2019) promote environmentally friendly materials, and the Rural Revitalization Policy (2018) calls for the use of local materials in rural housing upgrades. Yet large-scale concrete programmes often overshadow these provisions, and enforcement varies widely across provinces (MOHURD China, 2019). India's National Building Code (2016) and Energy Conservation Building Code (2017) provide openings for bamboo and earth-based technologies, and state-level policies in Himachal Pradesh and Uttarakhand support vernacular construction in seismic zones. However, adoption depends heavily on local political will and awareness (Government of India, 2016).

Myanmar's National Housing Policy (2017) and National Urban Policy Framework (2020) highlight the importance of local resources and skills, but technical standards remain underdeveloped, and enforcement is inconsistent (Government of Myanmar, 2020). In Nepal, the revised National Building Code (2020) explicitly includes earthen, bamboo, and stone masonry, and post-earthquake reconstruction guidelines promoted local materials with seismic reinforcement. Despite this progress, skilled labour shortages and limited investment hinder scaling (Government of Nepal, 2020). Pakistan has codified timber-laced masonry retrofitting in its Building Code (2007) and recently committed to locally sourced and climate-resilient construction in its Revised National Housing Policy Framework (2025). Nevertheless, the mainstream market still favours cement and steel (Government of Pakistan, 2007; 2025).

Overall, the region demonstrates three common patterns.

- First, nature-based materials are rarely given the same formal standing as conventional materials in building codes, which limits their legitimacy.
- Second, policy references often remain aspirational, with few binding measures or incentives to stimulate uptake.
- Third, even where enabling policies exist (as in Nepal and Bhutan) weak enforcement, high compliance costs, and limited institutional capacity undermine practical implementation.

These gaps mean that vernacular knowledge and nature-based practices survive largely through heritage protection frameworks, post-disaster reconstruction, or isolated NGO- and donor-led projects, rather than being embedded in mainstream housing and infrastructure policy.

3. Country snapshots

This section presents short snapshots of nature-based construction practices across the eight HKH countries. Each profile highlights distinctive materials, policy trends, and implementation dynamics, drawing from both scoping review and survey responses.

The focus is not on comprehensive national coverage, but on illustrating how broader regional patterns play out in specific contexts. Additional technical and policy details are provided in Annex A.



Afghanistan

Traditional construction in Afghanistan is dominated by mudbrick, stone, and timber. These materials have historically formed the backbone of rural and peri-urban housing, offering affordability, insulation from extreme temperatures, and a degree of cultural continuity. Mudbrick remains particularly widespread, especially in drought-prone lowland areas, while timber-laced stone masonry is more common in mountainous regions. However, these systems are often self-built, with wide variation in quality due to lost artisanal knowledge and lack of formal training.

The Afghanistan National Building Code (2013) sets out structural safety provisions but offers little practical guidance on vernacular methods. As a result, builders operate without standards, support, or recognition — reinforcing the perception that natural materials are inferior or outdated.

A survey respondent captured this reality plainly: “For most families, mudbrick is not a choice but the only option — they cannot afford cement.”

While donor-led initiatives have occasionally supported community-led housing reconstruction — such as in Herat and Bamiyan — these efforts remain scattered and are rarely integrated into national housing strategy. Without technical guidelines or institutional backing, nature-based construction in Afghanistan continues to function as a system of necessity rather than choice. Yet its enduring prevalence underscores a critical opportunity: to build resilience and safety by upgrading what people already use, rather than replacing it altogether.

Bangladesh

Bangladesh has long relied on bamboo, jute stick, mud, and thatch for rural housing, reflecting the availability of fast-growing biomass in flood-prone geographies. These materials are central to the cultural identity of rural settlements, but their use has declined in favour of brick and reinforced concrete — even in hazard-prone areas where traditional systems outperform them. Despite this shift, research institutions like Housing and Building Research Institute (HBRI) continue to explore alternatives such as compressed stabilised earth blocks (CSEBs) and jute-based composites.

The BRAC modular bamboo housing project is a widely cited example, offering elevated, mobile structures designed for flood resilience. More recently, BRAC's amphibious earth house pilot — designed to float above rising waters — has expanded the vision for nature-based, climate-resilient design. The METI Handmade School offers a further demonstration of how earthen and bamboo systems can deliver safety, comfort, and pride. Yet, these innovations remain isolated, with little policy support or quality control to bring them into the mainstream. Natural materials remain largely confined to informal or experimental niches — a missed opportunity in one of the world's most climate-vulnerable countries.

CASE STUDY: Chittagong Hill Tracts in Bangladesh.

Communities in the Chittagong Hill Tracts have historically used elevated bamboo Machang houses, drawing on indigenous knowledge of site selection and lightweight bamboo construction to adapt to flood risks. These Machang houses are typically raised 7 to 8 feet above the ground on bamboo stilts, with bamboo-framed floors, woven bamboo walls, and thatched roofs that require repairs every three years.

In recent years, communities in Chemi Dolu Para and Mrolong Para have demonstrated a blended approach by combining treated bamboo with metal poles and concrete for foundations and supports, while metal trusses are used for pitched roofs. This approach has increased the durability of Machang houses in flood-prone areas. Bamboo remains central to the structural system, retaining traditional layout principles, while being complemented by the selective use of metal poles, concrete footings, and metal roof trusses.



Kabir Uddin/ICIMOD



Bhutan

Bhutan has perhaps the strongest enabling environment in the region for nature-based construction, grounded in the national philosophy of Gross National Happiness.

Policies such as the National Construction Industry Policy and National Housing Policy explicitly support the use of certified local materials like rammed earth, timber, and bamboo. These materials are not only culturally embedded but remain visible in government buildings, schools, and heritage zones, where they continue to be mandated.

However, Bhutan also faces modernising pressures. Urban growth in Thimphu and other towns has increased demand for concrete, while builders report a decline in traditional skills and a lack of financial incentives to comply with material mandates. Despite this, Bhutan continues to lead through vision. The planned Gelephu Mindfulness City—a 1000 km² urban initiative rooted in sustainability, wellbeing, and vernacular aesthetics—represents a bold step toward integrating tradition with future development. Bhutan’s experience highlights how cultural legitimacy and policy support must be matched by investment in skills, innovation, and enforcement.

CASE STUDY: Gelephu Mindfulness City — Bhutan’s Vision for a Mindful, Sustainable Urban Future

Bhutan is advancing an unprecedented urban initiative called Gelephu Mindfulness City (GMC) — a new city envisioned to integrate sustainability, cultural identity, and well-being at scale. The project spans over 2,500 km² on the southern border with India and is designed around principles of Gross National Happiness, embedding green space, walkable neighbourhoods, renewable infrastructure, and eco-friendly transport into its master plan.

GMC aims to attract investment in green technology, health, education, and creative industries, with an international airport and economic zone designed to foster climate-aligned growth while preserving local ecosystems and cultural heritage. While still in early phases, GMC reflects Bhutan’s broader intent to reconcile traditional values with modern development imperatives and demonstrates how policy frameworks can shape region-wide thinking on sustainable construction and planning.





China (Yunnan and Tibet)

In the HKH-relevant provinces of Yunnan and Tibet, China continues to demonstrate a living vernacular tradition of earth and timber construction. Rammed earth, adobe, and timber-laced masonry have long provided thermal comfort and seismic resilience in these high-altitude regions. These practices persist in rural areas, heritage zones, and some post-earthquake reconstruction, though they are steadily being replaced by reinforced concrete and brick, often seen as symbols of progress.

As one architect put it: “Concrete is the choice of progress; earth is seen as the past.”

While survey data from China was limited, scoping review reveals growing policy interest in sustainable construction. The Rural Revitalisation Policy (2018) encourages the use of local materials in culturally significant areas, while the Green Building Evaluation Standards (2019) allow for the inclusion of natural materials under certain conditions. Yunnan and Tibet have also hosted pilot projects that retrofit timber-earth homes for improved seismic safety.

Yet challenges remain. National housing programmes heavily favour industrial materials, and green building standards often prioritise factory-made “eco-materials” over vernacular ones. Skills in traditional joinery and rammed earth construction are declining. Still, innovation continues: hybrid timber-earth systems have shown promising seismic results, and cultural tourism is helping sustain artisanal techniques in Tibetan villages. These footholds suggest that with stronger certification and implementation, China could reframe its traditional systems not as heritage relics, but as models for resilient, low-carbon settlement development.

India (Himalayan states)

India's Himalayan states — including Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and the Northeast — have a deep tradition of nature-based construction tailored to seismic and climatic conditions. Systems like Kath-Kuni (timber-stone interlocking) and Dhajji Dewari (timber-laced masonry) offer proven resilience and remain visible in temples, homes, and public buildings. Bamboo is widely used across Northeast India, not only for housing but also in cultural and community infrastructure.

Yet this legacy is under pressure. India's construction sector is rapidly industrialising, and concrete and brick are now associated with modernity and upward mobility. In most cities, the shift is already complete; in mountain regions, the transition is accelerating. While building codes and heritage regulations offer some support, enforcement is inconsistent and often limited to protected zones.

Amid this backdrop, organisations like the Hunnarshala Foundation in Gujarat have helped redefine what's possible. Their post-disaster reconstruction projects — using stabilised earth blocks, bamboo, and hybrid wall systems — have combined traditional materials with modern engineering, creating structures that are both low-carbon and aspirational.

These examples remain largely outside government-led housing initiatives but show how scaled investment in training, certification, and public procurement could bring nature-based materials into the mainstream. India holds enormous potential to lead the region in innovation, but only if traditional knowledge is integrated, not sidelined, in the country's green construction transition.



Myanmar

Myanmar's vernacular construction systems (bamboo, thatch, mud, and timber) remain widely used in rural areas, mostly wood, mixed wooden bamboo and mixed bamboo thatch are commonly used in traditional houses of northern Shan state, Yangon division and Bago Division (Cho Oo et al 2003). They are affordable and locally sourced, but are typically unregulated and informal, built without engineering support or integration into national housing frameworks. As a result, they are often treated as a stopgap rather than a viable alternative to concrete or brick.

Policy support for nature-based materials remains weak. The Myanmar National Building Code (2016) and the National Housing Strategy (2017) mention the use of local materials, but provide little technical guidance or enforcement. In practice, housing recovery efforts following natural disasters have offered the most visible use of local materials.

One example is the [Housing NOW](#) project, which used pre-fabricated bamboo modules in post-cyclone reconstruction to deliver safe, low-cost shelters. Despite this success, such models have not been scaled or absorbed into national programmes.

Like elsewhere in the HKH, Myanmar's builders face gaps in training, standardisation, and market visibility. Yet the enduring popularity of bamboo, combined with its suitability for lowland climates, suggests that with the right investment in research, demonstration, and policy reform, Myanmar could unlock scalable solutions rooted in its own architectural heritage.

Nepal

Nepal stands out in the HKH for having policy recognition of nature-based materials. Bamboo, adobe, rammed earth, and stone masonry are promoted through post-disaster guidelines as temporary shelters since the 2015 earthquake but yet requires standardization and recognition in the National Building Code. Recently, a construction design manual for cement bamboo frame technology was endorsed by the Ministry of Urban Development (MoUD and Habitat for Humanity, 2026). The use of nature-based materials are both seismic-resilient and culturally familiar, with a long history of vernacular use across rural and peri-urban areas. However, enforcement is limited, and many urban developers continue to use concrete and brick due to perceptions of modernity and uncertainty about code compliance.

Despite these challenges, Nepal is home to promising innovation. The Kathmandu-based organisation ABARI has developed hybrid bamboo-earth buildings that combine seismic safety with thermal comfort and low embodied carbon. These systems have been applied in schools, homes, and public structures, showcasing that local materials can meet both aesthetic and structural standards. Yet, concerns remain about the reliability of bamboo supply, lack of treatment infrastructure, and the cost of scaling up. Nepal's case illustrates both the technical viability of nature-based construction and the gaps in market systems and institutional support that prevent its wider uptake.

CASE STUDY:

ABARI — Sustainable Earth and Bamboo Construction (Nepal)

ABARI's sustainable bamboo and earth architecture strengthens local skills and demonstrates high-performing alternatives in Nepal.

ABARI is a research-driven architecture and construction practice in Nepal that champions the use of compressed earth blocks, bamboo, and stone to create climate-responsive, low-carbon buildings rooted in vernacular knowledge. Their work ranges from rammed earth and bamboo schools to community shelters, combining passive design, local materials, and contemporary detailing to enhance resilience and performance. ABARI also engages deeply with local craftspeople to strengthen traditional skills and knowledge transfer. Their projects demonstrate how cultural heritage can be mobilised to advance sustainable construction in earthquake-prone contexts.

