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Forest governance and rural-architecture practices: A comparative study of Baduy (Indonesia) and Temiar (Malaysia)

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ABSTRACT
Forests are central to the material, ecological, and cultural foundations of rural life in Southeast Asia. In Indonesia and Malaysia, the availability of timber and bamboo is shaped by customary norms and national forest governance. It continues to influence construction practices, settlement form, and the durability of rural architecture. Nevertheless, research rarely examines how forest management regimes directly affect material flows from forests to dwellings. This article addresses this gap by comparing two forest-dependent communities: the Baduy of Banten, Indonesia, and the Temiar Orang Asli of Peninsular Malaysia. Using a mixed documentary and remote-analysis approach, the study synthesises peer-reviewed literature (2018–2024), ethnographic documentation, and photographic archives to examine how customary and state governance systems regulate timber and bamboo extraction, species selection, and settlement morphology. The findings show that the Baduy maintain a highly restrictive customary forest-management regime that conserves forest structure, ensures long-term availability of hardwood species, and sustains an ecologically continuous timber-bamboo architectural tradition. In contrast, the Temiar operate within hybrid governance shaped by state forest policies, logging concessions, and customary ethics, resulting in more variable timber access and adaptive construction strategies. Across both cases, forest governance emerges as a critical determinant of material choice, spatial adaptation, and the technical performance of rural buildings. The study argues that timber architecture in rural Southeast Asia cannot be separated from the forest systems that regulate and supply its materials. These insights highlight the need for forestry policies that recognise the architectural and spatial implications of forest management and support community-based, ecologically rooted building cultures.
Keyword: Community Forestry Vernacular Settlements, Forest Governance, Material Ecology, Timber Architecture

1. Introduction

Forests have long shaped the material, social, and spatial worlds of rural communities across Southeast Asia. In Indonesia and Malaysia, forests remain critical ecological infrastructures while simultaneously serving as cultural, economic, and architectural foundations for village life. For centuries, rural settlements have depended on locally available timber and bamboo for domestic construction, agricultural tools, ritual structures, and communal facilities. However, in the contemporary era of accelerated environmental change, decentralised forest governance, and pressures from commercial extraction, the relationship between forest management and rural architecture is undergoing rapid transformation. Understanding how forest policy, resource regulation, and ecological change influence the built environment is therefore crucial for both forestry scholars and architectural researchers.

In Southeast Asian scholarship, the dominant research focus has long been biophysical: forest cover, watershed protection, carbon sequestration, biodiversity, or timber yields. Meanwhile, rural architecture has been studied largely through the lenses of anthropology, material culture, vernacular typology, and environmental

adaptation. Only recently have scholars begun to explore the intersection between these two domains. They focus specifically on how forest management structures influence the construction choices, settlement patterns, and spatial practices within rural communities. Despite this growing interest, substantial gaps remain, especially regarding how community forestry regimes (e.g., social forestry schemes in Indonesia) shape the availability, selection, and use of timber and bamboo in rural house-building.

This gap is particularly visible in studies of vernacular settlements. While the architecture of groups such as the Baduy in Banten (Indonesia) and the Temiar Orang Asli in Peninsular Malaysia has been documented, most analyses prioritise cultural rituals, cosmological orders, or typological features. Fewer studies explicitly connect these architectural characteristics to environmental governance or resource management. Yet these communities maintain some of the strongest customary norms regarding forest protection and controlled material extraction. These norms directly affect how timber is harvested, which species are selected, what tools may be used, and when building activities may occur. In many cases, the forest is treated not only as an ecological resource but also as a moral and cosmological space, meaning construction practices cannot be separated from broader environmental ethics.

Such dynamics are highly relevant today, especially as both countries confront increasing ecological pressures. In Indonesia, social forestry initiatives offer new opportunities for community-based access to forest resources and timber supply under regulated management. Meanwhile, in Malaysia and other parts of Southeast Asia, there is growing recognition of indigenous forest users, including Orang Asli, in protected area management and forest governance. Empirical studies that follow the resource from forest to village to dwelling remain rare. One of the few recent works to document a community-based timber/bamboo building tradition provides insight into how the Baduy manage forest-derived bamboo for vernacular housing. Bamboo and timber, therefore, deserve greater attention as mediators between ecological governance and building culture [1]. Another study shows that indigenous communities (including some Orang Asli) maintain forest-based livelihoods, forest dependence, and small-scale forest use, which can contribute to conservation and sustainable resource management [2].

