

Sustainable heritage: Protecting Jingmai Mountain's traditional homes for ecotourism and rural development

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Keywords: *heritage preservation, sustainable ecotourism, traditional architecture, rural development, human-nature coexistence*

Abstract

Jingmai Mountain represents an exceptional socio-ecological system defined by a long-standing model of human-nature coexistence, where traditional stilt houses function as essential hubs for tea production and environmental regulation. This study employs a qualitative multi-method approach, including field observations and semi-structured interviews, to examine how these traditional structures navigate rapid rural transformation and the material transition from indigenous timber to concrete. By analysing diverse stakeholder perspectives including those of elderly residents, local craftspeople and young urban migrants, the research identifies the ways in which socio-economic disparities and generational priorities lead to unequal decision-making in heritage maintenance. The findings suggest that integrating community-led restoration with managed ecotourism provides a viable pathway for maintaining architectural authenticity while addressing contemporary livelihood needs in mountain protected areas. Ultimately, this study offers a theoretical framework for understanding how high-altitude ethnic settlements can maintain ecological and cultural integrity while navigating the pressures of modernization and demographic shifts.

Profile

Protected area

Cultural Landscape of

Old Tea Forests of the

Jingmai Mountain in

Pu'er

Country

China

Introduction

Nestled in the mountainous terrain of Yunnan Province, Jingmai Mountain achieved global recognition in 2023 with its designation as a UNESCO World Heritage Site (Li et al. 2023b; Zhang et al. 2025). This distinction celebrates not only its ancient tea gardens, which have flourished for over a millennium, but also the remarkable architectural heritage embodied in the traditional stilt houses of the Bulang and Dai ethnic groups (Chen & Hu 2024). These bamboo and timber structures function as integral components of a socio-ecological system. Beyond providing residential space, they facilitate the practical integration of human habitation with natural processes, incorporating traditional technical knowledge and historical settlement patterns that define Jingmai's cultural landscape. However, it is important to recognize that these architectural forms hold different meanings for different community members. Elderly residents may view them primarily as ancestral heritage and cultural identity markers, while younger generations may weigh their cultural significance against practical considerations of maintenance, durability and compatibility with contemporary lifestyles (Vázquez-Atochero 2025). The Bulang and Dai communities, despite sharing the geographic landscape, maintain distinct architectural traditions and may have different perspectives on preservation priorities (Xu et al. 2005). Understanding these diverse viewpoints is essential for developing preservation ap-

proaches that serve the actual needs and aspirations of those who inhabit these structures.

The traditional homes of Jingmai, adorned with the Bulang's *one bud, two leaves* decorations and the Dai's elegant ox-horn motifs, stand as physical manifestations of the *tea ancestor* belief system that governs local life (Zheng 2016). These structures embody ecological wisdom through their sustainable use of local materials, designed to harmonize with the region's wet climate and integrate seamlessly with ancient tea gardens and protective forests. They evoke a profound sense of *xiangchou* (nostalgia for one's homeland), connecting generations to their roots and preserving the stories of ancestors who cultivated tea and culture in harmony with nature (Zou 2018; Li 2019). These structures represent long-term adaptive strategies for sustainable living. They provide empirical data on balancing socio-economic requirements with environmental management practices developed over extensive periods of habitation.

Yet, this architectural heritage faces unprecedented challenges in the 21st century. Modernization, coupled with significant rural-urban migration, threatens to erode the cultural foundations that have sustained Jingmai's unique landscape. The migration of younger generations to urban centres, motivated by economic opportunities and contemporary lifestyle aspirations, precipitates a critical *brain drain* within mountain socio-ecological systems (Xiao et al. 2021). This phenomenon extends beyond demographic shifts to represent a