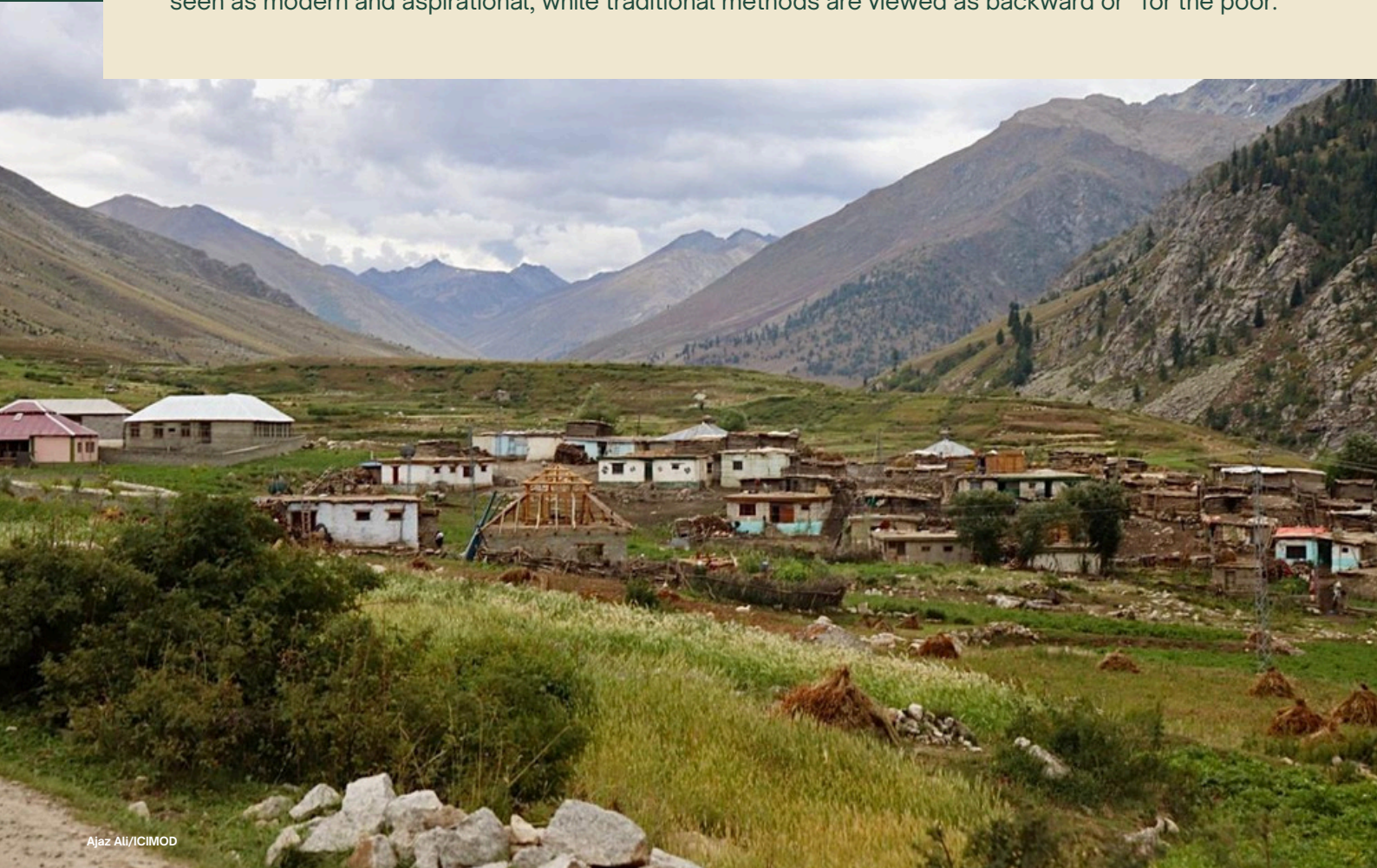


Nripal Adhikary/ABARI

Pakistan

In Pakistan's northern regions, especially Gilgit-Baltistan, Chitral, and Kashmir, vernacular construction systems like Dhajji Dewari and Taq have evolved to meet seismic and climatic challenges. These timber-laced masonry systems provide flexibility and shock absorption during earthquakes, while also offering cultural continuity and thermal performance. After the 2005 Kashmir earthquake, Dhajji Dewari was widely credited with preventing structural collapse in affected areas.

Pakistan is one of the few countries in the HKH to formally recognise these traditional systems. Dhajji Dewari is included in the 2007 Seismic Provisions of the Building Code, setting a precedent for the codification of nature-based materials. However, policy recognition has not translated into widespread practice. Survey respondents and interviewees described a construction culture where concrete is seen as modern and aspirational, while traditional methods are viewed as backward or “for the poor.”



Ajaz Ali/ICIMOD

Despite this, efforts to protect and revive vernacular systems continue. The Aga Khan Development Network (AKDN) has led restoration and conservation work in Gilgit-Baltistan, demonstrating that Dhajji Dewari is not only structurally resilient but also compatible with modern architectural needs. Yet without investment in training, material supply chains, and public visibility, these systems remain niche.

Pakistan's case illustrates a broader regional paradox: where nature-based materials are codified but not legitimised in the market. Unlocking their full potential will require shifting mindsets as much as shifting policies — and building trust in the systems that have long withstood the test of both time and earthquakes.



David Iloba / Pexels

4. Cross-Cutting Barriers and Opportunities

This section synthesises cross-cutting insights that emerged across countries, drawing on scoping review, survey responses, and expert interviews. While the focus is on barriers, each theme also highlights emerging models, experiments, or enabling conditions.

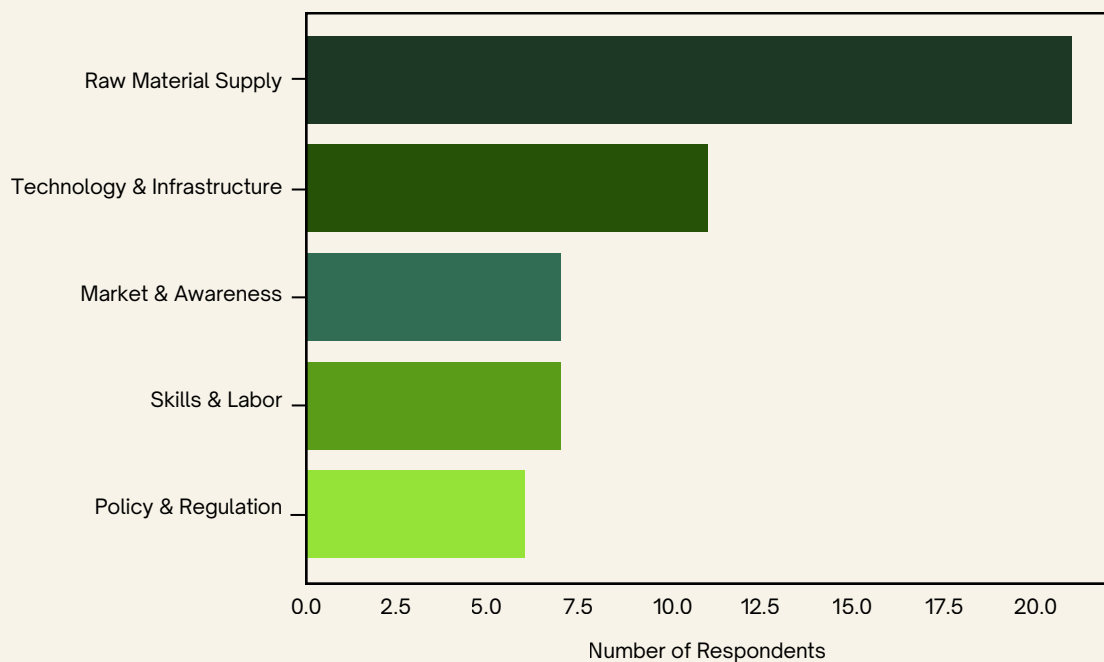


4.1 Thematic Insights.

The evidence gathered through scoping review, online surveys, and interviews reveals a construction sector in the HKH that is caught between tradition and modernity. On one hand, natural building materials such as earth, stone, timber, and bamboo are deeply rooted in local cultures, adapted to seismic and climatic conditions, and remain affordable for many rural households. On the other, the dominance of concrete, steel, and fired brick has reshaped both markets and aspirations, marginalising vernacular systems.

Surveys and interviews converged on a set of persistent, cross-cutting barriers that limit the wider use of nature-based construction materials. These challenges are not specific to any one country or stakeholder group, but recur across contexts—though their intensity and manifestations vary. The barriers cited are shown in the figure below and explored in the subsections that follow.

Most Frequently Cited Barriers to Nature-Based Construction



4.1.1 Raw Material Supply

Across the HKH, raw material supply emerged as the most frequently cited barrier to the wider use of nature-based construction materials. While bamboo, timber, earth, and stone are widely available in many contexts, respondents described the supply of these materials as localised, seasonal, and highly fragmented, with few mechanisms to ensure consistent quality or quantity. This contrasts sharply with the industrial materials sector, where cement, steel, and brick benefit from established production systems, structured logistics, and predictable distribution networks.

Small-scale and largely informal producers dominate the natural-materials landscape. Bamboo harvesters in Bangladesh, Nepal and Myanmar, earthen block makers in Nepal and India, and timber suppliers in Pakistan and Bhutan typically operate with limited access to market chain, investment, or processing infrastructure. Respondents noted that this results in variable pricing, inconsistent availability, and limited ability to support larger-scale construction.

A Nepali contractor explained, “I can build ten bamboo houses with no problem. But if I want to build fifty, the supply becomes unreliable. That’s why developers do not trust it.”

Seasonality further undermines material reliability. Bamboo harvesting in Bangladesh and timber extraction in Bhutan, Nepal and Pakistan are tied to specific seasons and community forest rules, creating uneven supply across the year. In Bhutan, respondents highlighted that even where timber is certified, procurement processes are slow and geographically constrained. The result is a system in which materials exist in abundance, yet predictable access is scarce.

Demand patterns reinforce these dynamics. In rural and low-income communities, natural materials remain common because they are accessible and inexpensive. Households in Bhutan continue to build with rammed earth and timber; in India’s northern areas, timber-laced masonry retains cultural trust because of its seismic performance; and in the Terai and delta regions of Nepal and Bangladesh, bamboo remains indispensable for everyday housing. However, in urban and peri-urban markets—where demand is growing fastest—industrial materials dominate.

As one Indian architect noted, “Clients want concrete because they believe it represents progress. Even when I show them examples of Kath-Kuni that survived earthquakes, they hesitate.”

Without structured supply chains, natural materials struggle to compete. Respondents repeatedly emphasised that the absence of certification, organised producer networks, and quality control systems prevents bamboo, timber, and earthen materials from gaining legitimacy in formal markets.

A Bhutanese architect noted, “We cannot just hand a new block to a mason and expect it to work—we need systems of training and infrastructure to support it.”



Jitendra Raj Bajracharya/ICIMOD

Despite these constraints, the evidence points to emerging opportunities. Targeted initiatives (such as BRAC’s modular bamboo housing in Bangladesh, ABARI’s hybrid earth–bamboo systems in Nepal, and heritage-driven timber procurement in Bhutan) demonstrate that structured demand combined with training and treatment facilities can improve reliability and unlock scaling potential.

However, these examples remain an exception rather than the norm. For most of the HKH, raw material supply continues to represent a foundational challenge: natural materials are abundant in principle but unreliable in practice, limiting their ability to compete with industrial alternatives at scale.

4.1.2 Technology and Infrastructure

While interest in nature-based construction is growing across the HKH, most innovations remain trapped at the pilot stage due to limited technical infrastructure. Respondents consistently cited the absence of testing facilities, engineering standards, and certification systems as a key barrier to scaling.

Several countries have taken steps to include bamboo, earth, and hybrid systems in national building codes, but these codified solutions often lack formal validation. As one respondent in Nepal explained, *“We codified the techniques, but we forgot to build the infrastructure around them. The knowledge is disappearing, and the systems to test and certify these materials don’t exist.”* In Bangladesh, engineers working on modular bamboo housing reported that reinforced bamboo components had been developed and tested locally, but without national standards or formal approval systems, so the mainstream uptake remained out of reach.

The consequences are tangible. Builders may be willing to experiment with earthen blocks or bamboo beams; but without certification, there is no guarantee of structural performance, and clients often hesitate to accept liability. As one engineer in Bangladesh put it: *“We have designed reinforced bamboo beams that could replace steel, but without certification no one will risk using them at scale.”*

This challenge is compounded by the lack of product development and technical R&D infrastructure. Even when hybrid solutions exist, such as stabilised earth blocks or timber-earth joinery systems, they often remain locally validated but not nationally standardised. In Nepal, for example, technical guidance for bamboo and earthen systems is included in post-disaster guideline, but respondents noted that the required validation systems—material testing labs, approved treatment protocols, or design guidelines—are often missing or inaccessible.

Respondents also emphasised the importance of infrastructure to support product consistency and replication. Without basic processing facilities (for curing bamboo, stabilising soil, or grading timber), innovations cannot reach scale.

A Bhutanese architect noted, *“We cannot just hand a new block to a mason and expect it to work—we need systems of training and infrastructure to support it.”*

Despite these challenges, there are positive signals. In Bhutan, heritage-based procurement has supported limited investment in timber grading and processing. In Nepal, private sectors like ABARI are partnering with engineering institutes to test and codify earthen and bamboo components. In Bangladesh, modular bamboo housing systems are being refined through field testing and performance monitoring. These examples show that technical and material innovation is not the barrier—it is the infrastructure around those innovations that remains missing.

To move beyond niche experimentation, countries will need to invest in testing facilities, national certification bodies, and support for research and validation. Without these, nature-based construction systems will remain seen as “alternative” or “unproven,” even when they outperform industrial materials in specific contexts.



Santosh Raj Páthak/ICIMOD

4.1.3 Market and Awareness

Across the HKH, natural building materials are widely perceived as inferior, temporary, or backward—a view that strongly influences market dynamics and decision-making. Survey respondents and interviewees alike emphasised that these perceptions are a major barrier to wider adoption, even in contexts where natural materials are more resilient, affordable, or climate-adapted than industrial alternatives.

Respondents described a persistent bias in favour of cement and steel, particularly in urban areas. These materials are widely seen as symbols of modernity, wealth, and durability, while bamboo, earth, and timber are associated with poverty or informality.

In Bhutan, a planner noted the disconnect: *“We talk about Gross National Happiness and sustainability, but when it comes to construction, even officials prefer concrete houses.”*

This stigma affects both consumer behaviour and professional practice. In Nepal, architects described resistance from clients even when hybrid solutions were proposed. “People still believe concrete is the only safe and permanent material,” one interviewee explained. In Bhutan, despite government policies promoting rammed earth, private clients often reject it, believing it “belongs to the past, not the future.” These cultural perceptions influence procurement choices, financing decisions, and professional recommendations—further entrenching the dominance of industrial materials.

Yet paradoxically, respondents also pointed to the deep cultural value of traditional building systems. In Bhutan, rammed earth and timber are central to national identity. In northern India, Kath-Kuni construction is protected as heritage. These systems are celebrated in temples, cultural districts, and tourism—but often excluded from everyday housing.

As one Nepali architect put it: *“Even when I explain the thermal and seismic benefits of earth, the client will say, ‘But my brother in Kathmandu built with concrete. Why should I go backwards?’”*

The limited visibility of successful nature-based projects reinforces these perceptions. Without demonstration homes, institutional buildings, or high-profile examples, consumers and policymakers alike struggle to see natural materials as viable or modern. Several respondents suggested that targeted demonstration projects could help reframe these materials as contemporary, desirable, and high-performing.

