

Research on the Protection Strategy of Traditional Villages in Western Sichuan from the Perspective of Disaster Prevention and Mitigation: A Case Study of Kuapo Village, Wenchuan County

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Abstract

There are numerous traditional villages distributed in the western part of Sichuan Province, China. Traditional villages in western Sichuan, as important carriers of regional culture, have developed unique architectural wisdom through long-term adaptation to nature. However, in recent years, frequent natural disasters have posed serious threats to the protection of these traditional villages. Most existing studies on traditional villages in western Sichuan focus on villages that were collapsed and rebuilt after the "Wenchuan Earthquake," and few start from the perspective of disaster prevention and mitigation. This paper takes the "authentic" Qiang village of Kuapo in Wenchuan County as the research object. Based on the perspective of disaster prevention and mitigation, through field investigations, typical architectural mapping, and disaster risk factor analysis, it discovers that traditional villages possess inherent disaster prevention and mitigation experience in aspects such as site selection, layout, material structure, and spatial form

Keywords

Disaster Prevention and Mitigation; Traditional Villages; Building Preservation

1. Introduction

The No. 1 Central Document of 2025 was released, proposing to solidly promote comprehensive rural revitalization, emphasizing "strengthening the protection and utilization of traditional villages and inheriting rural historical context." Numerous ethnic villages are distributed in western Sichuan Province, China. These villages are not only living carriers of multi-ethnic cultural integration but also the crystallization of wisdom in mountain human settlements adapting to natural risks. Traditional villages in western Sichuan, represented by ethnic minority settlements

such as the Qiang and Tibetan, embody centuries of disaster prevention and mitigation experience in their unique site selection, layout, architectural forms, and spatial organization, such as the terraced defense system built along mountains, the seismic performance of stone-wood structures, and self-organized disaster response mechanisms. Against the backdrop of climate change and frequent extreme disasters, risks of earthquakes, landslides, and debris flows in western Sichuan are intensifying, and traditional villages face the dual challenge of "cultural survival" and "safety resilience."

2. Disaster Prevention and Mitigation: Concepts and Theoretical Framework

2.1. Connotation and Evolution of Disaster Prevention and Mitigation

Disaster Risk Reduction is a core component of disaster risk management systems, covering the entire lifecycle of disaster prevention, risk mitigation, emergency response, and post-disaster recovery. The United Nations Sendai Framework for Disaster Risk Reduction 2015-2030 proposes the core concept of "reducing disaster risk and enhancing resilience," emphasizing the integration of disaster prevention and mitigation into sustainable development goals. In the field of traditional dwelling preservation, disaster prevention and mitigation not only focus on the physical defense of spaces against disasters but also need to pay attention to the vulnerability of traditional dwellings as cultural heritage. This involves assessing traditional disaster prevention wisdom, exploring its adaptive transformation (Figure 1), and shifting the paradigm from "passive disaster relief" to "active defense." This requires making disaster risk management proactive and systematic, deeply coupled with local knowledge, ecological wisdom, and cultural heritage.



Figure 1. Kuapo Village, a Traditional Chinese Village

2.2. Disaster Risk Characteristics of Traditional Villages

Traditional villages in western Sichuan are mostly located in alpine canyon areas on the eastern edge of the Qinghai-Tibet Plateau. Influenced by the combined effects of plate tectonics and monsoon climate, they exhibit a "disaster chain effect"

characteristic: earthquakes trigger mountain loosening → heavy rainfall induces landslides → debris flows destroy settlements .

3. Analysis of the Current Situation of Kuapo Qiang Village

3.1. Village Characteristics and Indigenous Disaster Prevention and Mitigation Wisdom

Kuapo Village is located in the alpine canyon area of Longxi Township, Wenchuan County, about 22 km from the county seat. It is a typical high-mountain slope-type traditional Qiang village, at an altitude of approximately 2200 meters ^[4]. The village buildings are built along the mountain, scattered but well-proportioned, distributed in a terraced pattern on a platform surrounded by mountains on three sides. Kuapo Village is one of the best-preserved Qiang villages since the 5.12 Wenchuan Earthquake. On March 19, 2023, Kuapo Village was included in the sixth batch of the List of Traditional Chinese Villages

3.2. Disaster Risk Factors and Vulnerability Characterization

"Hazard factors refer to aberrant factors that may cause casualties, property losses, socio-economic losses, and ecological environment degradation. Hazard factors include natural hazard factors, such as typhoons, rainstorms, floods, earthquakes, landslides, debris flows, hailstorms, tsunamis, etc., and also include environmental and man-made hazard factors, such as environmental pollution, traffic accidents, chemical accidents, etc. Hazard factors are the causes of disaster losses."