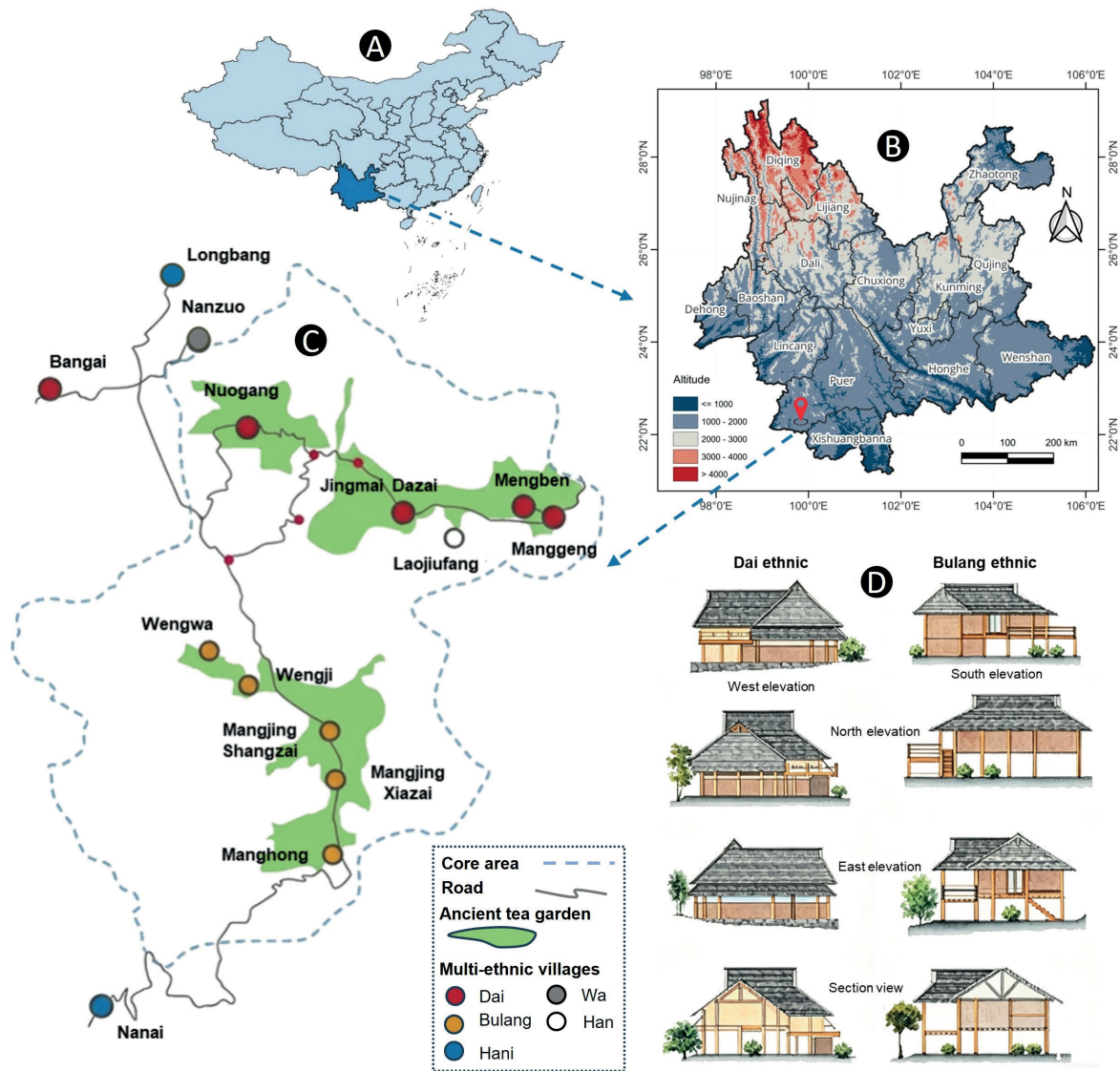


Figure – Jingmai Mountain World Cultural Heritage Core Zone, Yunnan, China. (A) Approximate location within China; (B) approximate location within Yunnan Province; (C) distribution of ethnic villages; and (D) traditional stilt dwellings of the Dai and Bulang people. The traditional Dai stilt house in Jingmai has a floor area of 100–180 m², with a raised ground floor that is light and transparent; the first floor consists of a front porch, a main room, a sun terrace, etc. The traditional Bulang stilt bamboo house in Jingmai has a floor area of 60–160 m², generally consisting of a raised ground floor and stairs, with a flexible layout that adapts to irregular terrain (Subfigure D was redrawn from Chen Dugui, *People's Daily (Overseas Edition)*, Oct. 16, 2023).

fundamental rupture in the intergenerational transmission of indigenous knowledge (Li et al. 2023a; Zhao et al. 2025). Specifically, as the primary practitioners of traditional construction move away, the specialized tacit knowledge required for the maintenance and repair of bamboo and timber structures faces a high risk of extinction. This systemic loss of expertise undermines the community's capacity for autonomous heritage management, rendering traditional architectural forms increasingly vulnerable to physical decay and structural replacement. This cultural erosion not only jeopardizes Jingmai's heritage, but also diminishes the inspiration these homes provide for sustainable living worldwide.