As one Bhutanese planner put it, **“We must make tradition modern—not leave it behind.”**

These perceptions are also shaped by market dynamics. Because nature-based materials are typically produced informally and lack certification, they are excluded from formal procurement systems, housing finance schemes, and standardised construction processes. As a result, their use often remains confined to localised or donor-supported niches. This reinforces the impression that they are not part of a serious, modern building economy.

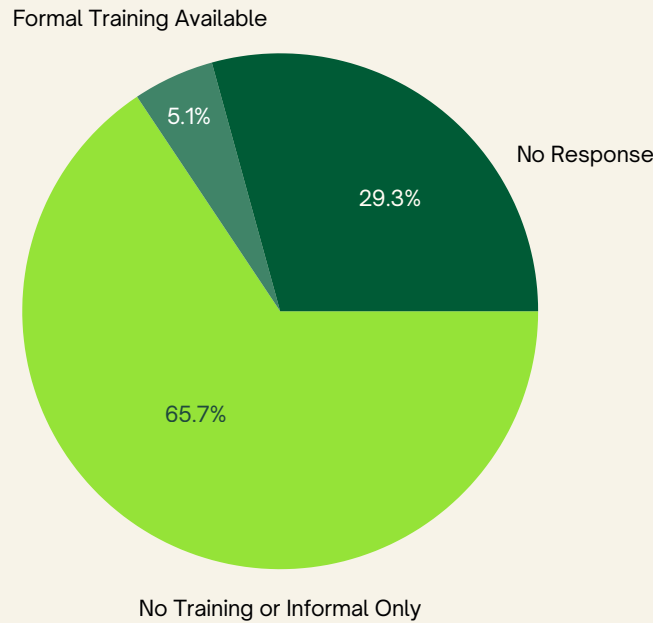
Affordability further complicates perception. While natural materials are often cheaper and more accessible in rural areas, this affordability is itself seen as a mark of inferiority. As one Indian architect explained, “The poor build with mud because they must, not because they choose to. As long as that is the perception, middle-class families will never follow.”

Together, these insights point to the need for a deliberate reframing of nature-based materials, not just as cost-saving or traditional, but as resilient, adaptable, and future-facing. Visibility, market confidence, and positive cultural narratives are as essential as technical performance if natural systems are to gain traction across the region.

4.1.4 Skills and Labour

The erosion of traditional building skills and the shortage of trained labour emerged as one of the most consistently cited barriers across the HKH. Respondents from Nepal, Bhutan, Myanmar, and Afghanistan highlighted that while natural materials are often available and policy frameworks may reference them, the number of builders with the skills to use them effectively is rapidly declining.

Access to Formal Training on Nature-Based Construction



Much of nature-based construction (especially with bamboo, timber, and earth) relies on highly craft-dependent techniques that are not easily replaced by generic labour. However, younger generations are increasingly entering industrial construction pathways or leaving the sector altogether.

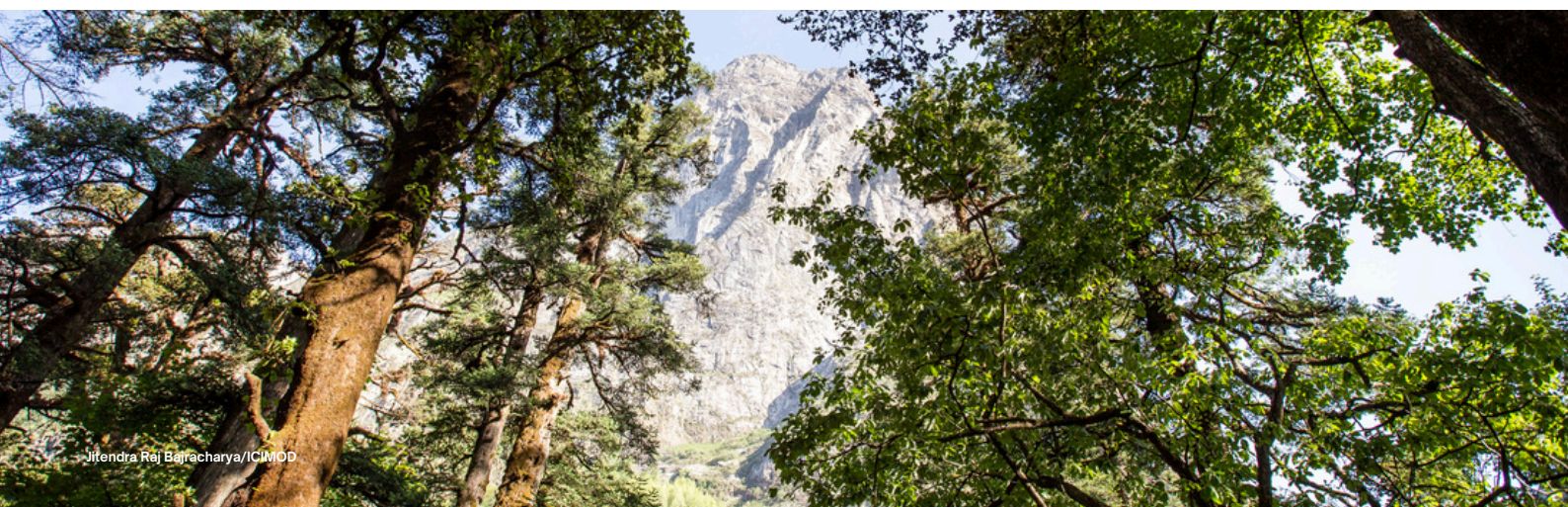
As a Nepali architect observed, “There are very few trained masons left who can build to standard.” This was echoed by respondents in Bhutan and Myanmar, where masons, carpenters, and joiners trained in vernacular systems are aging, and no pipeline of replacement workers currently exists.

The result is a growing disconnect between policy and practice. In Nepal, the post-earthquake reconstruction guideline explicitly includes earthen masonry and bamboo structures, but without trained builders, these codified systems cannot be implemented. In Bhutan, despite policy support for rammed earth and timber, architects noted that a lack of skilled masons is one of the greatest obstacles to uptake. Even small-scale projects can be difficult to complete when experienced labour is scarce or prohibitively expensive.

Interviewees also described a collapse in apprenticeship systems and knowledge transfer. In many communities, traditional construction skills were passed down informally through families or master-apprentice relationships. Today, those systems are vanishing without being replaced by formal training programmes. A respondent from Myanmar remarked: “*We don’t need to invent new systems—we need to train young builders to do what their grandparents already knew.*”

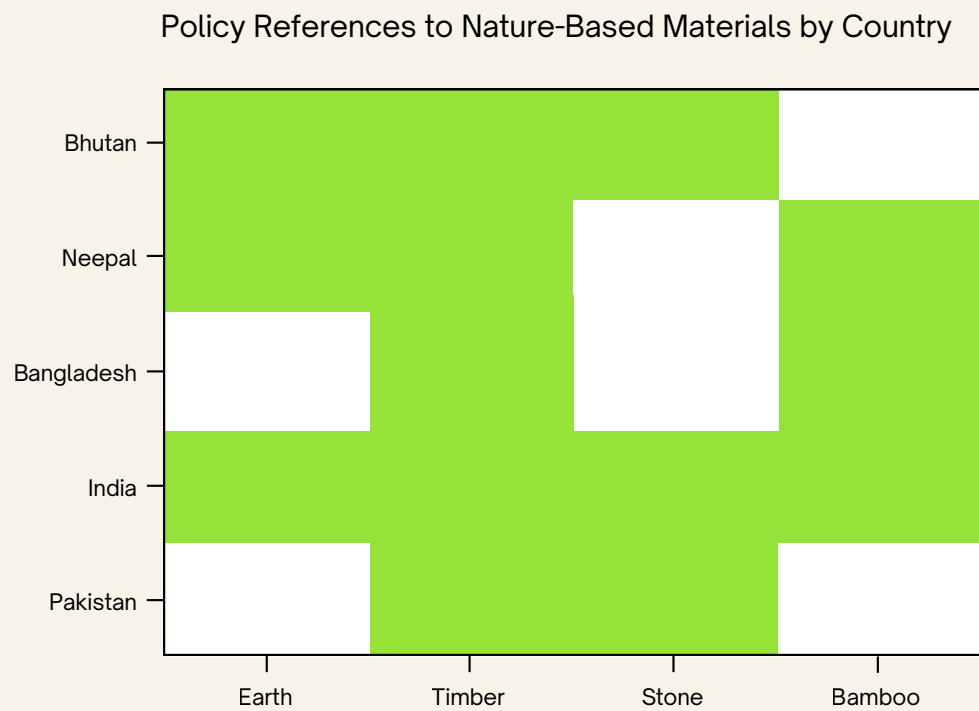
This shortage of skills also constrains the ability to experiment or scale up new approaches. Even when hybrid systems—such as stabilised earth blocks or timber-bamboo frameworks—are designed by architects or engineers, contractors may lack the knowledge or confidence to execute them.

Multiple respondents called for vocational training programmes, curriculum reform, and institutional partnerships that recognise vernacular construction as a professional and valuable skillset. Without targeted investment in skills development, nature-based systems will remain confined to heritage zones, pilot projects, or informal self-construction—unable to meet the quality, safety, or scale required by mainstream housing markets.



Jitendra Raj Bajracharya/ICIMOD

4.1.5 Policy and Regulation



Across the HKH, policy frameworks are increasingly recognising nature-based construction—but this recognition rarely translates into effective implementation. Building codes and housing strategies in many countries reference bamboo, earth, and timber. However, respondents consistently reported that these provisions are either too vague, not enforced, or unsupported by the regulatory mechanisms required to turn intent into action.

In Bangladesh, bamboo is included in the National Building Code, but respondents noted that *“there is no certification, no quality control—so it is as if it is not there at all.”* Similarly, in India, architects acknowledged the inclusion of natural materials in national and state-level codes, but stressed that enforcement is weak, and approval processes favour industrial systems. One interviewee summarised: *“Natural materials are in the code, but not in the system.”*

Nepal offers a case of partial progress. The post-earthquake reconstruction guideline developed with the revised National Building Code (2020) includes typologies for bamboo and earthen masonry for temporary shelters. Yet respondents highlighted the lack of trained inspectors, limited validation of infrastructure, and minimal uptake by mainstream contractors. As one architect put it, *“The guideline exists, but the ecosystem around it does not.”*

In Pakistan, the picture is similar. Timber-laced masonry is codified in seismic guidelines and supported by NGOs like the Aga Khan Development Network. However, implementation remains marginal. A contractor explained: *“When the earthquake comes, people remember Dhajji Dewari. But in between, everyone wants concrete.”*

By contrast, Bhutan stands out for embedding vernacular systems into both its National Construction Industry Policy and National Housing Policy. These policies mandate traditional materials in heritage zones and promote local timber use. Still, architects flagged practical constraints: “We can write beautiful policies, but without masons and without subsidies, it remains on paper.” Here, as elsewhere, enabling policies are undermined by gaps in capacity, cost competitiveness, and market confidence.

The most consistent insight across countries was that inclusion in policy is not enough. Without clear technical standards, enforcement mechanisms, public procurement support, and institutional coordination, natural materials remain outside formal construction markets. Multiple respondents used the phrase “paper codes” to describe current frameworks—technically valid, but practically invisible.

To change this, stakeholders called for stronger institutional mechanisms to translate policy into practice. These include not only enforcement, but also investment in training, certification, pilot projects, and procurement systems that reward sustainable material choices. Without these systemic supports, the policy recognition of nature-based materials risks becoming symbolic rather than structural.



4.2 Innovation and emerging opportunities

While the HKH construction sector faces deep structural barriers, the evidence also points to growing experimentation and pockets of momentum. These signals are not yet system-wide, but they offer glimpses of what a more sustainable, locally rooted construction paradigm could look like. From modular housing pilots to heritage-informed public procurement, actors across the region are testing new ways to position nature-based materials as modern, scalable, and resilient.

The following four opportunity areas illustrate how systems of policy, knowledge, and demand are beginning to shift.



4.2.1 Demonstration Projects as Catalysts

One of the most promising entry points for shifting perceptions and market confidence is through high-visibility demonstration projects. These initiatives visibly challenge the idea that natural materials are outdated or temporary by delivering high-quality, durable structures that meet both cultural and modern performance standards.

In Bangladesh, BRAC’s modular bamboo housing systems—designed for flood-prone communities—have become a powerful example of how nature-based systems can deliver flexibility, resilience, and dignity. These homes are elevated, mobile, and modular, allowing families to adapt to seasonal water levels. As one Bangladeshi respondent explained, “When families see that their homes can float above the floods, they see bamboo differently.”

In Nepal, firms like ABARI are combining bamboo and earth into hybrid systems that meet seismic codes while remaining low-carbon and locally sourced. Their projects range from schools and health centres to residential housing, demonstrating how traditional materials can be reimaged as high-performance systems.

Bhutan offers another model. Public buildings—especially in heritage zones—continue to be constructed using rammed earth and timber, reinforcing the legitimacy of these materials in the eyes of both citizens and professionals. While these projects often face compliance and cost challenges, their visibility plays a key role in shaping public perception.

4.2.2 Institutional Enablers and Policy Footholds

In several countries, enabling policies are beginning to open space for experimentation. While enforcement remains a challenge (as discussed in Section 4.1), some frameworks have already supported meaningful action.

In Nepal, post-earthquake reconstruction provided a rare opportunity to mainstream vernacular systems through updated guidelines, training, and technical support. This guideline developed alongside with revised National Building Code (2020) includes provisions for bamboo and earthen construction, which have been used in thousands of rural recovery projects.

Bhutan's National Housing Policy and National Construction Industry Policy explicitly encourage the use of traditional materials in designated districts. Although implementation gaps remain, this policy environment has helped sustain markets for skilled masons and carpenters, particularly in culturally sensitive areas.

Other countries are beginning to explore similar footholds. In China, rural revitalisation policies reference the role of local materials in upgrading housing stock, while subnational green building standards increasingly include provisions for low-carbon construction.