Given these conditions, an interdisciplinary examination is required to understand how environmental governance, ecological supply, and cultural practices collectively shape rural timber architecture. This study focuses on two contrasting yet comparable case studies: the Baduy community in Banten, Indonesia, and the Temiar Orang Asli in Peninsular Malaysia. Both groups maintain customary relationships with their surrounding forests, rely on local timber and bamboo for house construction, and practice forms of spatial ordering informed by ecological ethics. Despite differences in governance regimes, strict customs for the Baduy, hybrid and state-influenced for many Orang Asli communities, both offer valuable insights into how forest regimes shape material culture and architecture.

2. Method

This study employed a mixed documentary and remote-analysis approach appropriate for forestry and rural architectural research when field access is limited. The methodological design follows two complementary strategies: (1) a structured literature-based analysis focusing on verified, peer-reviewed research on forest governance and rural-architecture practices in Indonesia and Malaysia; and (2) a remote spatial and visual assessment anchored in publicly available geospatial data and ethnographic documentation.

2.1. Literature-based analysis

The primary analytical component consisted of a systematic review of recent scholarship (published from 2007 to 2024) concerning forest management systems, community forestry, timber and bamboo resource flows, and vernacular architecture practices in Southeast Asia. Database searches were conducted through repositories of forestry and anthropology departments in Indonesia and Malaysia. Keywords included “community forestry,” “timber architecture,” “forest-based settlements,” “vernacular construction,” “Baduy,” “Temiar,” “Orang Asli,” “bamboo construction,” and “rural architecture.”

Sources were filtered using five criteria:1) The publication must be peer-reviewed or published by a recognised academic institution, ministry, or national research body; 2) The study must concern Indonesia or Malaysia, or offer directly relevant comparative data from similar tropical forest ecologies; 3) The content must explicitly address material use, forest governance, or rural spatial practices; 4) Ethnographic, architectural, or forestry-based evidence must be clearly documented; and 5) Publication year must fall within the six-year window to ensure contemporary relevance.

This stage produced a corpus of verified research on Baduy forest ethics and material practices, Malaysian community forestry and Orang Asli material ecologies, and broader regional analyses of forest governance and vernacular construction. From this corpus, content was coded into three analytical themes forming the basis for the Results and Discussion section:

(1) Forest management and material access;
(2) Timber and bamboo species selection and harvesting rules;
(3) Settlement form, building typology, and spatial arrangements shaped by ecological constraints.

2.2. Remote spatial and visual documentation

Due to time and field-access limitations, this study incorporated a remote-based spatial analysis of the selected case-study communities: Baduy (Banten, Indonesia) and Temiar settlements (Peninsular Malaysia). This method does not aim to replace ethnographic fieldwork but rather to extract morphological and environmental patterns from documented sources that have been independently validated.

The remote analysis involved high-resolution basemaps from Google Earth and government-provided GIS portals, open-access ethnographic photo collections (e.g., Indonesian National Cultural Documentation Centre), university archives, community forestry programme repositories, and the photographic appendices included in the verified literature.

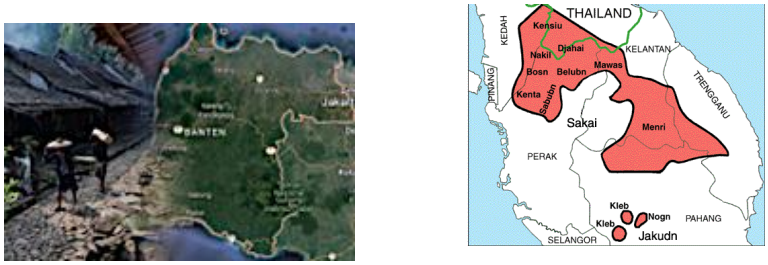
3. Results and Discussion

Case-study selection was made to the Baduy and Temiar. The Baduy community was selected because it represents one of Indonesia's most intact customary forest-management regimes, maintaining strict material rules and a highly regulated interface between settlement and forest. The Temiar were selected as a Malaysian counterpart due to their continued engagement with forest environments, reliance on timber-based construction, and documented interactions with state forest authorities and logging activities. Both communities provide verifiable documentation of how forest governance shapes material flows, spatial organization, and construction practices. They also offer contrasting positions on the spectrum of customary autonomy, making them well-suited for comparative analysis. Embedded into the text and not supplied separately. Below is an example that the authors may find useful.

3.1. Forest management and material access

Forest management in the Baduy community operates almost entirely within the framework of adat, the customary law that defines land classification, permissible activities, ecological responsibilities, and social obligations. Existing studies consistently show that the Baduy distinguish between several forest and cultivation zones - such as leuweung kolot (old forest), leuweung titipan (protected forest), and huma (cultivation areas) - each carrying specific rules for access and resource extraction [3,4]. These zones function as an indigenous regulatory system that prevents large-scale clearing, restricts exploitation, and maintains ecological balance around the settlements.

