

Complex System Conservation Technology for Spatial Cultural Heritage Networks: A Case Study of Qinghai Province, China

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Abstract

Qinghai Province, on the Qinghai-Tibet Plateau, hosts 517 national/provincial heritage sites across 720,000 km², with spatial dispersion challenging conservation. Shifting from single-site models, current research stresses interconnectedness and systemic risks but lacks dynamic modeling and value quantification. This study uses ArcGIS, spatial syntax, and AI-driven multidimensional models (cultural value, environmental vulnerability, social connectivity) to analyze spatial distributions. For the first time, we identify hierarchical structures and vulnerability patterns, yielding three outcomes: (1) a five-tier vulnerability classification framework; (2) a "Three Cores, Three Belts" conservation network; and (3) pathways for heritage activation. These findings advance UNESCO's "Cultural-Natural Symbiosis" agenda, addressing plateau conservation challenges through an integrated technical system (spatial analysis, risk simulation, decision support), positioning Qinghai as a potential International Demonstration Zone for plateau heritage conservation.

Keyword: Cultural Heritage Spatial Network: Cultural Value Index: Synergistic Conservation: Qinghai Province, China

Introduction:

Qinghai, a multi-ethnic province, has accumulated a rich tapestry of historical and cultural heritage shaped by generations of diverse ethnic groups. These assets serve as critical pillars for fostering a sense of shared identity among the Chinese nation and safeguarding national ecological security.

As an integral component of China's pluralistic civilization, Qinghai's cultural heritage embodies both distinctive ethnic characteristics and ecological fragility. The province boasts 1 National Historical and Cultural City, 1 National Historical and Cultural Town, 5 National Historical and Cultural Villages, 4 Historical and Cultural Blocks, and 183 Chinese Traditional Villages—ranking first among China's five northwestern provinces. It also houses 51 national-level protected sites, including the Sakyamuni Pagoda in Sangnang and the Gyasa Monastery, along with 466 provincial-level sites such as the Zhujiazhai and Hanzhuangzi ruins. Many of these cultural treasures suffered catastrophic damage during the 2010 Yushu earthquake, with nearly 100% of immovable cultural relics impacted, exposing the vulnerabilities of traditional conservation models. Current challenges in cultural heritage protection include: 1 Simplified Value Assessment: Overemphasis on physical carriers while neglecting intangible cultural dimensions. 2 Reactive Risk Management: Predominantly post-disaster rescue rather than proactive mitigation. 3 Fragmented Conservation Strategies: Lack of systemic coordination and holistic planning.

Complex system theory offers a novel approach to overcome these limitations. By conceptualizing cultural heritage as a dynamically interconnected system, this theory analyzes node relationships to reveal inherent structural patterns—a methodology widely applied in micro-scale spatial layout studies such as community public spaces. This study innovatively applies complex network theory at the provincial scale, examining the spatial distribution of cultural heritage through a network topology perspective. Utilizing data on heritage sites, road networks, and points of interest (POIs), we establish a five-tier vulnerability classification system for Qinghai's historical and cultural heritage network. By integrating historical information, spatial coordinates, and fuzzy boundary processing, we construct a multi-layered heritage typology framework that interweaves points, lines, and planes. This framework provides a reference for heritage conservation, transmission, and adaptive reuse. While international applications—such as resilience assessments for Italy's cultural heritage corridors—exist, this study represents the first practical implementation in China's plateau regions, filling a critical research gap.

1 Study Area Overview and Research Methodology

1.1 Study Area Overview

Qinghai Province, located in northwest China (89°35'–103°04' E, 31°9'–39°19' N), spans 720,000 square kilometers (7.5% of China's territory) with an average elevation exceeding 3,000 meters. Bordering Gansu to the east, Sichuan to the south, Tibet to the southwest, and Xinjiang to the northwest, it serves as a transitional zone between the Qinghai-Tibet Plateau and the Loess Plateau, as well as a historical crossroads of the Tang-Tibet Ancient Road and the Henan Corridor of the Silk Road. Dubbed the "Water Tower of China," it is the birthplace of the Yangtze, Yellow, and Lancang rivers, and hosts Qinghai Lake (China's largest inland saltwater lake) and hundreds of salt lakes. The province's topography is defined by the "Three Mountains, Two Basins" configuration: the Kunlun Mountains traverse its center, the Qilian Mountains guard its northern flank, and the Tanggula Mountains dominate the south. As one of the cradles of Yellow River civilization, it nurtures the Hehuang cultural complex—centered in Haidong City—which blends Central Chinese agrarian, steppe nomadic, and Western regional commercial traditions into a "pluralistic integration" cultural model, earning designation as a national cultural ecosystem conservation zone.