4.2.3 Innovation Pathways and Material Development

Across the region, architects and engineers are exploring ways to modernise traditional materials without losing their core strengths. These hybrid approaches aim to improve durability, meet modern codes, and unlock financing by creating confidence in structural performance.

In Nepal, stabilised earth blocks are gaining traction for their improved water resistance and load-bearing capacity. In Bangladesh, reinforced bamboo beams have been engineered for structural use, though full certification remains a challenge. Architects in China and India described similar experiments, often in partnership with universities or NGOs.

These innovations remain constrained by limited testing, certification, and investment. However, they represent a growing ecosystem of experimentation, and suggest that the technical viability of nature-based construction is not the core constraint. What is needed is a system to validate, finance, and replicate these breakthroughs.

4.2.4 Regional Knowledge Exchange and Scaling Potential

Finally, multiple respondents called for stronger platforms for cross-border regional learning and coordination. Many of the most promising innovations—whether in flood-resilient bamboo housing, post-earthquake timber joinery, or rammed earth procurement—are happening in isolation. As one Nepali architect put it, “We don’t need to start from scratch. We need to learn from each other.”

ICIMOD and other regional actors have an opportunity to facilitate this knowledge exchange by convening practitioners, researchers, and policymakers. Comparative case studies, shared standards, or joint demonstration projects could reduce duplication and help promising models scale across similar geographies.

Several respondents also highlighted the importance of aligning construction innovation with broader agendas (such as disaster risk reduction, green growth, and heritage conservation) to access funding, policy attention, and public support.

4.3 Synthesis and Implications

Taken together, the thematic analysis highlights a construction system in the HKH that is constrained less by technical feasibility than by systemic misalignment. Nature-based materials are widely available, culturally embedded, and demonstrably resilient in seismic and climatic extremes. Yet their use remains marginal because the institutions, markets, and narratives that shape construction decisions overwhelmingly favour industrial materials.

Across all five themes, a consistent pattern emerges: recognition without enablement. Natural materials are acknowledged in policy but weakly enforced; codified in standards but unsupported by testing and certification; valued culturally but stigmatised in contemporary housing markets; affordable in principle but excluded from formal finance and procurement systems. These gaps reinforce one another, creating a self-perpetuating cycle in which low demand discourages investment, limited supply undermines confidence, and skills erosion further reduces uptake.

At the same time, the evidence points to important points of leverage. Demonstration projects, post-disaster reconstruction programmes, heritage-informed public procurement, and hybrid material innovations show that it is possible to reconcile tradition with modern performance expectations. Where structured demand, training, and institutional support align—as seen in parts of Bhutan, Nepal, and Bangladesh—nature-based systems begin to move beyond niche or informal use.

A further implication is the risk of irreversible loss. Skills, knowledge systems, and supply networks associated with vernacular construction are eroding rapidly. Without deliberate intervention, future efforts to revive nature-based construction may face much higher costs, not because materials are unavailable, but because the human and institutional capacity to use them has disappeared.



Finally, the findings suggest that opportunities in the HKH are inherently regional rather than national. Similar materials, hazards, and constraints recur across borders, yet innovation and learning remain fragmented. The absence of systematic regional exchange limits the ability to scale proven approaches and reinforces duplication of effort.

These insights point to a clear conclusion: advancing nature-based construction in the HKH will require coordinated action across policy, markets, skills development, and infrastructure, rather than isolated technical fixes. The following section translates these system-level findings into a set of practical, priority recommendations.

5. Recommendations.

The evidence presented in this report highlights a paradox. Nature-based materials in the HKH are affordable, resilient, and culturally embedded, yet they remain marginal in mainstream housing and infrastructure. This is not because they lack technical value, but because the systems around them—policy frameworks, markets, training, and consumer perceptions—are weak.

The following recommendations are drawn directly from the thematic analysis, online surveys, and interviews. They outline the actions required to create an enabling environment where natural materials can compete on equal footing with industrial products.

5.1 Strengthen policy frameworks and enforcement

One of the most consistent messages from both survey and interview respondents was that “paper codes” mean little without enforcement. In Nepal, bamboo and earthen masonry are recognised in the post-earthquake reconstruction guideline and recently a construction design manual for bamboo is endorsed, yet architects noted that very few builders have ever been asked to apply those provisions in practice. Similarly, in Pakistan, contractors pointed out that although timber-laced masonry (Dhajji Dewari) is codified in seismic provisions, municipal authorities continue to approve concrete block housing in earthquake-prone zones.

The message is clear: recognition alone is insufficient.

Governments should not only update building codes to include typologies for earthen, bamboo, and timber systems but also create clear enforcement mechanisms at municipal levels with local building by-laws. Housing and climate policies should go further, positioning natural materials as central to disaster risk reduction and national climate commitments. Bhutan’s example—where rammed earth and timber are embedded in policy and heritage protection—shows what is possible, though even there enforcement gaps remain. Stronger frameworks would legitimise natural materials in the eyes of both professionals and consumers. Priority should be given to municipal and provincial authorities, where approval processes and enforcement decisions are actually made.

5.2 Create financial and market incentives

To enable wider adoption of nature-based construction, financial and market systems must recognise these materials as legitimate, investable assets. Across the HKH, respondents highlighted that bamboo, earth, and timber-based buildings are routinely excluded from formal finance, insurance, and procurement mechanisms. As a result, households and developers face structural disincentives to choose natural materials, regardless of their affordability or performance.

Governments and financial institutions can play a catalytic role by aligning incentives with policy intent. This includes adapting housing finance and mortgage products to recognise nature-based construction as acceptable collateral, extending subsidies and tax incentives currently available to industrial materials, and integrating natural materials into public procurement frameworks. Where public housing, schools, or infrastructure projects specify cement and steel by default, they inadvertently reinforce market bias against local materials.

Targeted market interventions can help address this imbalance. Respondents pointed to the potential of government-backed demand guarantees, concessional finance for certified producers, and procurement quotas for low-carbon or locally sourced materials. Without such measures, natural materials are likely to remain confined to informal or donor-supported niches, rather than competing on equal footing within mainstream construction markets.



5.3 Invest in training and skills transfer

The erosion of artisanal knowledge was described by respondents as one of the most urgent threats.

A Nepali architect put it bluntly: “We codified the techniques, but we forgot to train people. The knowledge is disappearing.”

Bhutanese planners echoed this, noting that even with supportive policies, projects are constrained by a shortage of skilled masons. Myanmar respondents added that young builders increasingly focus on industrial methods, leaving traditional skills to fade.

Addressing this requires a multi-pronged approach. Vocational training programmes should be scaled up, with modules on vernacular methods updated to meet modern safety standards. Universities and architecture schools should embed nature-based systems into curricula so that professionals graduate with both awareness and competence. Training should also be accredited, giving artisans formal recognition that improves their employability and credibility. Without investment in skills transfer, policy reforms and market incentives will have little practical effect.

5.3 Invest in training and skills transfer.

Demonstration projects are critical for translating technical potential into institutional confidence. Across the region, respondents emphasised that many nature-based systems fail to scale not because they perform poorly, but because they lack validated, widely recognised proof of performance under real-world conditions.

Pilot projects should therefore prioritise technical and regulatory validation, rather than visibility alone. Well-documented demonstrations—such as public buildings, social housing, or post-disaster reconstruction projects—can provide the empirical basis needed for inspectors, engineers, and regulators to approve nature-based systems. Where possible, these pilots should be designed in partnership with testing institutions and regulatory bodies, so that performance data feeds directly into standards and approval processes.

Importantly, pilot projects should be geographically and programmatically strategic. Respondents noted that demonstrations tied to disaster risk reduction, climate adaptation, or public service delivery are more likely to gain policy traction than isolated showcase buildings. Without this validation function, pilot projects risk remaining symbolic rather than transformative.

5.5 Change perceptions and build consumer demand.

Shifting perceptions is essential to creating sustained demand for nature-based construction. Survey and interview findings consistently showed that consumer attitudes—particularly the association of concrete with progress and natural materials with poverty or informality—strongly shape housing choices across the HKH.

Changing these perceptions requires more than awareness campaigns. Respondents stressed the importance of normalising nature-based materials through everyday, high-quality applications. Public buildings, housing schemes, and disaster recovery programmes can play a powerful signalling role by demonstrating that bamboo, earth, and timber are not exceptional alternatives, but credible, modern construction choices. However, these materials should remain competitive as the market price of industrial materials to ensure affordability.

Narratives should emphasise performance, durability, and resilience rather than tradition alone. Where natural materials are framed primarily as heritage or low-income solutions, they risk reinforcing the very stigma that limits uptake. By contrast, positioning them as climate-resilient, safe, and desirable—supported by visible, well-executed examples—can help shift aspirations and expand consumer demand beyond niche markets.

5.6 Support innovation and certification.

Where demonstration projects create confidence, certification systems translate that confidence into market access. Across the region, there is strong interest in hybrid systems that combine traditional familiarity with modern performance. Respondents described experiments with stabilised earth blocks in Nepal, reinforced bamboo in Bangladesh, and seismic-tested timber-earth systems in Yunnan. But as one Bangladeshi engineer explained, “without certification, no one will risk using them at scale.”

To unlock this innovation, governments and regional institutions should establish testing and certification centres. These centres could validate new materials, fast-track approvals, and build confidence among professionals and financiers. Investment in research and development is also critical, particularly for prefabrication and modular systems that could bring down costs. By formalising innovation, the region can move beyond pilots to mainstream adoption.

5.7 Foster regional collaboration

Finally, respondents consistently highlighted the value of regional exchange. Many of the interventions outlined above are already being tested somewhere in the HKH; the central challenge is that they are rarely shared or scaled across borders. Several interviewees argued that Bangladesh’s experience with flood-resilient bamboo housing and Nepal’s post-earthquake reconstruction should be shared more widely. A Bhutanese respondent added: “We should not each reinvent the wheel; we should learn from each other.”

Regional institutions such as ICIMOD are well-placed to convene this exchange. A regional platform could share technical standards, case studies, and training curricula, while also promoting cross-border exchanges of artisans and professionals. Developing a regional strategy for nature-based construction would ensure that lessons learned in one country inform practice across the HKH. This is particularly important given the shared challenges of seismic risk, flooding, and rapid urbanisation.

6. Conclusion



This study set out to provide a regional snapshot of the state of nature-based construction across the Hindu Kush Himalaya, drawing together scoping review, survey responses, and practitioner interviews. Taken together, the findings point to a sector characterised by contradiction: nature-based materials are widely available, culturally embedded, and technically capable of meeting the region’s climatic and seismic challenges, yet they remain marginal within formal construction systems.

The analysis shows that this marginalisation is not primarily a technical problem. Across countries and materials, barriers arise from misalignment between policy frameworks, market incentives, skills systems, and social perceptions. Natural materials are often recognised in principle but unsupported in practice—codified without enforcement, valued culturally but stigmatised in contemporary housing markets, and affordable at household scale yet excluded from formal finance and procurement systems. These dynamics reinforce one another, limiting demand, discouraging investment, and accelerating the erosion of skills and supply chains.

At the same time, the report documents multiple points of traction. Demonstration projects, post-disaster reconstruction programmes, heritage-informed public procurement, and hybrid material innovations show that nature-based systems can be adapted to modern performance requirements and regulatory contexts. Where institutional support, technical validation, and market demand align, these approaches begin to move beyond niche or informal use.

A further implication is the risk of irreversible loss. Traditional construction knowledge, skilled labour, and locally rooted value chains are declining rapidly. Without deliberate intervention, future efforts to reintroduce or scale nature-based construction are likely to face higher costs and greater constraints—not because materials are unavailable, but because the capacity to use them has been lost. The market price will further influence consumer choice if production and supply chain of natural materials are confined to small scale while industrial materials are comparatively cheaper and more accessible in the market.



Finally, the findings underscore the importance of a regional perspective. Similar materials, hazards, and barriers recur across the HKH, yet learning and innovation remain fragmented. Strengthening regional exchange and coordination offers an opportunity to accelerate progress by building on existing experience rather than duplicating effort.

Overall, the evidence suggests that advancing nature-based construction in the HKH will depend less on developing new technologies than on creating enabling conditions across policy, markets, skills development, and institutional coordination. The recommendations that follow outline practical steps to address these systemic gaps and support a more resilient, locally grounded construction sector across the region.

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Amba Jamir	Male	Independent researcher/consultant	India
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Tikender Singh Panwar	Male	Ex deputy mayor Shimla	India
Ramesh Negi	Male	Integrated Mountain Initiative	India
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Phyoe Thet Khaing	Female	Puls Far East Limited, Myanmar Country Production Office	Myanmar
Catarina Luísa Teles Ferreira Camarinhas	Female	UN-Habitat	Myanmar
Myo Zaw Aung	Male	Network Activities Group	Myanmar
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Rima Lamichhane	Female	Prime Ceramics	Nepal
Dhiraj Kumar Shah	Male	Shah hemp inno ventures	Nepal
Mahendra Bahadur Chitrakar	Male	Federation of Nepal brick associations	Nepal
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Shanti Kala Subedi	Female	Krishnam Smart Engineering Solution Pvt. Ltd. Nepal	Nepal

Name	Gender	Organization	Country
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Anne Feenstra	Male	Sustainable Mountain Architecture, Chakupat, Lalitpur	Nepal
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Rumi Singh Maharjan	Female	Atelier for Crafts Heritage and Architecture Pvt. Ltd. (CHA Atelier)	Nepal
Rajendra Gautam	Male	Global Development Management and Engineering Services	Nepal
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Arunbabu Rana Magar	Male	Baha Spatial Agency	Nepal
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Raj Kumar Giri	Male	Forest Research and Training Centre	Nepal
Yek Raj Adhikari	Male	Ministry of Urban Development/ Department of Urban Development and Building Construction.	Nepal
Pranab Pradhan	Male	Green Bamboo Creation Pvt. Ltd.	Nepal
Narendra Kumar KC.	Male	Provincial office Kolhapur Banke	Nepal
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Syed Zeeshan Ali Shah Syed Haroon Ali Shah	Male	Speed Traders Services	Pakistan
Najeem Khan	Male	World Health Organization	Pakistan
Yumna Imtiaz	Female	University of Oregon	Pakistan

Name	Gender	Organization	Country
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Muhammad Shehryar Jamil	Male	Baltistan Culture & Development Foundation (BCDF)	Pakistan
Ishtiaq Ahmad Mr	Male	World Relief	Pakistan
Raheel Khan Kasi	Male	Secours Islamique France (SIF)	Pakistan
Muhammad Jaffar Mazhar	Male	Forest, Wildlife and Environment Department	Pakistan
Aitezaz Mahfooz	Male	Khyber Pakhtunkhwa Forest Department	Pakistan
Azeem Sardar Gill	Male	The Urban Unit	Pakistan
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Abdullah Khan Kakar	Male	Muslim Aid	Pakistan
Muhammad Naveed	Male	Secours Islamique France	Pakistan



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Annex A: Country Profiles



Afghanistan

1. Overview

Afghanistan's construction sector reflects both the resilience of vernacular traditions and the disruptions caused by decades of conflict, displacement, and limited institutional capacity. Traditional systems of mudbrick, stone, and timber remain widely used in rural and peri-urban contexts, where affordability and availability drive material choice. These systems are valued for their thermal performance and cultural familiarity, yet they are rarely codified, supported, or incentivised by national policy. In urban centres, reinforced concrete and fired brick dominate, seen as symbols of durability and modernity.

