

Preventive Conservation of the Historic Environment: Concepts, Framework, and Empirical Evidence

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Abstract

Against the backdrop of climate change and rapid urbanization, historic environments face mounting risks from both natural and human-induced hazards. Conventional "passive defense" conservation strategies are increasingly inadequate for addressing these multi-source challenges. Consequently, a proactive approach centered on "early detection and preventative intervention" is essential to enhance the safeguarding of historic environments. By synthesizing ancient Chinese urban planning wisdom with contemporary research on cultural heritage preservation, this study clarifies the concept of preventive conservation for historic environments. We categorize four key value elements—landscape base, street space, cluster lots, and characteristic nodes—and analyze the mechanisms of multi-source hazards. Recognizing the historic environment as a vulnerable receptor, we propose a preventive conservation framework rooted in value-based protection. Using the Ciqikou Historic and Cultural District in Chongqing as a case study, we explore flood response strategies, recommending a layered approach of "risk classification, element classification, and disaster stratification." This study aims to provide a methodological reference for advancing the preventive conservation of historic environments.

1. The Evolution of Preventive Conservation Theory

1.1 Roots of Preventive Ideology in Ancient Chinese Urban Planning

Throughout Chinese history, the frequency of natural disasters fostered a deep-seated "preventive" consciousness. Ancient principles, such as those documented in *Guanzi·Chengma*, advocated for urban designs that respected natural topography ("relying on natural materials and local advantages") rather than rigid geometric forms. In agrarian society, disaster management systems were established to encompass prediction, monitoring, and relief. Ancient thinkers emphasized the harmony between humanity and nature, advocating for proactive adaptation to natural phenomena rather than mere passive avoidance.

1.2 Evolution of Western Heritage Preventive Conservation Theory

In the 1840s, Eugène Viollet-le-Duc introduced "stylistic restoration," which, while promoting active protection, drew criticism regarding authenticity. By the late 19th century, Gustavo Giovannoni's "scientific restoration" advocated for routine maintenance and repair,

laying the groundwork for preventive conservation. The concept was formalized in museum contexts by the 1930s, focusing on controlled environments. In the 1950s, Cesare Brandi integrated "preventive restoration" into the architectural realm, emphasizing the elimination of hazards to ensure structural integrity. This evolved into "programmed conservation" in the 1970s, which prioritized the correlation between heritage and its environment. Since the 1990s, international organizations such as UNESCO, ICOMOS, and the IPCC have increasingly aligned heritage conservation with climate change mitigation.

2. Characteristics and Exploration Directions of Preventive Conservation for Historic Environments

2.1 Current Research Progress

Since the 2000s, preventive conservation has expanded from museum collections and individual monuments to broader historic environments. Scholars have increasingly recognized the necessity of holistic, multidisciplinary approaches to maintain heritage integrity in the face of climate change and extreme weather.

2.2 Conceptual Characteristics

Preventive conservation for historic environments differs from museum-based approaches. While museum conservation involves controlling micro-environments (e.g., light, humidity), historic environments are large-scale, complex, and exposed to uncontrollable external risks. According to Article 7 of the *Venice Charter*, heritage cannot be separated from its historic context. Thus, conservation must shift from spatial preservation to a multi-objective, multi-element strategy that views the historic environment as a cohesive system.

2.3 Value-Based Core

The essence of preventive conservation lies in protecting the historic environment's value. Hazards should be evaluated based on how they threaten the "authenticity" and "integrity" of this value. We define preventive conservation for historic environments as: *the interpretation of the relationship between the environment and hazard-prone conditions, the identification of hazard impact mechanisms, and the implementation of nature-based risk reduction and value-enhancement strategies.*

3. Framework for Preventive Conservation of the Historic Environment

We propose a logic-based framework: "**Value and Risk Measurement — Risk Assessment — Planning Response**" (Fig. 1).

Value and Risk Measurement: Deconstructs the historic environment into value elements (landscape base, street space, etc.) and analyzes hazard-prone environments.

Risk Assessment: Utilizes quantitative indicators and scenario simulation (e.g., HEC-RAS models) to map historic environmental risks.

Planning Response: Implements strategies through:

Risk Classification: Prioritizing protection based on hazard levels.

Element Classification: Tailored interventions for different structural components.

Disaster Stratification: Managing risk through source control and diffusion prevention.