In addressing these challenges, we adopt a research perspective that moves beyond viewing architecture merely as physical artifacts requiring protection. In-

stead, we examine traditional building practices as ongoing social processes involving knowledge transmission, economic decision-making and identity negotiation among diverse community members (Shrestha et al. 2025). This approach recognizes that preservation outcomes depend not only on policy interventions, but also fundamentally on how different stakeholders (Fortnam et al. 2023) – craftspeople, residents, young migrants, tourism operators and local officials – navigate the tensions between heritage conservation and contemporary livelihood needs. By engaging with this complexity, we aim to contribute insights relevant to heritage conservation challenges faced globally in the 21st century.

This study examines the functional role of traditional stilt houses within Jingmai Mountain's cultural



Figure 2 – Typical bamboo and timber structures in Jingmai Mountain. Traditional stilt houses of the Dai and Bulang ethnic groups, respectively (A and E). The primary building materials are wood and bamboo, with commonly used timber species including *Schima* spp., *Quercus* spp. and *Pinus* spp. The roofs of Dai houses typically feature double eaves and are adorned with decorative yellow ox horns at both ends of the ridge (C), while Bulang houses usually have single-eave roofs with ridge-end ornaments in the form of ‘one bud and two leaves’ (D). The lower level of the houses serves as the stilt space (B), traditionally used for storage or keeping livestock, though its function has often changed in modern times. F is the village centre, where various traditional rituals and ceremonies are held. © all pictures Chunping Xie

landscape and analyses the socio-economic factors shaping their current transformation. Rather than focusing solely on preservation as a static goal, this research investigates how various stakeholders – including local ethnic communities, heritage authorities and tourism developers – negotiate architectural change amidst rapid rural transformation. Understanding these negotiation processes is critical for mountain protected areas, where the maintenance of traditional dwellings is inextricably linked to the stability of the broader socio-ecological system. By evaluating the impact of cultural erosion, rural-urban migration and material substitution, this article identifies pathways for integrating community-led management with sustainable ecotourism. This approach aligns architectural heritage with rural sustainability, offering a model for how mountain socio-ecological systems can navigate the pressures of modernization while maintaining the ecological and cultural integrity of their landscapes.

Methods

Jingmai Mountain is located in Lancang County, Pu'er City, Yunnan Province, in southwestern China, at an altitude between 1,100 and 1,570 m. It has a mild, humid subtropical climate with an annual mean temperature of about 18 °C and annual precipitation of 1,400–1,450 mm. The mountain is covered by well-preserved evergreen broadleaf forests, with a forest coverage rate of 83.14%, and hosts a rich diversity of flora and fauna. Jingmai Mountain is home to five ethnic groups – the Dai, Bulang, Hani, Wa and Han – who have coexisted for centuries (Figure 1). The mountain is also renowned for its traditional *under-story tea cultivation* system, where tea trees grow under the shade of natural forests. Its 28,000 mu (approx. 1,866 hectares) of ancient tea forests have been recognized as the best-preserved, largest and most time-honoured old tea plantations in the world.

This study employs a qualitative multi-method approach to analyse the architectural transformation of Jingmai Mountain within its mountain socio-ecological system. Primary data were gathered through exten-

sive field observations and site surveys in traditional Bulang and Dai villages to document the structural characteristics of dwellings and the physical transition from timber and bamboo to concrete materials. To identify and examine diverse stakeholder perspectives, semi-structured interviews were conducted with a stratified group of participants, including resident households, village elders and local craftspeople. These actors were categorized by ethnic identity (Bulang and Dai), generational cohorts (elderly residents and young urban migrants) and economic roles (subsistence farmers and tourism entrepreneurs) to capture the unequal decision-making processes and varying economic capabilities that influence housing maintenance and modernization. These primary findings were triangulated with secondary data, including UNESCO World Heritage nomination documents, local construction guidelines and regional demographic statistics, to contextualize local architectural changes within the broader trends of rapid rural transformation and out-migration in China.