The Afghanistan National Building Code (2013) provides overarching safety provisions, but references to natural materials are limited and largely generic. Survey responses and scoping review confirm that local builders continue to rely heavily on vernacular practices without formal guidance, training, or certification. This results in wide variation in quality and safety, and contributes to the perception that natural materials are inferior.

2. Traditional and current practices

- | | |
|---------------------------------------|---|
| Mudbrick and adobe. | Mudbrick is Afghanistan's most common vernacular building material, particularly in rural areas. It is inexpensive, provides insulation against extreme summer and winter temperatures, and can be produced locally with minimal equipment. However, poor-quality bricks and weak mortar are common where traditional expertise has been lost, reducing structural performance. |
| Stone and timber. | Stone masonry reinforced with timber has historically been used in mountainous regions. Timber provides lateral strength, while stone walls give durability and thermal mass. Artisanal knowledge of timber joinery is increasingly rare, particularly as deforestation has reduced availability of quality timber in many areas. |
| Hybrid and transitional forms. | Many peri-urban households use combinations of mudbrick, stone, and salvaged industrial materials. These hybrids illustrate both adaptability and vulnerability: when poorly constructed, they are susceptible to seismic collapse. |

Despite their limitations, these vernacular systems remain essential. As one Afghan survey respondent observed, “for most families, mudbrick is not a choice but the only option—they cannot afford cement.”

3. Policy and institutional landscape

The Afghanistan National Building Code (2013) contains broad structural guidelines but provides little detail for traditional systems. The lack of technical guidance leaves engineers and contractors without recognised standards for mudbrick or timber-laced stone, perpetuating informal use and quality inconsistency.

Policy implementation is further constrained by limited enforcement capacity at municipal and provincial levels. Survey respondents noted that building permits are rarely applied in rural areas, and oversight is minimal. International agencies and NGOs (e.g., UN-Habitat, UNDP) have produced training manuals and post-conflict reconstruction guidelines that reference local materials, but these remain project-based rather than systemic.

4. Barriers and opportunities

Barriers.

- Skills erosion. Traditional building knowledge has not been systematically passed on, particularly during periods of displacement.
- Negative perceptions. Mudbrick and stone are often seen as unsafe or temporary, especially in comparison to concrete.
- Weak policy support. National codes reference natural materials only superficially, and enforcement is minimal.
- Resource pressure. Timber availability is declining due to deforestation and conflict-driven extraction.

Opportunities.

- Affordability and accessibility. Mudbrick remains one of the most cost-effective and widely available options for rural households.
- Climate performance. Traditional systems provide thermal comfort in Afghanistan’s extreme climate.
- Cultural continuity. Vernacular methods remain central to community identity in rural areas.
- Post-disaster reconstruction. Donor-led programmes demonstrate that improved mudbrick and timber-laced stone can be retrofitted for greater resilience.

5. Stakeholder perspectives

Survey responses from Afghanistan were limited (two in total), but both underscored reliance on vernacular systems due to affordability. One respondent noted that “*without training or standards, builders copy what they know, which can be dangerous in earthquakes.*” While no direct interviews were conducted with Afghan practitioners, parallels from neighbouring contexts suggest similar challenges around stigma, skills, and enforcement.

6. Country-specific recommendations

Strengthen guidance on vernacular systems within the National Building Code.	Introduce specific typologies and technical standards for mudbrick and timber-laced stone, drawing on post-disaster reconstruction manuals developed by UNDP and UN-Habitat.
Invest in vocational training.	Support training for masons in rural areas, combining traditional methods with seismic reinforcement.
Promote demonstration projects.	Showcase improved mudbrick and stone structures that meet resilience standards, particularly in seismic-prone areas such as Bamiyan and Herat.
Align with donor programmes.	Leverage international reconstruction projects to build national capacity rather than isolated pilots.
Explore sustainable timber strategies.	Address declining timber availability through reforestation and sustainable management policies, ensuring long-term viability of timber-laced masonry.

7. Conclusion

Afghanistan’s vernacular construction remains essential for millions of households but is undermined by weak policies, stigma, and skills shortages. Although the evidence base is thinner than in other HKH countries, the findings suggest that modest interventions—updating codes, investing in training, and documenting successful pilots—could significantly enhance the safety and legitimacy of natural materials.

By building on what communities already use and know, Afghanistan can improve resilience while preserving affordability and cultural continuity.



Bangladesh

1. Overview

Bangladesh's construction sector reflects the tension between tradition and modernity. While concrete, brick, and steel dominate in cities and infrastructure, vernacular systems—particularly bamboo, mud, and jute-based composites—remain widespread in rural areas, especially for low-income housing. These nature-based materials are culturally familiar and abundant, but they are increasingly stigmatised as “temporary” or “inferior.”

The country faces acute climate risks, particularly recurrent flooding and cyclones, which have historically reinforced the value of flexible, lightweight structures such as bamboo. Yet as incomes rise and urbanisation accelerates, households increasingly aspire to build in brick and concrete, even in flood-prone zones where these materials perform poorly.

Survey responses from Bangladesh were the largest in the study (28), providing insights from NGOs, architects, engineers, contractors, and value chain actors. Together with documented case studies and policy analysis, they paint a detailed picture of both the potential and the challenges facing nature-based construction.

2. Traditional and current practices

Bamboo

Bamboo remains Bangladesh's most important natural construction material. It is used for housing, fencing, scaffolding, and furniture, valued for its availability, low cost, and renewability. In rural areas, whole bamboo culms are used for posts, walls, and flooring. However, untreated bamboo is vulnerable to pests and moisture, contributing to perceptions of fragility.

Mud and jute-based materials.

Earthen walls and jute sticks are widely used in rural areas, often in combination with bamboo. Mud walls provide thermal comfort but require regular maintenance after floods. Jute fibres are increasingly being developed into composites, with research institutions exploring their potential as low-cost, sustainable alternatives to synthetic materials.

Transitional housing.

Many peri-urban households construct hybrid dwellings, combining bamboo and mud with corrugated metal sheets or brick. This reflects both affordability constraints and aspirations for more “modern” housing.

Innovation.

A notable example of climate-adaptive innovation is BRAC's modular bamboo housing initiative. Designed for flood-prone areas such as Gaibandha and Sylhet, these elevated structures use treated bamboo panels and modular systems that allow for disassembly and relocation during monsoon floods. The model has been credited with reducing displacement and asset loss during seasonal floods, while also challenging perceptions that bamboo is a fragile or temporary material. Complementing this, the METI Handmade School in Rudrapur—built using bamboo, mud, and local craftsmanship—demonstrates how natural materials can achieve global architectural acclaim and serve as dignified, high-performing spaces for education and community.



3. Policy and institutional landscape

The Bangladesh National Building Code (2015, revised 2020) references timber, bamboo, and clay, but survey respondents consistently noted that there are no effective certification systems or enforcement mechanisms to support their safe use. As one architect commented, “bamboo is in the code, but in practice, no one trusts it because there is no system to prove its quality.”

National housing policies emphasise affordability and resilience but do not include concrete measures to mainstream natural materials. HBRI has been active in researching alternative materials, such as CSEBs and jute composites, but these remain confined to pilot projects.

Implementation is further constrained by enforcement gaps. Local authorities rarely apply code provisions to low-income or rural housing, where the majority of natural materials are used. As a result, most construction with bamboo or earth remains informal and unregulated, limiting its ability to compete in formal markets.

4. Barriers and opportunities

Barriers.

- **Negative perceptions.** Concrete and brick are strongly associated with modernity and status. Survey respondents noted that families often prefer brick even in flood zones where bamboo would be safer.
- **Policy gaps.** While bamboo is mentioned in the building code, the absence of certification and enforcement undermines its legitimacy.
- **Durability issues.** Untreated bamboo deteriorates quickly, reinforcing perceptions of fragility.
- **Market fragmentation.** Bamboo producers are largely small-scale and informal, with limited access to formal supply chains.

Opportunities.

- **Flood resilience.** Bamboo housing, particularly modular and elevated systems, is uniquely suited to Bangladesh’s climate risks.
- **Affordability.** Bamboo, mud, and jute-based materials remain cheaper than industrial alternatives, particularly in rural contexts.
- **Innovation.** Treated bamboo panels, jute composites, and CSEBs show potential to modernise vernacular practices.
- **Institutional capacity.** HBRI provides a foundation for research and policy development that could be scaled with stronger support.

5. Stakeholder perspectives

Survey and interview data highlight both the challenges and the optimism around natural materials in Bangladesh.

- On perceptions: One architect explained, *“Clients want brick because they believe it lasts forever, even if it cracks in floods. Bamboo could save their homes, but they see it as poor people’s material.”*
- On market gaps: A contractor noted, *“We could build more with bamboo, but there is no standardisation. Each supplier is different, and we cannot guarantee quality.”*
- On innovation: NGO respondents praised modular bamboo housing, with one describing it as *“a model that changes how people see bamboo—from fragile to resilient.”*

These perspectives show that while barriers are real, visible examples of success can shift attitudes.

6. Country-specific recommendations.

Develop certification systems for bamboo and earthen construction. Standards for treatment, grading, and durability would give contractors and financiers confidence.

Expand research and dissemination. Scale up HBRI’s work on CSEBs and jute composites, ensuring findings are translated into policy and practice.

Promote demonstration projects. Support flood-resilient bamboo housing as a mainstream model, not only as an NGO pilot.

Incentivise local value chains. Provide subsidies or procurement support for treated bamboo and other certified natural materials, linking small-scale producers to formal markets.

Integrate training programmes. Build artisan and contractor capacity in bamboo treatment and earthen block construction, with accredited certification.

7. Conclusion

Bangladesh demonstrates both the challenges and opportunities of nature-based construction. On the one hand, bamboo, mud, and jute-based systems remain widespread but stigmatised, informal, and poorly regulated. On the other hand, the country has strong institutional foundations through HBRI, proven innovation models such as modular bamboo housing, and a clear alignment between natural materials and national resilience needs.

By strengthening certification, supporting innovation, and changing perceptions through demonstration, Bangladesh could play a regional leadership role in revitalising nature-based construction.



Alex Treadway/ICIMOD

Bhutan

1. Overview

Bhutan presents one of the most distinctive cases in the HKH, where cultural heritage and national policy both reinforce the use of nature-based materials. The country's philosophy of Gross National Happiness has shaped approaches to housing and construction, embedding environmental sustainability and cultural identity into national priorities. As a result, traditional systems such as rammed earth, stone masonry, and timber framing remain prominent, particularly in heritage zones and public buildings.

At the same time, Bhutan is not immune to the pressures seen elsewhere in the region. Urbanisation and rising incomes have fuelled demand for concrete and steel, particularly in Thimphu and other growing towns. Younger generations of builders are less likely to train in vernacular crafts, and contractors often prefer industrial methods that are faster and more easily standardised. Bhutan therefore illustrates both the possibilities and the challenges of mainstreaming nature-based construction.

2. Traditional and current practices

Rammed earth.	Rammed earth is central to Bhutanese architecture. It is widely used for walls of dwellings, monasteries, and fortresses (dzongs). Rammed earth provides excellent thermal mass, suiting Bhutan's mountainous climate, and is deeply embedded in the country's architectural identity.
Stone and timber.	Stone masonry reinforced with timber is also common, particularly in highland regions. Timber is used for framing, floors, and intricate joinery, reflecting Bhutan's artisanal traditions.
Hybrid forms.	Modern buildings often combine traditional exteriors with reinforced concrete cores, blending heritage aesthetics with structural performance. This hybridisation demonstrates adaptability but also signals the encroachment of industrial materials.
Conservation and public buildings.	Rammed earth and timber are maintained in public projects, heritage restoration, and government buildings. These high-visibility uses sustain legitimacy for natural materials, even as private housing trends shift toward concrete.

3. Policy and institutional landscape

Bhutan stands out in the HKH for embedding vernacular systems into national policy:

- The National Construction Industry Policy (2020) encourages green growth and explicitly promotes the use of certified local timber and bamboo.
- The National Housing Policy (2020) mandates that new housing developments reflect traditional aesthetics and, where possible, traditional materials.
- The National Human Settlement Policy (2019) emphasises cultural preservation alongside urban development.

Despite this supportive policy framework, implementation challenges remain. Compliance can be costly for contractors, and younger artisans are not being trained at sufficient scale. As one Bhutanese planner explained in interview, “We can write beautiful policies, but without masons and without subsidies, it remains on paper.”

One of the most ambitious recent initiatives is the planned [Gelephu Mindfulness City](#), envisioned as a model for green urbanism rooted in Bhutanese values and architectural heritage. Proposed as part of Bhutan’s economic diversification strategy, the city will integrate traditional construction methods—such as timber, stone, and rammed earth—into modern infrastructure and urban planning. While still in early stages, Gelephu has been framed as a “mindfulness city” that reflects Bhutan’s Gross National Happiness philosophy in both design and function. If implemented successfully, it could become a regional exemplar of how vernacular materials and cultural identity can shape modern urban development.