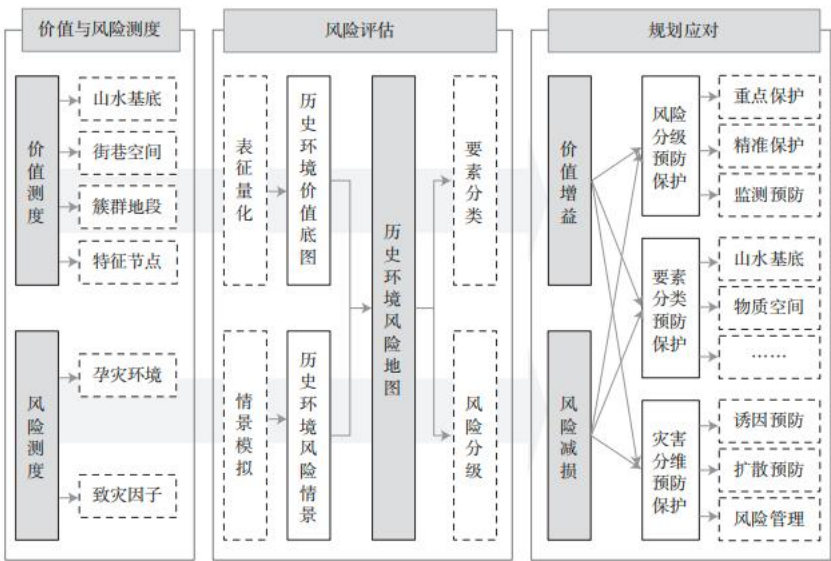


Fig.1 Framework for preventive conservation of historical environmental based on value

4. Empirical Analysis: The Ciqikou Historic and Cultural District

4.1 Overview and Hazard Profile

Located along the Jialing River, Ciqikou is highly susceptible to flooding. The 2020 extreme flood reached 192.65m, severely threatening the district’s safety and integrity.

4.2 Assessment and Strategy

By integrating ArcGIS with HEC-RAS hydrodynamic modeling, we simulated 10-year, 50-year, and 100-year flood scenarios (Fig. 3). The resulting risk maps identified critical areas—particularly the confluence of the Phoenix and Qingshui streams—where high-value elements are most vulnerable.

Our planning response adopts the "Three-Dimension" strategy:

Risk Classification: High-risk areas (e.g., the wharf) require priority intervention; medium-risk areas require precise protection; low-risk areas require routine monitoring.

Element-Based Protection: Applying nature-based solutions (NbS) to enhance resilience.

Disaster Stratification: Integrating monitoring, warning, and emergency response mechanisms into the district's management system.