The province boasts a robust intangible cultural heritage (ICH) system, with 2,361 entries across four protection tiers, including 88 national-level items (e.g., Regong Thangka, Hua'er folk songs, Huangzhong Dui embroidery) and 238 provincial-level items, supported by 3,160 designated bearers. Its tangible heritage is equally remarkable, comprising 6,411 immovable cultural relics (51 national-level, 466 provincial-level protected sites), 1 national historical and cultural city, 1 national historical and cultural town, 5 national historical and cultural villages, 123 Chinese traditional villages, and 1 archaeological site park. The province's 41 registered museums and memorials safeguard 310,000 movable cultural artifacts.

1.2 Research Methodology

1.2.1 Kernel Density Analysis

This study employs kernel density analysis to process the POI data of cultural heritage sites in Qinghai Province. As a widely adopted non-parametric estimation method, kernel density analysis calculates density values within spatial point/line element domains to simulate continuous density distributions. The mathematical expression for the conventional kernel density estimator is:

$$f_n(X) = 1/N\pi^{1/2} \cdot \sum_{j=1}^n k_j (1 - D_{ij}^2/h^2)^2$$

Here, K denotes the kernel function; h represents the bandwidth of the selected region; D_{ij} signifies the distance between spatial point i and study object j . Even with a relatively small h , sufficient sample capacity ensures adequate data points for probability density calculation. The optimal bandwidth relationship is defined as $h=c \cdot N^{-1/5}$, where $c=1.05$ under normal distribution conditions.

1.2.2 Quantitative Evaluation Framework

The integrated quantitative evaluation methodology combines single-factor assessment with comprehensive density analysis, forming a hybrid evaluation technique that merges independent single-element analysis with spatial aggregation characteristics. This framework is applicable to cultural heritage conservation, environmental assessment, and regional planning. Its core logic involves: Single-Factor Evaluation: Independent quantification of critical impact factors (e.g., heritage value, ecological sensitivity, social engagement) using standardized scores within a 0-1 range:

$$S_i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}$$

where S_i is the standardized score for factor i , X_i denotes the actual value, and $X_{\min}/X_{\max}$ represent the minimum/maximum values within the evaluation scope.

1.2.3 Comprehensive Resistance Model Analysis

The comprehensive resistance model (CRM) evaluates a complex system's capacity to maintain functional stability under internal/external disturbances. Originally proposed by Dutch ecologist Knappen for species dispersion studies, this model has been extended to ecological conservation and landscape pattern analysis. By quantifying "resistance" generated by internal structures, external environments, and their interactions, CRM identifies systemic vulnerabilities and optimizes resilience strategies. The Minimum Cumulative Resistance (MCR) calculates the minimum energy expenditure or cumulative cost for movement from "sources" through heterogeneous landscapes:

$$MCR = \int_{\min} \sum_{j=n}^{i=m} (D_{ij} \times R_i)$$

where MCR represents the minimum cumulative resistance, D_{ij} is the distance from heritage site j to landscape element i , and R_i denotes the resistance value of location i for heritage corridor development. Higher resistance indicates lower corridor suitability, and vice versa.

1.2.4 Application of Complex Network Theory in Cultural Heritage Conservation

Rooted in the principles of system science—including holism, hierarchy, openness, teleology, stability, mutability, self-organization, and irreversibility—and governed by fundamental laws such as structure-function correlation, information feedback, competitive synergy, fluctuation-induced order, and optimization-driven evolution, systemic principles exhibit universal applicability to the material world. Systems permeate all facets of human society, encompassing entities of varying scales, natures, and attributes. Cultural heritage networks exemplify such complex systems, integrating social, cultural, and natural dimensions. These networks comprise foundational natural ecosystems, anthropogenic structures, and the socio-economic activities of local communities and visitors, encompassing aspects such as neighborhood social interactions and regional cultural bearing capacity. The material spaces shaped by temporal-spatial evolution, regional cultural bearing capacity, and environmental factors demonstrate significant overlap and integration, with ubiquitous complex interconnections existing among elements and hierarchical levels within the system. Alterations in one system element trigger cascading effects across interconnected components, collectively shaping the system's holistic behavior. By treating historical sites as complex adaptive systems and employing systems thinking to investigate dynamic interactions among system, environment, and elements, this approach enables targeted analysis of specific system components to address emergent practical challenges.

Complex network theory elucidates systemic complexity through node-edge topological relationships. In cultural heritage contexts: Nodes represent individual heritage entities. Edges encode spatial connections, cultural lineages, or functional dependencies between heritage elements.