The Inner Baduy (Baduy Dalam) are especially strict in enforcing prohibitions against commercial timber extraction, mechanized tools, or activities that may disturb forest continuity. While published studies do not provide detailed inventories of tree species or rotational harvesting techniques, they consistently highlight a cultural ethos of minimal disturbance, selective harvesting, and maintenance of forest cover. This sustained ecological continuity ensures that materials for traditional houses, primarily bamboo, rattan, and locally available timber, are sourced from areas where harvesting is allowed under adat guidance [5].



(a) (b)

Figure1. (a) Baduy location (Source: Harian Rakyat Bengkulu); (b) Temiar location (Source: Wikipedia)

Importantly, the literature emphasizes the continuity between forest governance and architectural materiality. Baduy architecture avoids industrial materials and instead relies on natural, biodegradable components; this is not framed as a formal "prohibition" in academic texts but as an extension of Baduy ecological ethics, cultural identity, and religious obligations. Thus, the built environment becomes a manifestation of a governance system that prioritizes conservation, restraint, and intergenerational sustainability.

Forest governance in Temiar communities differs significantly from that of the Baduy due to the Malaysian legal context. While Orang Asli hold deep customary knowledge about forest resources, they are officially situated within state-managed forest reserves, wildlife areas, and lands subject to logging concessions. This creates a hybrid governance system in which traditional ecological knowledge coexists with, and sometimes conflicts with, state administrative structures [6,7].

Existing literature documents the Temiar's reliance on the forest for food, medicinal resources, and cultural practices, and describes their ecological worldview as emphasizing balance, respect for forest beings, and non-disruptive use [7]. Studies show that land-use change, logging pressure, and encroachment have reduced access to forest resources in some Temiar areas, including Kelantan, often forcing communities to adapt their sourcing strategies or negotiate with state agencies and concession holders [6]. Temiar resource practices can therefore be described as selective, small-scale, and guided by cosmological principles, but the extent to which these practices shape architectural form remains an understudied area. The available evidence supports their continued dependence on forest materials, cultural protocols surrounding extraction, and tensions arising from state–customary governance overlap, but not the detailed architectural linkages often assumed in vernacular-ecology narratives [8].

3.2. Timber and bamboo species selection and harvesting rules

Baduy architecture is widely recognized as an extension of their ecological worldview, where material choices, construction methods, and spatial forms embody the ethic of leuweung titipan - the duty to protect entrusted forests [3,4]. Houses are predominantly constructed from natural materials readily available within adat-permitted zones, especially bamboo, rattan, forest grasses, and locally sourced timber. The reliance on these materials is not merely practical but symbolic, reflecting values of simplicity, non-disruption, and bodily and spiritual alignment with nature.

Structural systems typically employ lashings, mortise joints, and woven elements, avoiding metal fasteners and industrial components. Existing literature notes that these practices are tied to the Baduy's principle of tanpa merusak ("without causing damage"), which guides not only forest harvesting but also the material life cycle of built structures. Buildings are designed to decay naturally and return to the ecosystem, reinforcing a continuous material loop between forest and settlement.

The homogeneity of Baduy architectural expression, especially among the Inner Baduy, stems directly from the continuity of adat governance. With limited external intervention or commercial development, Baduy settlements preserve vernacular typologies that remain closely integrated with forest ecologies and seasonal rhythms.

In Temiar communities, architectural material culture reflects a more dynamic interface between customary knowledge and external pressures. The traditional Temiar house, documented in anthropological and ethnographic accounts, relies on forest-derived materials such as bamboo, lightweight timber, and rattan; however, access to these materials is often mediated by the status of forest reserves, logging concessions, and land-use changes surrounding their settlements [9].

Unlike the Baduy case, studies highlight a general orientation toward selective, small-scale extraction guided by elders' ecological knowledge and cosmological beliefs, especially regarding the need to maintain harmony with forest spirits and avoid unnecessary disturbance. This worldview shapes the ethos of building, even if the material consistency of traditional architecture is increasingly challenged by restricted resource access, market pressures, and infrastructural interventions.

Today, timber architecture often exhibits hybridization—structures combining traditional bamboo/timber frames with purchased materials such as zinc roofing, industrial boards, or manufactured fasteners. This material hybridity should not be interpreted as cultural loss but rather as an adaptive response to shifting governance conditions and ecological constraints. Where forest access remains relatively intact, traditional

forms persist; where resources are limited, communities creatively integrate available alternatives while maintaining the cultural logic of spatial organization and communal living.