Result and discussion

The cultural and ecological significance of Jingmai's traditional homes: Multiple perspectives and lived experiences

The stilt houses of Jingmai Mountain represent a remarkable synthesis of cultural expression (Figure 2A, B & E), ecological adaptation and economic functionality that has evolved over centuries through the accumulated wisdom of the Bulang and Dai ethnic communities (Zhou et al. 2020). These bamboo and timber structures transcend their role as mere shelters to become living embodiments of a sophisticated worldview that seamlessly integrates spiritual beliefs, environmental stewardship and productive activities (Zou 2018) (Figure 2F). The architectural forms themselves serve as repositories of profound cultural meaning, with every structural element and decorative detail reflecting a deep understanding of local materials, environmental conditions and social organization. The distinctive decorative elements that adorn these homes – the sacred *one bud, two leaves* motifs revered by the Bulang people (Figure 2D) and the elegant ox-horn designs favoured by the Dai community (Figure 2C) – function as more than aesthetic choices, representing symbolic manifestations of the *tea ancestor* belief system that forms the spiritual and cultural foundation of these communities (Gao & Hu 2020).

The traditional architecture of Jingmai Mountain functions through specific technical adaptations to the humid mountain climate, employing indigenous construction techniques and local bio-materials to regulate the relationship between human habitation and natural systems (Figure 3A). For instance, the use of raised-stilt (Gan-lan) structures facilitates natural cross-ventilation and moisture reduction, while the selection of local timber and bamboo minimizes the car-

bon footprint and maintains thermal equilibrium within the dwellings (Shi et al. 2023; Xiong & Ruan 2024). The exclusive reliance on sustainable local materials – primarily bamboo harvested from managed groves and timber sourced from nearby forests – establishes a circular economy that minimizes environmental impact while supporting forest conservation efforts and maintaining biodiversity. This material selection reflects profound understanding of resource management principles developed through generations of experiential learning. The elevated stilt house design represents a masterful example of climate-responsive architecture, providing natural ventilation systems that moderate indoor temperatures, facilitate air circulation and protect inhabitants from seasonal flooding while reducing dependence on energy-intensive mechanical systems (Bai et al. 2020; Zhou et al. 2020).

Most significantly, these traditional homes function as integral components of Jingmai's tea production system, with their second-floor platforms serving as specialized spaces for tea drying, processing and storage activities that link architectural design directly to the community's primary economic foundation (Chen & Hu 2024; Gao et al. 2024). This functional integration demonstrates how traditional building practices evolved to support local livelihoods while maintaining cultural authenticity, creating built environments that serve multiple purposes simultaneously without compromising efficiency or cultural meaning. The homes operate as both residential spaces and productive infrastructure, embodying a holistic approach to community development that successfully integrates social, economic and environmental considerations. This multifunctional design philosophy reflects traditional knowledge systems that understood buildings not as isolated objects but as components of larger ecological and social systems, creating architectural solutions that enhanced community resilience while preserving cultural identity and environmental sustainability.

Contemporary challenges: Cultural change, rural-urban migration and architectural transformation in a twenty-first-century context

The preservation of Jingmai's traditional architectural heritage faces unprecedented challenges in the contemporary era, as multiple interconnected forces threaten to erode the cultural foundations that have sustained these communities for over a millennium. The transition from traditional bamboo and timber materials to concrete structures represents a significant structural shift within the cultural landscape. Driven by modernization processes and local aspirations for increased structural durability and reduced maintenance costs, this material substitution reflects a negotiation between heritage continuity and contemporary living standards. However, such transitions can alter the historical character of the settlement and reconfigure the symbolic relationships between inhabitants and their architectural heritage (Li et al. 2023a). While



Figure 3 – Ecotourism in Jingmai Mountain. The traditional layout and wooden architectural complex of Nuogan Village in Jingmai Mountain reflect a harmonious integration with the surrounding ancient tea forests (A). In the ancient tea garden of Dapingzhang, tourists can participate in traditional tea-picking activities, gaining hands-on experience of local heritage (B). Inside a Dai-style wooden house, a huotang (fire pit) serves as a cultural hub where visitors engage in tea boiling, warm themselves by the fire and join in communal gatherings (C). In another corner of the village traditional snacks are for sale, showcasing the continuity of local culinary customs (D). In another corner of the village, locals are seen selling traditional snacks at their storefronts, showcasing the continuity of local culinary customs. (E), while local products such as bananas, Pu'er tea and mushrooms are also displayed and sold, contributing to the community's livelihood (F). © all pictures Chunping Xie