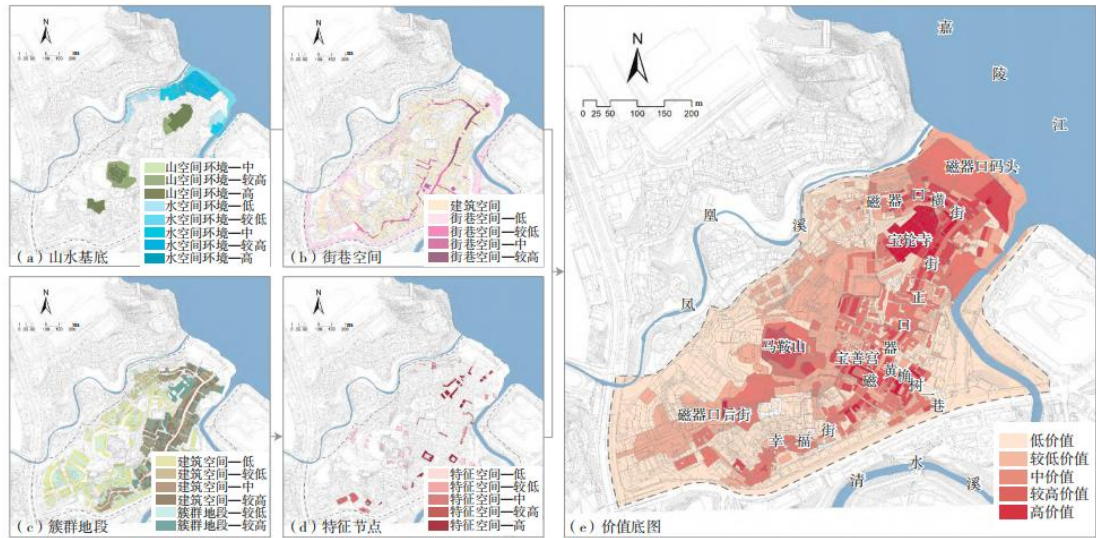


Fig.2 Values of Ciqikou historic district

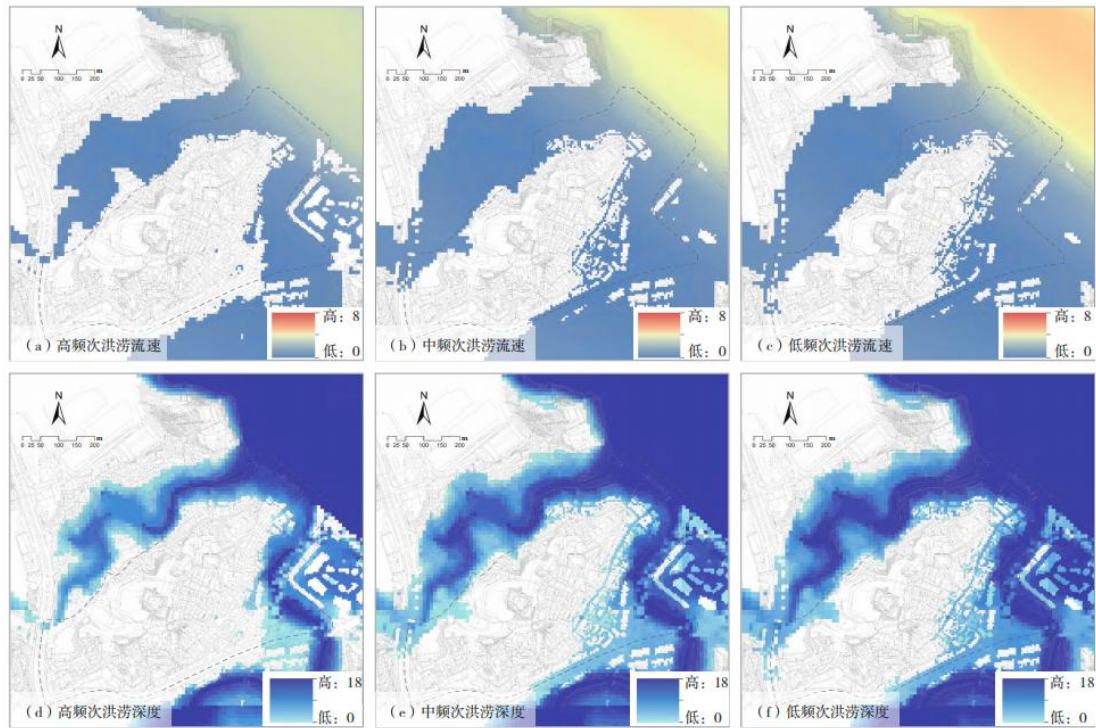


Fig.3 Flooding scenario simulation in the historic district of Ciqikou

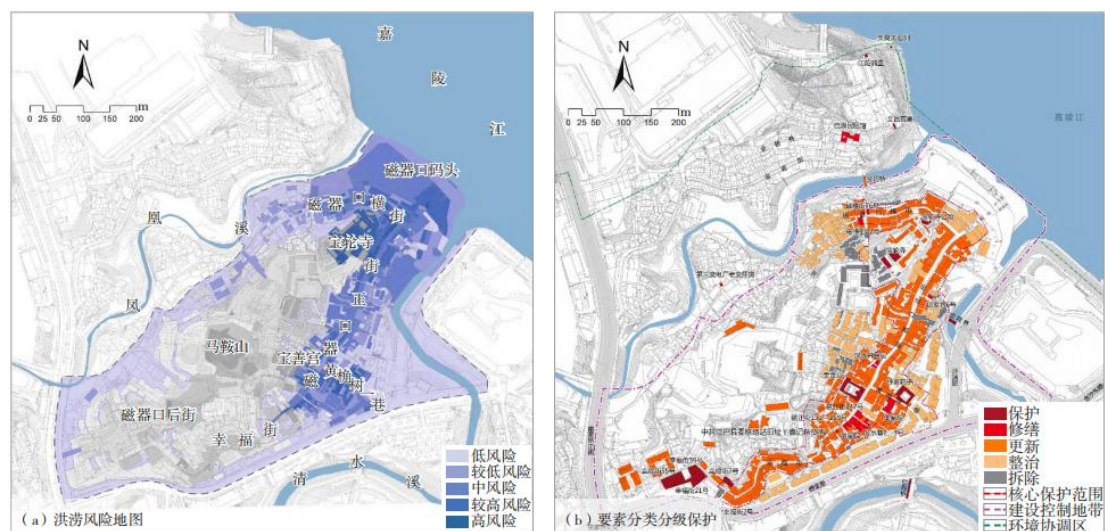


Fig.3 Flooding scenario simulation in the historic district of Ciqikou

5. Conclusion

Preventive conservation represents a paradigm shift from passive defense to proactive, value-centered management. While this study establishes a foundational framework for Ciqikou, future research must further investigate the nuanced mechanisms of multi-source hazards on diverse historic environments and the potential for secondary disaster impacts.

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