4. Barriers and opportunities

Barriers.

- **Skills erosion.** The pool of skilled rammed earth masons and timber joiners is shrinking.
- **Compliance costs.** Meeting policy requirements for traditional aesthetics and materials can raise construction costs.
- **Urban aspirations.** In Thimphu and other cities, households increasingly aspire to concrete and steel housing.
- **Limited innovation.** While heritage conservation sustains traditional forms, there has been less experimentation with hybrid or modernised natural materials compared to other HKH countries.

Opportunities.

- **Strong policy base.** Bhutan has some of the most supportive national policies for nature-based construction in the region.
- **Cultural continuity.** Vernacular architecture is a source of national pride and identity.
- **Public sector leadership.** The government’s use of rammed earth and timber in schools, offices, and heritage projects creates visible demand.
- **Tourism and heritage.** Maintaining traditional aesthetics supports Bhutan’s tourism sector, which values authenticity and cultural preservation.

5. Stakeholder perspectives

Survey responses from Bhutan (8 in total) echoed both pride and concern. Several respondents emphasised the cultural importance of rammed earth, with one noting, “*Our heritage is built with it—losing it means losing who we are.*” Others stressed practical challenges: “*Clients think rammed earth is old-fashioned and slow compared to concrete,*” said an architect. Policymakers highlighted that enforcement is difficult without sufficient training and subsidies.

These perspectives suggest that while Bhutan is a leader in embedding nature-based materials into policy, the gap between policy intent and on-the-ground implementation is widening.

6. Country-specific recommendations.

Scale up vocational training.	Expand programmes to train a new generation of rammed earth masons and timber artisans, linking them to certification systems.
Support cost-sharing mechanisms.	Provide subsidies or incentives to offset higher costs of traditional construction, ensuring compliance is affordable.
Promote innovation within tradition.	Encourage research into hybrid systems—such as stabilised earth blocks or timber-concrete composites—that retain aesthetics while enhancing performance.
Leverage tourism and heritage.	Use tourism revenues to support conservation and new builds that reinforce cultural identity.
Strengthen monitoring and enforcement.	Ensure municipal authorities are resourced to apply policy provisions consistently.

7. Conclusion

Bhutan demonstrates that policy and cultural pride can sustain nature-based construction in ways rarely seen elsewhere in the HKH. Rammed earth, stone, and timber remain visible in public projects and heritage contexts, providing both functionality and identity. Yet without stronger investment in training, cost-sharing, and innovation, the country risks losing practical capacity even as policies remain supportive.

Bhutan’s experience offers an important lesson for the region: cultural legitimacy and policy frameworks are essential foundations, but they must be matched with skills, resources, and incentives to be sustainable.



China

1. Overview

China's construction sector is vast and dominated by industrial materials, yet in the HKH-relevant provinces of Yunnan and Tibet, vernacular traditions of earth and timber construction remain visible.

These systems have evolved to provide thermal comfort in high-altitude climates, combining rammed earth, adobe, and timber-laced masonry. While urbanisation and mass housing programmes have accelerated the use of concrete and brick, traditional practices continue to play a role in rural areas, heritage conservation, and earthquake recovery initiatives.

Survey participation from China was limited (four responses), but scoping review highlights an emerging policy interest in green building, local materials, and rural revitalisation. Hybrid experiments with timber-earth construction have been tested for seismic performance, suggesting opportunities for innovation if policy and market support can be strengthened.

2. Traditional and current practices

Rammed earth and adobe.

Rammed earth has long been used in Tibetan villages, providing thermal mass that keeps homes warm in winter and cool in summer. Adobe blocks are also common in rural Yunnan, where they are inexpensive and locally produced.

Timber structures.

Timber is widely used in framing and roofing, particularly in Tibetan settlements where intricate joinery is a cultural marker. In Yunnan, timber is combined with earth walls for hybrid forms adapted to seismic risks.

Hybrid systems.

Modern experiments have tested combinations of timber framing with earth infill, designed to improve seismic resilience. Some local governments have supported pilots that retrofit traditional houses with seismic reinforcement.

Transition to concrete.

As incomes rise and urbanisation expands, many households replace earth and timber with brick and reinforced concrete. These are perceived as modern, durable, and aligned with aspirations for upward mobility. One survey respondent noted, "Concrete is the choice of progress; earth is seen as the past."



3. Policy and institutional landscape

China has introduced several policies relevant to nature-based construction, though their implementation has been uneven:

- The Rural Revitalization Policy (2018) encourages the use of local materials and traditional forms in rural housing upgrades, particularly in areas designated for cultural tourism.
- The Green Building Evaluation Standards (2019) provide a national framework for classifying environmentally friendly materials, opening space for natural materials but often prioritising industrial “eco-materials” such as fly-ash cement.
- Provincial and municipal initiatives in Yunnan and Tibet have supported conservation of vernacular systems, sometimes linked to heritage preservation and tourism.

Despite these policy openings, large-scale housing and urbanisation programmes overwhelmingly favour concrete and brick. Enforcement of rural revitalisation provisions varies significantly across provinces, and natural materials are often overshadowed by industrial products in both markets and official programmes.

4. Barriers and opportunities

Barriers.

- **Policy overshadowing.** National emphasis on industrial housing solutions limits the visibility of natural materials.
- **Perceptions of modernity.** Concrete and brick are strongly associated with progress, while earth and timber are seen as outdated.
- **Skills decline.** Artisanal timber joinery and rammed earth techniques are practiced by fewer builders each year.
- **Limited survey evidence.** Stakeholder perspectives are underrepresented in available data.

Opportunities.

- **Policy footholds.** Rural revitalisation and green building standards create openings for natural materials.
- **Seismic resilience.** Timber-earth hybrids tested in Yunnan have shown promising results in earthquake performance.
- **Cultural tourism.** Tibetan vernacular architecture remains a draw for visitors, sustaining artisanal practices in heritage contexts.
- **Innovation potential.** Pilot projects demonstrate that traditional forms can be upgraded with modern engineering to meet safety standards.

5. Stakeholder perspectives

Survey respondents from China, though few in number, reinforced themes common across the region. One architect noted, *“Local governments support earth and timber in heritage villages, but in new housing everyone wants concrete.”* Another emphasised the innovation potential: *“If timber and earth can be certified as safe, they could return as modern solutions, not just for heritage.”*

These perspectives suggest that perceptions are a critical barrier, but they also highlight optimism that policy openings and hybrid technologies could change the narrative.

6. Country-specific recommendations

Strengthen provincial implementation of rural revitalisation policies. Ensure that mandates for local materials are enforced and linked to technical guidance.

Expand testing and certification of timber-earth hybrids. Build on seismic experiments in Yunnan to create codified standards.

Invest in training for artisanal skills. Support younger builders to learn timber joinery and rammed earth techniques, linking them to heritage tourism.

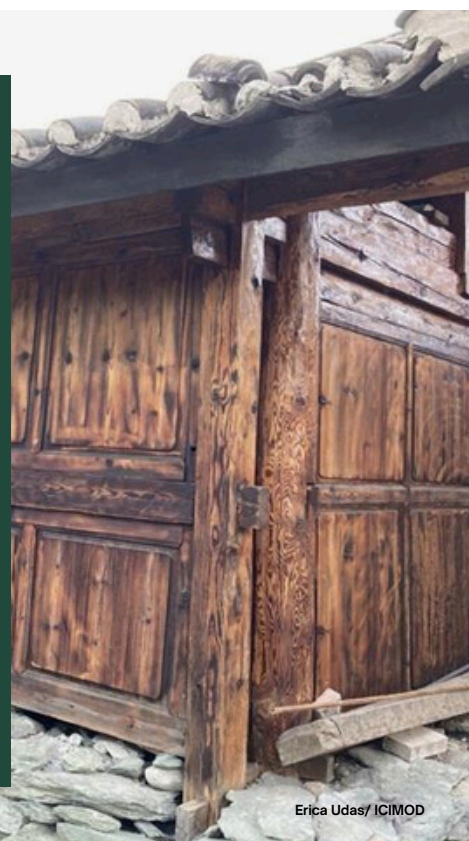
Promote demonstration projects. Showcase modernised natural material housing in rural revitalisation programmes, framing them as aspirational rather than outdated.

Align green building standards with vernacular systems. Ensure that natural materials are recognised as environmentally friendly options alongside industrial “eco-materials.”

7. Conclusion

China illustrates both the challenges and the opportunities of sustaining natural construction within a rapidly industrialising context. Vernacular systems in Yunnan and Tibet remain valued for cultural identity and climatic performance, but they are increasingly marginalised by concrete and brick.

Policy frameworks such as the Rural Revitalization Policy provide a foothold, and seismic-tested hybrids show technical potential. However, without stronger enforcement, certification, and perception-shifting demonstration projects, natural materials will remain confined to heritage zones and pilot projects. With targeted investment, China could demonstrate how vernacular systems can be modernised and scaled within a national strategy for green and resilient housing



Erica Udas/ ICIMOD

India

1. Overview

India's Himalayan states—including Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and the northeastern hill states—have a long tradition of vernacular construction adapted to seismic and climatic conditions. Systems such as Kath-Kuni (timber–stone interlocking) and Dhajji Dewari (timber-laced masonry) are recognised for their earthquake resilience and cultural significance. In northeast India, bamboo remains a key construction material, embedded in both everyday practice and cultural identity.

Nationally, India's construction sector is heavily industrialised, dominated by cement, steel, and fired brick. In urban areas, these materials are associated with modernity and upward mobility. Yet at the state level, particularly in Himalayan regions, vernacular methods retain importance, both as heritage and as functional solutions in hazard-prone contexts. Survey responses from India (11 in total) reflected this duality: pride in traditional systems and concern over their decline in the face of rapid urbanisation.



2. Traditional and current practices

Kath-Kuni.

This method involves interlocking timber beams with stone masonry walls, creating highly earthquake-resistant structures. It is distinctive to Himachal Pradesh and has been used for centuries in temples, homes, and community buildings.

Dhajji Dewari.

Similar in principle to timber-laced masonry in Pakistan, Dhajji Dewari uses timber frames with stone or brick infill, allowing flexibility during seismic events. It remains visible in Jammu & Kashmir, though increasingly replaced by reinforced concrete.

Bamboo construction.

In Assam and the northeast, bamboo remains widely used for housing and public infrastructure. It is valued for renewability and affordability but is often stigmatised as “temporary.” Untreated bamboo's vulnerability to pests and rot reinforces these perceptions.

Hybrid systems.

Modern builders often combine traditional methods with concrete, either as foundations, reinforcements, or finishes. These hybrids reflect both adaptation and aspiration, but also risk diluting the structural benefits of vernacular systems. The [Hunnarshala Foundation](#), based in Bhuj, Gujarat, has pioneered post-disaster and eco-sensitive housing using stabilised earth blocks, bamboo, and lime plasters. Its hybrid construction systems blend vernacular aesthetics with seismic resilience and have been deployed in reconstruction efforts following earthquakes and floods. The organisation also runs training programmes for artisans and masons, linking local materials with formal certification. Their work illustrates how hybrid nature-based systems can achieve policy recognition, community trust, and market viability.

Conservation and cultural use.

NGOs, academic institutions, and heritage organisations continue to promote vernacular systems. The Indian National Trust for Art and Cultural Heritage (INTACH) has documented and restored Kath-Kuni and Dhajji Dewari structures, demonstrating their resilience and cultural value.

3. Policy and institutional landscape

India has one of the most extensive regulatory frameworks in the region:

- The National Building Code (2016) and Energy Conservation Building Code (2017) both reference alternative and eco-friendly materials, including bamboo and earthen technologies.
- The Building Materials & Technology Promotion Council (BMTPC) has produced manuals and compendiums on indigenous construction technologies.
- State-level policies in Himachal Pradesh and Uttarakhand encourage vernacular systems in seismic zones, sometimes mandating their use in heritage areas.
- Research institutions such as the Auroville Earth Institute and Indian Institute of Technology (IIT) Roorkee actively develop and test alternative materials and disaster-resilient housing systems.

Despite this enabling framework, enforcement and uptake are limited. Survey respondents stressed that building codes are often ignored in practice, and contractors prefer concrete because it is easier to standardise and market. As one architect explained, “The code mentions bamboo and earth, but in practice, no engineer wants to sign off on it—concrete feels safer on paper.”

4. Barriers and opportunities

Barriers.

- **Perceptions of modernity.** Concrete and brick are strongly associated with upward mobility, even in hazard-prone zones where they perform poorly.
- **Limited enforcement.** Code provisions for natural materials are often overlooked in municipal approvals.
- **Skills decline.** Few young masons are trained in Kath-Kuni or Dhajji Dewari, leading to knowledge loss.
- **Market fragmentation.** Bamboo production and processing remain largely informal, with limited access to certification and supply chains.

Opportunities.

- **Seismic resilience.** Traditional systems like Kath-Kuni and Dhajji Dewari are uniquely suited to earthquake-prone Himalayan regions.
- **Research capacity.** Institutions such as IITs, BMTPC, and the Auroville Earth Institute provide strong foundations for innovation and standardisation.
- **Policy openings.** National codes and state-level policies already reference natural materials, offering a platform for mainstreaming.
- **Heritage and tourism.** Vernacular systems are valued as cultural assets, supporting both tourism and conservation.

5. Stakeholder perspectives

Survey respondents from India expressed both pride and frustration. One architect noted, “*Kath-Kuni houses are part of our heritage, but clients still ask for concrete because they think it is safer.*” Another explained, “*The knowledge is disappearing—there are few masons left who know how to build in the traditional way.*”

Respondents also pointed to opportunities. Engineers highlighted the work of Auroville Earth Institute in demonstrating stabilised earth blocks as a modernised alternative. A planner from Himachal Pradesh remarked that “if people could see Kath-Kuni tested and certified, they would trust it again.”

These perspectives suggest that perception, certification, and training are the main levers for revitalising vernacular systems in India.

6. Country-specific recommendations.

Codify and certify vernacular systems. Develop national and state-level standards for Kath-Kuni, Dhajji Dewari, and bamboo construction, validated through seismic testing and certification.