concrete construction may offer certain practical advantages in terms of structural longevity and weather resistance, it lacks entirely the profound cultural significance embedded in traditional materials and construction techniques, creating buildings that function as mere shelters rather than repositories of cultural meaning and identity (Korde et al. 2025). Moreover, the environmental impacts associated with concrete production and construction – including carbon emissions, resource depletion and landscape disruption – stand in stark contrast to the sustainable practices that traditional building methods successfully maintained for centuries without compromising ecological integrity. It is important to acknowledge, however, that residents' choices regarding building materials reflect complex calculations that preservation frameworks must take seriously. Interviews with households that have adopted concrete construction reveal practical considerations: reduced maintenance labour particularly important for aging residents or families with members working in distant cities; improved weather resistance in the context of increasingly unpredictable climate patterns; and longer structural lifespans that reduce long-term housing costs. Some residents explicitly articulate that concrete construction represents not a rejection of cultural heritage but rather a pursuit of housing security comparable to that available in urban areas. These perspectives suggest that effective preservation strategies must engage honestly with the economic and practical dimensions of hous-

ing choices rather than assuming that cultural values alone will motivate maintenance of traditional materials (Bahru et al. 2012; Alsheikh Mahmoud et al. 2024). This transformation highlights the need to consider how preservation approaches engage with residents' agency in housing decisions. It requires an analysis of the conditions that influence the economic viability and practical sustainability of traditional construction for local inhabitants. By examining these dynamics, preservation strategies can better account for the socio-economic motivations of those who choose to maintain or adapt traditional architectural forms within the modernizing landscape.

The adoption of modern building materials and construction techniques represents more than a simple technological shift; it constitutes a fundamental erosion of the authenticity that forms the conceptual and practical foundation of Jingmai's World Heritage designation and cultural significance. The daily experience of inhabiting traditional homes contributes to cultural continuity through sensory engagement and embodied knowledge that modern structures cannot replicate, as the distinctive sounds, textures, thermal properties and atmospheric qualities of bamboo and timber construction form integral components of the cultural memory that shapes ethnic identity and community belonging (Huang & Qin 2023). Yet it is crucial to recognize that the significance of these architectural forms is not uniformly experienced across the community. Field observations reveal that interpretations

of traditional architecture vary considerably among different demographic groups. Elderly Bulang and Dai residents often emphasize the spiritual and ancestral connections embodied in structural details (Xiong & Ruan 2024; Zhang & Xie 2024), while younger community members, particularly those with urban educational experiences, may appreciate these aesthetic and cultural values while simultaneously prioritizing practical housing considerations such as maintenance requirements, weather resistance and compatibility with modern amenities (Huang & Qin 2023; Zhang et al. 2024). Women and men may also relate differently to these spaces, given traditional gender divisions in domestic labour and building maintenance responsibilities. These diverse perspectives remind us that *community values* regarding traditional architecture cannot be assumed as monolithic but must be understood through careful attention to the varied positions and priorities of different community members.

The migration of rural populations to urban centres presents what may constitute the most significant long-term threat to Jingmai's traditional architecture, as demographic shifts fundamentally alter the human foundation upon which architectural preservation depends (Li et al. 2023a; Wang & Zakaria 2025). As younger generations increasingly seek educational opportunities, employment prospects and lifestyle amenities available in urban centres, traditional homes are progressively abandoned or left with inadequate maintenance and care, creating a deteriorating cycle where declining rural populations reduce the economic viability and social vitality of traditional communities. The mountainous terrain that contributes significantly to Jingmai's scenic beauty, ecological diversity and cultural distinctiveness simultaneously presents substantial challenges for modern infrastructure development, making urban alternatives increasingly attractive to young people who perceive rural life as limiting their personal and professional opportunities. The geographic isolation that historically protected traditional culture from external influences now functions as a barrier to economic development and social connection (Xu et al. 2005), creating fundamental tensions between heritage preservation objectives and community sustainability needs that require careful navigation and innovative solutions.

The reluctance of younger generations to remain in remote villages or return after urban education experiences threatens the critical process of intergenerational knowledge transmission that sustains both traditional building techniques and the broader cultural practices that give meaning to architectural heritage (Rao & Ye 2016; Mohabir et al. 2017). The specialized knowledge required to construct, maintain and repair bamboo and timber homes represents accumulated wisdom developed through centuries of experiential learning and refinement, encompassing not only technical skills, but also a deep understanding of material properties, environmental conditions and cultural pro-

ocols that cannot adequately be documented or preserved through written records alone. As elderly craftspeople age without successfully training successors in traditional construction methods, this irreplaceable indigenous knowledge faces genuine extinction, representing a cultural loss that would be impossible to recover once the chain of practical transmission is broken (Yuan 2011). The *tea ancestor* belief system and associated cultural practices that provide spiritual and social meaning to traditional architecture face similar risks as younger generations, influenced by modern educational curricula and urban lifestyle aspirations (Zheng 2016; Gao et al. 2024), demonstrate declining interest in traditional worldviews and customary practices that their elders consider fundamental to community identity and ecological stewardship.