3.3. Settlement form, building typology, and spatial arrangements shaped by ecological constraints

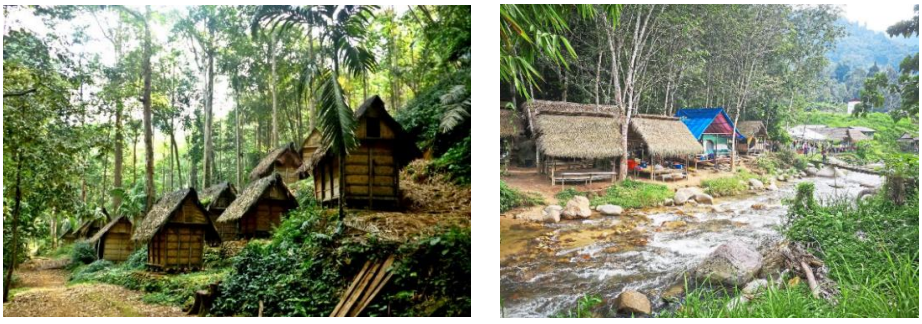
The spatial organization of the Baduy settlements reflects a deliberate integration of settlement, agriculture, and forest conservation, guided by customary zoning under adat and long-standing local regulations. The community's customary land rights are formally recognized by regional regulation, which designates specific areas for protected forest, settlement, and cultivation.

Baduy villages typically cluster as compact hamlets within the broader customary territory. This compactness helps minimize land clearing, preserve surrounding forest cover, and maintain ecological equilibrium - aligning with their principle of sustainable coexistence with the environment. Traditional dwellings are built using vernacular materials and techniques that reflect ecological sensitivity and respect for forest integrity. Elevated floor structures, bamboo or timber framing, and simple joinery are common, allowing for efficient use of local, renewable materials and minimal disturbance to the terrain [10,11].

Because land use and forest zones are clearly delineated by adat and customary law, settlement expansion is constrained: residential and cultivation areas remain distinct from strictly protected forest zones. Thus, the forest remains both a material source and a spatial boundary: the edges of Baduy villages coincide with the demarcation of the customary forest, ensuring that settlement morphology remains embedded in ecological thresholds rather than arbitrary administrative lines.

As of the latest peer-reviewed literature surveyed, there is insufficient publicly available academic documentation linking forest governance or customary tenure directly to spatial layout and settlement morphology among the Temiar Orang Asli in a manner comparable to the Baduy case. While broader studies on indigenous forest-use in Malaysia acknowledge the role of customary knowledge in resource management and community consent in forest governance processes, detailed ethnographic-architectural documentation of Temiar village layouts, building typologies, or settlement-forest boundaries remains rare or unpublished.

One recent report explores preservation of "traditional Orang Asli Temiar architecture" through tourism-driven chalets in a settlement context. However, this refers to an adaptive use of vernacular forms for external audiences and does not provide generalizable data on how forest governance influences settlement form at a community level [12,13].



(a) (b)

Figure 2. (a) Baduy village (Source: Geotimes Indonesia); (b) Temiar village (Source: The Star).

3.4. Comparison of Baduy (Indonesia) and Temiar (Malaysia)

The comparative analysis demonstrates how forest governance systems directly produce architectural consequences. In Baduy villages, strict customary forest regulation ensures long-term timber availability and stable settlement morphology. Architecture is materially and symbolically continuous with the forest, reflecting a deep ecological integration. In Temiar settlements, forest access is shaped by complex interactions between state policies and customary land claims. This creates variability in timber supply, encouraging adaptive building strategies that mix local materials with occasional purchased products. Spatial practices reflect both ecological adaptation and political constraints, leading to more fluid settlement patterns [14].

Across both cases, timber remains a structural backbone, while bamboo serves as a flexible, breathable, and renewable secondary material that enhances climatic performance. These findings reveal that timber architecture in rural Southeast Asia is fundamentally a product of forest management regimes, with bamboo enriching but not replacing the dominant wood-based structural logic.

The comparison between the Baduy of Indonesia and the Temiar of Malaysia reveals how different forest-governance regimes generate distinct architectural and spatial outcomes, even within broadly similar tropical forest ecologies. The Baduy operate under a highly restrictive adat-based system in which forest access, harvesting rules, and material selection are tightly controlled through customary law. This regime preserves forest structure, ensures stable availability of hardwood species, and supports a continuous timber–bamboo building tradition. Consequently, Baduy architecture displays strong ecological coherence: houses employ durable round-timber posts, woven bamboo envelopes, and terraced settlement layouts aligned with sacred spatial orientations. Their villages remain compact, morphologically stable, and materially consistent because the forest itself serves as both a resource base and a regulatory authority [15].