Invest in training. Expand vocational programmes in Himalayan states to train artisans in traditional techniques, linking them to accredited certification.

Leverage research institutions. Use IITs, BMTPC, and Auroville Earth Institute to translate research into codes, curricula, and practical guidance.

Promote demonstration projects. Showcase hybrid systems that combine vernacular methods with modern safety standards, particularly in seismic-prone zones.

Change perceptions. Use awareness campaigns and heritage conservation projects to position vernacular systems as resilient and aspirational, not outdated.

7. Conclusion

India demonstrates both the fragility and the resilience of vernacular construction in the HKH. Traditional systems remain valued for cultural identity and seismic performance, yet their practical use is shrinking due to perceptions, enforcement gaps, and skills erosion. With strong research institutions and an existing policy base, India is well placed to lead regional innovation—if these resources can be mobilised to certify, train, and demonstrate the viability of natural systems.

The country’s experience underscores the importance of bridging heritage and modernity, ensuring that vernacular systems are not confined to history but adapted for contemporary resilience and sustainability.



Myanmar

1. Overview

Myanmar's construction sector sits at the intersection of rapid urbanisation and deeply rooted vernacular traditions. In cities such as Yangon and Mandalay, reinforced concrete and fired brick dominate, reflecting aspirations for permanence and modernity. In rural and peri-urban areas, however, bamboo, timber, and thatch remain central to everyday housing. These systems are valued for affordability and familiarity, but they are increasingly stigmatised as “temporary” or “unsafe.”

Survey participation from Myanmar was modest (seven responses), but respondents consistently stressed the persistence of bamboo and timber in rural areas, alongside concern that skills and policy support are not keeping pace with demand. Scoping review and UN-Habitat reports further highlight how bamboo has been used in post-disaster housing projects, demonstrating its potential for resilience when applied systematically.

2. Traditional and current practices

Bamboo.

Bamboo is Myanmar's most important natural construction material. It is used extensively in rural housing, often for posts, walls, and flooring. Its renewability and availability make it indispensable, but untreated bamboo deteriorates quickly, reinforcing perceptions of fragility.

Timber.

Timber is widely used for housing and public buildings, though unsustainable logging and deforestation have reduced supply in some regions. Timber-framed housing remains aspirational for rural households, associated with sturdiness compared to bamboo and thatch.

Thatch and hybrid forms.

Thatch roofing and bamboo walls are common in low-income households, often combined with corrugated metal sheets as families transition toward industrial materials.

Innovation

UN-Habitat and NGO-led projects have piloted improved bamboo housing, particularly after Cyclone Nargis (2008). These projects demonstrated that treated bamboo, when designed properly, can withstand storms and floods better than unreinforced concrete block houses. The [Housing NOW](#) project, piloted by a coalition of NGOs and community groups, introduced pre-fabricated bamboo shelters following Cyclone Nargis.

These units were designed for rapid deployment, affordability, and resistance to flooding. Prefabrication and bamboo treatment addressed quality and durability concerns, helping shift perceptions of bamboo as a viable material for post-disaster and transitional housing. Despite promising results, this model has not yet been scaled or formally incorporated into national housing strategies.

3. Policy and institutional landscape

Myanmar's National Housing Policy (2017) and National Urban Policy Framework (2020) both reference the importance of local building materials and skills. However, the policies remain broad and aspirational, with little operational guidance or enforcement.

Building codes remain underdeveloped for bamboo and timber, and no certification systems exist to ensure quality or durability. Survey respondents noted that local authorities rarely regulate housing built with natural materials, which keeps them informal and marginalised.

4. Barriers and opportunities

Barriers.

- **Stigma and perceptions.** Bamboo is widely viewed as a “poor person’s material” despite its renewability and resilience potential.
- **Policy weakness.** National frameworks recognise local materials but provide no technical standards or enforcement.
- **Market fragmentation.** Bamboo producers operate informally, with no certification or access to formal supply chains.
- **Skills erosion.** Young builders increasingly prefer to work with concrete, leaving fewer trained in bamboo joinery and treatment.

Opportunities.

- **Disaster resilience.** Post-cyclone projects have proven bamboo’s value in flood- and storm-prone areas.
- **Affordability.** Bamboo and timber remain cheaper and more accessible than industrial materials in rural contexts.
- **Cultural familiarity.** Communities are accustomed to bamboo, making it easier to promote improved, modernised versions.
- **Policy entry points.** Existing housing and urban frameworks could be expanded to provide standards and incentives.

5. Stakeholder perspectives

Survey respondents from Myanmar reflected both reliance and concern. One NGO worker explained, “*Families continue to use bamboo because it is what they know and what they can afford, but they do not trust it to last.*” Another noted, “*Younger builders no longer learn bamboo construction—it is not part of the training.*”

At the same time, respondents highlighted optimism around improved designs. A contractor involved in cyclone reconstruction remarked, “When treated properly, bamboo is stronger than people think. After the storm, the bamboo houses survived where the cheap concrete blocks fell.” These perspectives suggest that changing perceptions will require visible proof of bamboo’s durability, backed by training and certification.

6. Country-specific recommendations.

Develop bamboo standards and certification.	Establish treatment and grading systems to ensure durability and build market confidence.
Scale up training.	Introduce vocational programmes to teach bamboo joinery and preservation methods, targeting younger builders.
Promote demonstration projects.	Expand post-disaster housing pilots into mainstream rural housing programmes, showing bamboo as resilient and modern.
Incorporate into policy.	Translate references to local materials in the Housing and Urban Policies into enforceable codes and procurement systems.
Support bamboo value chains.	Provide incentives for small-scale producers to formalise and access larger markets.

7. Conclusion

Myanmar illustrates both the persistence and marginalisation of vernacular systems. Bamboo and timber remain indispensable for rural households but are undervalued, informal, and poorly supported by policy. Demonstration projects after Cyclone Nargis proved that improved bamboo designs can outperform industrial alternatives in hazard-prone areas.

With investment in certification, training, and perception-shifting pilots, Myanmar could revitalise bamboo as a mainstream material that supports resilience, affordability, and cultural continuity.



Nepal

1. Overview

Nepal has long relied on vernacular construction systems adapted to its mountainous geography and high seismic risk. Earthen, bamboo, and stone-based systems are widely used in rural housing, while hybrid timber-laced masonry remains one of the most trusted forms of earthquake-resilient construction. Following the 2015 Gorkha earthquake, national policies and reconstruction programmes brought renewed attention to local materials, codifying them in building codes and promoting their use in recovery efforts.

Despite these advances, natural materials face persistent stigma in urban markets, where concrete and brick are viewed as modern and aspirational. Younger generations of artisans are not learning traditional skills at scale, and formal supply chains for bamboo and earthen blocks remain weak. Nevertheless, Nepal stands out in the HKH for explicitly recognising natural materials in its building codes and for the number of innovative pilots and practitioners—such as ABARI—pioneering hybrid systems that blend tradition with modern safety standards.

Survey participation from Nepal was high (22 responses), and interviews with Nepali practitioners provided rich insights, making this one of the best-documented cases in the region.

2. Traditional and current practices

Earthen construction. Earthen walls—both adobe and rammed earth—are common in rural areas, valued for thermal comfort and affordability. However, unreinforced earthen structures were particularly vulnerable in the 2015 earthquake, reinforcing perceptions of fragility.

Stone masonry. Stone walls, often dry-stacked or mortared with mud, are widespread in mountain villages. Their seismic performance varies greatly depending on craftsmanship and reinforcement.

Timber-laced masonry. Systems such as Dhajji Dewari (similar to northern Pakistan) and timber banding are historically widespread. These methods add horizontal timber layers to stone or brick masonry, improving seismic resilience. Post-earthquake evaluations confirmed their effectiveness, and they remain highly trusted in rural areas.

Bamboo. Bamboo is abundant in Nepal's Terai and mid-hill regions, used in housing, scaffolding, and furniture. However, untreated bamboo deteriorates quickly. Pilots with treated bamboo housing and hybrid bamboo-earth systems—especially by ABARI—have demonstrated the material's potential for modern, affordable housing.

Hybrids and innovation. One of the most prominent examples of innovation in Nepal is the work of ABARI, a design-build firm that blends traditional earth and bamboo systems with modern engineering. ABARI has developed earthquake-resilient homes using compressed stabilised earth blocks (CSEBs) reinforced with treated bamboo or timber, and has collaborated with the government and INGOs in post-earthquake reconstruction. Their work has demonstrated how vernacular materials can meet structural codes while remaining affordable and locally sourced. ABARI's approach has become a model for hybrid practice in the region, and their training programs are helping to build a new generation of artisans skilled in both traditional and modern techniques.



3. Policy and institutional landscape

Nepal is notable for being one of the few HKH countries to formally codify natural materials:

- The Nepal National Building Code (revised 2020) explicitly includes typologies for earthen, bamboo, and stone masonry, with seismic reinforcement requirements.
- Post-earthquake reconstruction guidelines (2015 onwards) promoted local materials with reinforcement, integrating them into donor- and government-supported rebuilding programmes.
- National climate policies increasingly link construction to resilience, though natural materials are not yet fully mainstreamed into broader development frameworks.

Despite this progress, enforcement remains inconsistent. Municipal authorities often lack the capacity or willingness to apply natural-material provisions, especially in urban areas where concrete dominates. Interviewees repeatedly stressed the gap between “what is written” and “what is built.”

4. Barriers and opportunities

Barriers.

- **Stigma and perceptions.** Many urban households see earthen or bamboo construction as a “poor person’s choice.” As one architect noted, “Clients hear ‘earth’ and think of their grandparents’ house collapsing.”
- **Skills erosion.** Masons trained in timber-laced masonry or earthen techniques are scarce. One interviewee reflected, “We codified the techniques, but we forgot to train people. The knowledge is disappearing.”
- **Weak supply chains.** Bamboo treatment facilities and CSEB producers exist but remain fragmented and small-scale.
- **Inconsistent enforcement.** Although natural materials are codified, codes are often ignored in practice.

Opportunities.

- **Seismic resilience.** Timber-laced masonry proved effective during the 2015 earthquake, giving it strong legitimacy in communities.
- **Policy framework.** Nepal’s explicit recognition of natural materials in the building code sets a regional precedent.
- **Innovation ecosystem.** Organisations like ABARI have created replicable models for hybrid construction that meet modern standards.
- **Donor engagement.** Post-disaster funding has supported experimentation and dissemination of natural material techniques.

5. Stakeholder perspectives

Survey and interview data from Nepal provided detailed insights:

- On perceptions: Architects reported that clients associate concrete with safety and permanence, even when shown data on seismic performance. *“People think concrete is the future—even if their neighbour’s earth house survived the earthquake and their concrete house cracked,”* one interviewee observed.
- On skills: Respondents stressed that training is critical. A mason-turned-entrepreneur explained, “We can build with bamboo, but without training and tools, we cannot build well enough for the city.”
- On innovation: Multiple stakeholders pointed to ABARI’s hybrid systems as proof of concept. One respondent said, *“ABARI showed that bamboo and earth can look modern and meet code—this changed minds.”*

These perspectives highlight both the persistence of stigma and the possibility of changing it through demonstration and training.

6. Country-specific recommendations

Expand vocational training.	Scale up programmes for masons and carpenters in earthen, bamboo, and timber-laced masonry techniques, linking them to certification.
Support supply chain development.	Invest in bamboo treatment facilities and CSEB production to ensure consistent quality and supply.
Strengthen enforcement.	Resource municipal authorities to apply building code provisions for natural materials.
Scale demonstration projects.	Showcase hybrid systems in urban as well as rural areas, proving their modernity and resilience.
Embed in climate and housing policy.	Align natural materials with national adaptation strategies and affordable housing programmes.

7. Conclusion

Nepal provides some of the clearest lessons for the HKH. It has codified natural materials in its building codes, promoted them in post-disaster recovery, and fostered innovation through organisations like ABARI.

Yet persistent stigma, skills shortages, and weak supply chains continue to limit adoption. Demonstration projects and training programmes have shown that perceptions can shift when communities see natural materials perform well. If Nepal can match its strong policy framework with investment in skills, enforcement, and supply chains, it could lead the region in demonstrating how vernacular systems can be modernised for contemporary resilience.

Pakistan

1. Overview

Pakistan's northern regions, particularly Gilgit-Baltistan, Chitral, and Kashmir, have a long tradition of vernacular construction systems adapted to seismic risk and mountainous climates. Timber-laced masonry techniques such as Dhajji Dewari and taq systems are recognised for their earthquake resilience and cultural importance. Stone and timber continue to be used in rural areas, though increasingly displaced by concrete blocks and fired brick in towns and peri-urban centres.

Pakistan is notable for formally recognising timber-laced masonry in its seismic provisions, an important policy precedent in the HKH. Yet despite this codification, implementation has been uneven. Survey respondents and interviewees described a construction sector where reinforced concrete is seen as modern and aspirational, while vernacular systems are often stigmatised as “old-fashioned” or “for the poor.” This mismatch between policy recognition and practice illustrates the systemic barriers facing nature-based construction.

Survey participation from Pakistan was relatively strong (20 responses), and together with case studies and comparative analysis, this profile highlights both the challenges and opportunities for revitalising vernacular systems in the country.



2. Traditional and current practices

Dhajji Dewari.

Dhajji Dewari is the most well-known traditional construction system in northern Pakistan. It uses a timber frame with masonry infill (stone or brick), creating a flexible “patchwork wall” that dissipates seismic energy. After the 2005 Kashmir earthquake, Dhajji Dewari was widely praised for saving lives and preventing catastrophic collapse.

Taq system.

Another timber-laced masonry technique, taq uses horizontal timber bands within thick stone or brick walls, improving lateral strength. It has been used for centuries in Kashmir and other mountainous regions.

Stone and timber housing.

In many rural areas, dry stone masonry combined with timber beams remains common, though often without reinforcement.

Transition to industrial materials.

In peri-urban and urban areas, reinforced concrete, cement blocks, and fired brick have become dominant. Households increasingly aspire to build in concrete, even in seismic zones where it is less resilient than timber-laced masonry.

Conservation and cultural use.