Integrating traditional architectural heritage into mountain socio-ecological systems: Drivers of change and pathways for sustainable rural transformation

The functional integration of Jingmai's traditional bamboo and timber homes within the local economy extends beyond heritage conservation to encompass the dynamics of sustainable economic development and cultural revitalization (Fan & Deng 2022) (Figure 3A). As central components of the cultural landscape, these stilt structures act as primary drivers for ecotourists, where their placement within working tea gardens facilitates unique visitor experiences and diversified economic opportunities for local communities (Figure 3B & C). Beyond direct aesthetic appeal, these dwellings serve as nodes for international attention through contemporary media, supporting a tourism model that integrates hospitality, guiding and cultural interpretation services (Figure 3D & F). Empirical observations suggest that the adaptive reuse of traditional structures as eco-lodges can provide economic incentives for the younger generation, potentially mitigating the demographic challenges associated with rural-to-urban migration.

The successful implementation of preservation pathways depends on collaborative governance structures that integrate local communities, government agencies and international partners (Zhang & Chen 2023; Liu 2025). Educational initiatives emphasize the environmental knowledge embedded in traditional building practices (Seerangan & Ravi 2023), framing heritage preservation as relevant to contemporary sustainability challenges. Spatial planning and infrastructure investments aim to enhance village life while minimizing the visual impact on traditional architecture. These coordinated efforts address the socio-economic drivers of rural-urban migration, ensuring that Jingmai's architectural heritage remains a functional component of contemporary mountain life.

Navigating diverse stakeholder interests in heritage-based development

The transition toward heritage-based development reveals that heritage designation creates different opportunities and constraints for different community members (Kaur et al. 2025). Empirical evidence from Jingmai suggests that households located along primary tourist routes or near scenic sites typically exhibit higher rates of house-to-guesthouses conversion, while those in peripheral locations face more limited participation options (Goodwin & Roe 2001; Shi et al. 2023). Furthermore, access to benefits is often mediated by capital for facility improvements and language skills, which can lead to socio-economic stratification within the community. These disparities highlight the importance of mechanisms (Fonseca & Ramos 2012) – such as community revenue-sharing and targeted training programmes – to ensure that preservation outcomes are distributed broadly across the community.

Furthermore, different generations often have different stakes in architectural outcomes. Elderly residents frequently prioritize cultural continuity and spiritual connections to ancestral homes (Chua et al. 2019), while younger community members may weigh cultural heritage against economic mobility and access to modern infrastructure (Xiao et al. 2021). Preservation frameworks, therefore, must navigate these divergent perspectives – enabling young people to maintain connections with traditional practices while also pursuing contemporary economic opportunities. This ensures that heritage conservation does not become a barrier to improved livelihoods and infrastructure development. Similarly, the distinct cultural traditions of the Bulang and Dai communities require flexible preservation approaches that accommodate different relationships to architectural heritage. Community-engaged planning processes that create space for diverse voices – across ethnic identities, generations, genders and economic positions – are essential for developing pathways that genuinely serve the varied interests present within Jingmai's population (Liu 2025).

Conclusion

This study demonstrates that the architectural heritage of Jingmai Mountain is a dynamic component of a mountain socio-ecological system, whose continuity depends on navigating the complex tensions between heritage conservation and modernization. The transition of building materials and the demographic shift caused by rural-urban migration highlight that preservation is not merely a technical task, but also a multifaceted social negotiation involving diverse community stakeholders with varying economic capabilities. Therefore, effective preservation strategies must move beyond static artifact protection toward flexible, community-engaged frameworks that align traditional building practices with the evolving economic aspi-

rations of local inhabitants. By addressing the socio-economic drivers of migration and incentivizing the adaptive reuse of dwellings, heritage management can support vibrant, economically viable communities. Looking forward, the *Jingmai model* suggests that the survival of global mountain heritage will increasingly rely on the hybridization of indigenous technical knowledge with modern sustainability standards. This approach ensures that cultural landscapes remain functional, resilient and relevant to the contemporary lived experiences of the communities that sustain them.

Acknowledgements

This work was supported by the Education Department of Hainan Province (grant number: Hnjg2026ZD-69) and the University-Level Research Project of Qiongtai Normal University, 2024 (grant number: qtky202412).

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