3.3. Realistic Contradictions Between Protection and Development

Although Kuapo Village is not included in the tourism development list, the preservation of its "authenticity" faces multiple contradictions, primarily manifested in the triple dilemma of "rigid protection paradigm," "fragmented disaster management," and "loss of cultural resilience": Kuapo Village's "authenticity" preservation faces the dilemma of a rigid protection paradigm. Current protection mechanically follows the principle of "restoring the old as it was" from the China Principles for the Conservation of Cultural Heritage Sites, limiting the intervention of some modern materials and scientific techniques, leading to "protective damage." (Figure 2) When repairing some dangerous buildings in Kuapo Village, traditional rammed earth and rubble stone are still used in key structures.



Figure 2. Schematic Diagram of Detailed Construction Methods in Kuapo Village

4. Protection Strategies for Traditional Villages in Western Sichuan

Based on the dual objectives of "authenticity protection" and "disaster resilience enhancement" for Kuapo Village, this study proposes a trinity collaborative strategy framework of "Holistic Protection - Systematic Disaster Prevention - Sustainable Revitalization", aiming to solve the realistic contradiction between "protection and development" and achieve the synergistic development of living cultural heritage and safety resilience.(Figure3)



Figure 3. Aerial Photograph of Kuapo Village

4.1. Holistic Protection: Adaptive Integration of Traditional Wisdom and Modern Technology

Core Protection Zone (e.g., Watchtowers, Village Gate): Watchtowers and the village gate, as core cultural symbols, hold extremely high historical and cultural value. Their restoration strictly adheres to traditional techniques, adhering to the principle of "original materials, original positions." For instance, when patching walls with local rubble stone, considering the difficulty in obtaining traditional vines and their slightly inferior durability, bamboo reinforcements are innovatively embedded. Bamboo strips possess good flexibility and certain strength, effectively enhancing the shear strength of the wall while preserving the characteristics of traditional craftsmanship and architectural style to the greatest extent.

4.2. Systematic Disaster Prevention: Resilient Reconstruction of Space-Structure-Ecology

Macro-Level Risk Avoidance: Designate "disaster isolation green corridors." Restore native vegetation (e.g., planting robinia pseudoacacia, sea buckthorn) in the eastern gully area. By constructing an ecological buffer zone with a width ≥ 30 meters, utilize the soil-fixing roots and debris-blocking branches and leaves of vegetation to effectively reduce the impact energy of debris flows, providing a natural disaster protection barrier for the village.

Meso-Level Disaster Resistance: Repair the three-level defense nodes of "village gate - watchtower - secret passage." Widen main alleys to 2.5 meters to meet emergency evacuation needs, and install emergency lighting facilities to ensure unobstructed evacuation routes during disasters, enabling villagers to evacuate quickly and safely.

4.3. Sustainable Revitalization: Symbiotic Mechanism of Cultural Heritage and Community Empowerment

Establish a Qiang Construction Skills Training Institute. Experienced elder craftsmen demonstrate traditional techniques like "Yujibei" on-site, transmitting the essence of the skills. The School of Architecture of Southwest Minzu University provides professional knowledge support, offering (mechanical simulation) and material optimization, injecting modern scientific elements into traditional skills and cultivating a new generation of craftsmen who master both traditional techniques and modern knowledge. Use 3D laser scanning and BIM technology to create a "digital twin model" of traditional buildings. Through precise measurement, record detailed information such as building component dimensions and joint practices, providing accurate data support for subsequent restoration work and achieving permanent digital preservation and transmission of traditional architecture.

5. Conclusion

The strategy system proposed in this study, through the collaborative path of "technological improvement - institutional innovation - cultural empowerment," continues the Qiang village's wisdom of "overcoming hardness with softness" while injecting modern resilience concepts. It provides an operational paradigm for solving the "protection dilemma" in western Sichuan's traditional villages. Future research needs to further explore quantitative evaluation indicators for the seismic performance of traditional buildings and integrate community participation mechanisms into policies and regulations, ultimately achieving the sustainable balance between "cultural heritage preservation" and "human settlement safety."

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