In contrast, the Temiar negotiate a hybrid governance landscape shaped by state forest policies, logging concessions, and customary ecological ethics. Their access to timber is more variable, often influenced by external decisions over land status and commercial extraction. This creates a more adaptive architectural culture in which structural timber is sourced from secondary forests when available, supplemented by purchased materials when necessary. Bamboo remains a vital component, especially for floors and wall mats, but plays a lighter, more modular role compared to the Baduy case. Spatially, Temiar settlements tend to be more flexible and dispersed, responding to terrain, resource proximity, and shifting political constraints. Overall, the comparison underscores that forest governance, customary or hybrid, acts as a primary driver of material flow, architectural practices, and settlement patterns. Rural timber architecture emerges not simply from cultural preference, but from the degrees of autonomy communities hold over their surrounding forests as shown in Table 1.

Table 1. Comparison of forestry governance and rural-spatial practices in Indonesia and Malaysia.

Dimension	Indonesia	Malaysia
1. Governance and conservation	Conservation initiatives integrate ecological protection with *adat* systems, sacred groves, agroforests, and village-scale stewardship. Architectural conservation is grassroots and often informal.	Conservation frameworks follow heritage legislation, institutionalized eco-parks, and formal restoration of Malay houses; emphasis on technical documentation and state-led protection.
2. Forest Management Mechanisms	Community-based approaches dominate, including *Hutan Adat* and *Hutan Desa*, which promote participatory stewardship and livelihood protection.	Strong emphasis on sustainable timber production, systematic forest reserves, and professionalized forest departments. Community participation exists but is less central.
3. Rural Architectural Material Practices	Timber and bamboo are widely used in vernacular architecture due to their local availability; bamboo is considered fast-renewable and culturally embedded in rural spatial systems.	Wood dominates traditional Malay architecture, while bamboo use is more limited and symbolic; materials are regulated through state forest reserves and certified supply chains.
4. Socio-Economic Functions of Forest Resources & Rural Architecture	Forest materials support everyday life—housing, craft, rituals, and multifunctional rural landscapes. Forests provide structural, environmental, and social functions reflecting local knowledge.	Wood-based resources contribute to cultural identity, economic activities, and tourism (heritage villages). Rural architecture strengthens place identity but is more regulated and standardized.

4. Conclusion

This study demonstrates that the built environments of rural Southeast Asian communities are inseparable from the forest systems that sustain them. By comparing the Baduy in Indonesia and the Temiar in Malaysia, it shows how forest governance - customary, state-regulated, or hybrid - shapes material flows, construction techniques, and spatial practices in timber-based settlements. Despite differences in cosmology, political context, and autonomy, both communities illustrate a core principle: rural architecture is a material expression of forest management. Forest governance dictates the availability, quality, and diversity of timber and bamboo used in construction. For the Baduy, strict adat regulations maintain intact forests and ensure long-term access to durable hardwoods and regenerating bamboo. Prohibitions on mechanised tools, forest clearing, and industrial materials create a closed material cycle where timber posts, roundwood beams, and bamboo walling

are outcomes of ecological stewardship, reflecting biodiversity protection and sustainable harvesting. Temiar communities face a more complex governance environment, where customary practices coexist with state forestry laws and commercial logging. Although local ecological knowledge guides harvesting, state forest reserves and shifting land classifications constrain access to materials, sometimes necessitating the purchase of timber. Nevertheless, Temiar construction continues to embody cultural principles of ecological balance, selective cutting, and respect for forest spirits.

These governance regimes produce visible architectural consequences. Baduy villages retain stable, terraced layouts defined by ecological thresholds, with houses relying on consistent timber and flexible bamboo for durable, climatically responsive structures. Temiar settlements display fluid, linear, or clustered patterns shaped by topography and dispersed resource locations, with elevated platforms, lightweight bamboo floors, and breathable wall mats that adapt to variable timber availability. These findings carry implications for policy and sustainable development. As Indonesia expands community forestry schemes and Malaysia debates Orang Asli land rights, recognizing that forest regulations affect ecological, cultural, and architectural resilience is crucial. Supporting access to construction-quality timber and fast-growing bamboo can strengthen traditional building knowledge, reduce reliance on high-carbon materials, and preserve settlement forms that embody long-term ecological wisdom. For both forestry and architectural scholarship, the Baduy and Temiar illustrate that sustainable forest management can foster sustainable building cultures. Understanding forests as both ecological infrastructures and architectural foundations provides a holistic view of rural sustainability: sustainable architecture begins not at the building site, but in the governance of the forest itself.

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