Organisations such as the Aga Khan Development Network (AKDN) have promoted conservation of traditional practices, particularly in Gilgit-Baltistan and Chitral, where Dhajji Dewari is both functional and culturally significant.

3. Policy and institutional landscape

Pakistan is relatively advanced in recognising natural materials within its regulatory framework:

- The Building Code of Pakistan (Seismic Provisions, 2007) formally codifies timber-laced masonry retrofitting methods, making Pakistan one of the first HKH countries to recognise such systems in national code.
- The Revised National Housing Policy Framework (2025) calls for promotion of locally sourced and climate-resilient materials, explicitly referencing natural systems.
- Provincial and NGO-led programmes, particularly after earthquakes, have supported training and dissemination of timber-laced masonry methods.

Despite this recognition, enforcement is weak. Survey respondents noted that municipal approvals overwhelmingly favour reinforced concrete. As one contractor explained, “When the earthquake comes, people remember Dhajji Dewari. But in between, everyone wants concrete.”

4. Barriers and opportunities

Barriers.

- **Perceptions of modernity.** Concrete and brick are seen as aspirational, while vernacular systems are often dismissed as outdated.
- **Limited enforcement.** Although codified, timber-laced masonry is rarely promoted or required by local authorities.
- **Skills erosion.** Fewer masons are trained in Dhajji Dewari or taq, and younger builders tend to work with industrial materials.
- **Environmental pressures.** Timber supply is constrained by deforestation and forest governance challenges.
- **Market competition.** Industrial materials benefit from scale and subsidies, while vernacular systems remain informal.

Opportunities.

- **Proven seismic resilience.** Dhajji Dewari and taq are recognised globally as earthquake-resistant systems.
- **Policy footholds.** Pakistan’s building codes and housing policy explicitly mention natural materials, creating a foundation for scaling.
- **NGO leadership.** AKDN and other organisations have sustained vernacular practices through conservation and training.
- **Cultural legitimacy.** In northern areas, communities trust timber-laced masonry because of lived experience of its resilience.
- **Climate policy alignment.** The Revised Housing Policy (2025) links local materials with climate resilience, providing a new policy driver.

5. Stakeholder perspectives

Survey responses and interviews highlighted strong views on both strengths and challenges.

- On resilience: A northern Pakistani contractor explained, *“People trust this method because it has saved houses during earthquakes when concrete blocks failed.”*
- On perceptions: An architect noted, *“Clients want concrete because it looks modern. Even if the code allows Dhajji Dewari, they see it as going backwards.”*
- On skills: Respondents stressed declining artisanal capacity. One commented, *“Our masons are retiring, and the new generation does not learn these techniques.”*
- On policy: A policymaker acknowledged, *“We wrote Dhajji into the code, but we did not build the system to enforce it.”*

6. Country-specific recommendations.

Enforce seismic code provisions. Strengthen municipal oversight to ensure timber-laced masonry is actively promoted in high-risk areas.

Invest in skills training. Establish accredited programmes for Dhajji Dewari and taq, linked to certification for masons.

Support sustainable timber supply. Align housing strategies with reforestation and community forest management to ensure long-term material availability.

Promote demonstration projects. Showcase timber-laced masonry as a modern and safe choice, using public buildings (schools, clinics) in seismic zones.

Leverage housing policy. Operationalise the Revised National Housing Policy Framework (2025) by creating subsidies and incentives for locally sourced, climate-resilient materials.

Shift perceptions. Launch awareness campaigns positioning Dhajji Dewari and taq as aspirational systems rooted in heritage and resilience, not poverty.

7. Conclusion

Pakistan offers some of the clearest evidence in the HKH of both the potential and the challenges of nature-based construction. Timber-laced masonry has proven itself repeatedly in earthquakes and is codified in national policy, yet remains marginal in practice. The gap between recognition and adoption is driven by perceptions of modernity, limited enforcement, and skills decline.

By enforcing its own code provisions, investing in skills, and linking sustainable timber supply with housing programmes, Pakistan could transform Dhajji Dewari and taq from marginal traditions into mainstream solutions. Doing so would not only enhance seismic resilience but also preserve a unique cultural heritage. Pakistan’s experience underscores a key lesson for the region: policy recognition is an essential first step, but it must be matched with training, enforcement, and public awareness to achieve real impact.

Annex B: Policy Comparison Matrix

The policy scan reveals that recognition of nature-based construction materials is uneven across the HKH. Several countries formally reference bamboo, timber, or earthen systems in building codes or housing policies, but these provisions are rarely translated into consistent enforcement. The result is a policy environment where natural materials are visible on paper yet marginal in practice.

Nepal and Pakistan stand out for having codified vernacular systems directly into their building codes, often in response to disasters. Nepal’s revised National Building Code (2020) explicitly includes earthen, bamboo, and stone masonry typologies, while Pakistan’s seismic provisions (2007) formally recognise timber-laced masonry. These provisions set important precedents, but enforcement remains weak, and both countries struggle with stigma and skills shortages.

Bhutan provides one of the strongest examples of integration of tradition into policy, linking natural materials to its philosophy of Gross National Happiness. Housing and construction policies explicitly mandate traditional aesthetics and encourage rammed earth and timber. However, the cost of compliance and a shrinking pool of skilled masons limit effectiveness, leaving a gap between ambition and implementation.

Bangladesh and Myanmar illustrate the challenges of partial recognition. Both have national housing or urban policies that acknowledge local materials, yet neither has certification systems or strong enforcement. Bamboo is included in Bangladesh’s building code, but without standards it lacks credibility among engineers and financiers. In Myanmar, bamboo remains widespread in rural housing, but largely unregulated and stigmatised as a “poor person’s material.”

India and China represent large-scale contexts where vernacular systems persist in heritage and rural zones but are overshadowed by industrial housing policies. India’s national codes mention alternative materials, and state-level policies in Himalayan regions encourage vernacular practices, yet enforcement is inconsistent. China’s Rural Revitalization Policy (2018) encourages local materials, and seismic-tested timber–earth hybrids show promise, but large-scale housing programmes continue to prioritise concrete and brick.

Finally, Afghanistan illustrates the weakest formal recognition. While the 2013 National Building Code provides broad safety provisions, it offers little guidance on mudbrick, stone, or timber, despite their prevalence in rural housing. Policy frameworks are underdeveloped, and implementation capacity is limited.

Across the region, several common patterns emerge. First, policies tend to be reactive—introduced after disasters or framed in heritage protection—rather than proactive drivers of mainstream construction. Second, enforcement gaps undermine credibility; even where natural materials are codified, municipal and local authorities often default to concrete approvals. Third, skills erosion is a cross-cutting constraint, limiting the ability to apply traditional systems even where policies encourage them. Finally, market incentives remain skewed toward industrial materials, with subsidies, procurement, and finance mechanisms reinforcing their dominance.

Country	Building Code Recognition	Housing / Urban Policy References	Green / Climate Policy Links	Enforcement & Implementation	Observed Gaps
Afghanistan	National Building Code (2013) provides broad structural provisions; limited guidance for mudbrick, stone, timber.	Few formal references to local materials in housing policy.	Climate and DRR policies reference resilience, but not specific to natural materials.	Limited institutional capacity; codes rarely enforced in rural/peri-urban areas.	Lack of technical standards for vernacular systems; absence of training or certification; very limited enforcement.
Bangladesh	National Building Code (2015; revised 2020) mentions bamboo, timber, clay.	Housing policies reference affordability, not materials.	Disaster resilience strategies highlight local resources, but not codified.	Enforcement extremely limited; no certification for bamboo or earthen systems.	Recognition without standards; perception of “poor people’s materials.”
Bhutan	Building regulations mandate traditional aesthetics and encourage local materials.	National Housing Policy (2020) and Human Settlement Policy (2019) explicitly promote vernacular systems.	National Construction Industry Policy (2020) encourages green growth.	Policies strong on paper, but compliance costly; skills shortage undermines implementation.	Gap between cultural/heritage mandates and practical capacity for delivery.
China (Yunnan, Tibet)	Green Building Evaluation Standards (2019) recognise eco-materials, but focus is industrial.	Rural Revitalization Policy (2018) encourages local/traditional materials.	National green growth strategies reference sustainable building, but rarely vernacular.	Provincial implementation uneven; rural revitalisation provisions inconsistently applied.	Heritage-focused support; limited innovation mainstreaming; limited enforcement.
India (Himalayan states)	National Building Code (2016) references bamboo, earthen technologies.	State-level policies (e.g. Himachal Pradesh, Uttarakhand) encourage vernacular in seismic zones.	Energy Conservation Building Code (2017) links to eco-materials.	Codes often ignored at local level; contractors default to concrete.	Strong research and policy frameworks not matched by implementation or perception change.
Myanmar	Building codes underdeveloped for bamboo/timber.	National Housing Policy (2017), Urban Policy Framework (2020) reference local resources.	Disaster resilience frameworks reference bamboo in practice, not in law.	Very limited enforcement; natural-material housing largely informal.	No certification systems; bamboo widely stigmatised as temporary.
Nepal	National Building Code (2020 revision) explicitly includes earthen, bamboo, stone typologies.	Post-earthquake reconstruction policies (2015 onwards) supported local materials with reinforcement.	Climate policies increasingly link housing and resilience.	Codes formally in place but enforcement inconsistent; municipal authorities under-resourced.	Codification without enforcement; stigma and supply chain fragmentation persist.
Pakistan	Building Code (Seismic Provisions, 2007) codifies timber-laced masonry retrofitting.	Revised National Housing Policy Framework (2025) explicitly calls for local/climate-resilient materials.	Policy links to climate resilience emerging.	Strong codification but limited enforcement; municipal approvals favour concrete.	Gap between national recognition and local implementation; declining skills.

Annex C: Case Studies

1. Modular Bamboo Housing – Bangladesh

Context

Bangladesh is among the most climate-vulnerable countries in the world, with recurrent flooding and cyclones driving widespread housing vulnerability.

Low-income rural households rely heavily on bamboo and mud, but these materials are widely perceived as temporary or fragile. BRAC and partner organisations have piloted modular bamboo housing as a response to both affordability and climate resilience.

The approach

The model elevates houses on bamboo stilts to protect against floods and uses prefabricated, treated bamboo panels for walls and flooring.

The structures are modular, meaning families can dismantle and reassemble them as floodwaters rise and recede. The treatment of bamboo addresses common concerns around pests and rot, extending durability significantly compared to untreated culms.

Impact

Survey respondents in Bangladesh pointed to this model as transformative, shifting perceptions of bamboo from “poor person’s material” to a climate-resilient option.

One NGO worker described it as “a house that moves with the flood, not against it.” Families reported increased safety and reduced loss of assets compared to conventional brick or mud dwellings that are easily damaged in floods.

Lessons

Certification and standardisation remain essential to build confidence among contractors and financiers.

Demonstration projects can shift perceptions when communities see them perform in extreme events.

Bamboo’s affordability and renewability align directly with Bangladesh’s resilience needs, but scaling requires stronger policy and market support.



2. Timber-Laced Masonry (Dhajji Dewari) – Pakistan

Context

The 2005 Kashmir earthquake exposed vulnerabilities in unreinforced concrete and brick housing, while highlighting the resilience of traditional timber-laced masonry systems. Dhajji Dewari, widely practiced in northern Pakistan, demonstrated remarkable earthquake performance, saving lives and limiting structural collapse.

The approach

Dhajji Dewari employs a timber frame filled with stone or brick masonry, creating flexible walls that dissipate seismic energy. The method is low-cost, uses local materials, and can be built by community masons with relatively simple training.

Impact

After 2005, Dhajji Dewari was promoted by the government and NGOs, and later codified in the Building Code of Pakistan (Seismic Provisions, 2007). Communities trust the method based on lived experience. As one contractor put it, “People trust this method because it has saved houses during earthquakes when concrete blocks failed.”

Lessons

- Codification matters, but enforcement is still weak. Contractors report that concrete remains the default in municipal approvals.
- Skills transfer is critical: many older masons are retiring, and new builders are not being trained in these systems.
- Awareness campaigns are needed to reposition Dhajji Dewari as modern and resilient, not outdated.



3. Rammed Earth – Bhutan

Context

Bhutan has embedded cultural identity and sustainability into national policy through its Gross National Happiness philosophy. Rammed earth remains central to Bhutanese architecture, used in both heritage buildings (dzongs, monasteries) and new government projects.

The approach

Rammed earth involves compacting soil between timber forms to create thick walls with excellent thermal mass. In Bhutan, it is often combined with timber joinery and stone foundations. Recent projects have used rammed earth in schools and public buildings, reinforcing its legitimacy.

Impact

Rammed earth provides durability, insulation, and cultural continuity. Survey respondents from Bhutan emphasised pride in these traditions. One architect noted, “Our heritage is built with it—losing it means losing who we are.” However, private clients often prefer concrete, reflecting perceptions of modernity.

Lessons

- Supportive policies sustain visibility, but compliance costs can discourage wider adoption.
- Skills erosion threatens continuity: there are too few masons trained in rammed earth today.
- Demonstration in public buildings shows the role of government as a market-maker





4. Hybrid Bamboo–Earth Construction – Nepal

Context

The 2015 Gorkha earthquake devastated Nepal, revealing the vulnerability of unreinforced masonry and earthen houses. In its aftermath, both government and NGOs promoted reinforced vernacular methods. ABARI (Architecture and Bamboo Research Institute) pioneered hybrid bamboo–earth systems that combine affordability with seismic safety.

The approach

ABARI’s designs use compressed stabilised earth blocks (CSEBs) reinforced with bamboo framing and seismic bands. The systems are engineered to meet building code requirements while remaining affordable for rural households.

Impact

Hybrid bamboo–earth houses have been built in multiple districts, gaining visibility through donor-funded projects.

As one Nepali architect explained, “ABARI showed that bamboo and earth can look modern and meet code—this changed minds.” Communities that experienced structural failures in concrete homes during the earthquake expressed new confidence in vernacular-hybrid approaches.

Lessons

- Innovation builds legitimacy when it is codified in building codes and backed by testing.
- Demonstration projects can shift perceptions of “poor” materials by showing them as safe and aspirational.
- Scaling requires investment in training masons and strengthening bamboo treatment supply chains.



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