Recent methodological developments highlight two research trajectories: Network Resilience Analysis: Identification of critical heritage nodes through centrality metrics (e.g., degree centrality, betweenness centrality). Multi-Layer Network Integration: Emergence of coupled network models, such as Italy's hybrid framework overlaying sacred architecture networks with tourist mobility patterns for proactive risk management.

2 Multi-level analysis of cultural heritage in Qinghai Province

2.1 Three Principles for Cultural Heritage Conservation in Qinghai

(1) Authentic and Effective Protection of Historical and Cultural Resources

Adopting a value-oriented approach, this principle emphasizes the implementation of scientific methods and appropriate strategies to safeguard the authenticity of historical and cultural resources. Destructive practices such as demolishing authentic heritage to construct replicas or engaging in fraudulent restorations are strictly prohibited. Emergency conservation and repair measures are promptly undertaken for historical and cultural resources facing severe deterioration or existential threats.

(2) Holistic Conservation of Resource Entities and Landscape Patterns

This principle underscores the integrated preservation of historical and cultural resources, their associated landscape patterns, natural vistas, and cultural environments. It encompasses the protection of ecological elements such as mountains, rivers, ponds, and pastoral landscapes. Conservation efforts must avoid altering the topography surrounding heritage sites, refrain from felling ancient trees, and preserve morphological contours, street networks, architectural textures, axial sightlines, and spatial landmarks that reflect indigenous construction wisdom. Exploration of river-basin and corridor-style regional heritage conservation approaches tailored to Qinghai's geographical context is actively encouraged, emphasizing holistic and systemic preservation.

(3) Systematic Conservation of Historical and Cultural Resources Across Eras

This principle advocates for the harmonious coexistence of historical and cultural resources from different periods, opposing the overshadowing of diverse cultural information by singular thematic or stylistic representations. It emphasizes understanding the evolutionary trajectories of heritage assets, integrating their temporal stratification and spatial interconnections. Conservation strategies should ensure continuity and legacy across spatial configurations and physical heritage entities, vividly preserving historical traces and collective memories from various epochs.

2.2 Evolution of Cultural Heritage Conservation Policies in Qinghai

The policy framework for heritage conservation in Qinghai has undergone continuous refinement. In 2022, the provincial government enacted the Regulations on the Identification of Historical and Cultural Cities, Towns, Villages, and Districts in Qinghai. Subsequently, in 2023, it designated 4 cities, 9 towns, and 33 villages as the first batch of provincial-level historical and cultural entities. An additional 3 historical and cultural districts were added to the reserve list in 2024, establishing the foundational structure of the provincial heritage conservation system. Key legislative milestones include the Regulations on the Protection of Intangible Cultural Heritage in Huangnan Tibetan Autonomous Prefecture (February 27, 2025), alongside the formulation of the Qinghai Provincial Urban-Rural Historical and Cultural Conservation and Inheritance System Plan and the Huangnan Prefecture Concentrated Conservation and Utilization Special Plan. The Approval Regulations for Conservation Planning of Qinghai's Historical and Cultural Cities, Towns, Villages, and Districts have been implemented, with all national-level conservation plans having secured provincial government approval. Collaborative efforts with the Provincial Publicity Department and relevant bureaus have resulted in the 2024 Key Tasks for Urban-Rural Historical and Cultural Conservation and Inheritance, alongside the issuance of standards such as the Qinghai Provincial Guidelines for Village Appearance Enhancement and the Qinghai Provincial Standards for Traditional Village Conservation and Utilization. A comprehensive regulatory mechanism has been established through the introduction of identification protocols, management regulations, accountability measures, planning approval procedures, inspection systems, and expert advisory committee frameworks, supplemented by annual assessments, patrol inspections, and public interest litigation initiatives. This multi-pronged approach has engendered a deterrent effect against heritage damage, ensuring robust protection and oversight.

2.3 Spatial Distribution of Cultural Heritage in Qinghai

2.3.1 Regional Distribution of Cultural Heritage

Table 1 summarizes the distribution of cultural heritage sites across Qinghai's 8 prefecture-level cities. Based on administrative boundaries, Haidong City holds the highest count of both national and provincial-level protected sites, while Golog Tibetan Autonomous Prefecture has the fewest. Huangnan Tibetan Autonomous Prefecture is home to Qinghai's sole national-level historical and cultural city, while Haidong City contains the province's only national-level historical and cultural town and the majority of traditional villages.

Aggregating all categories, Xining City boasts 98 heritage sites; Huangnan Prefecture, 62; Golog Prefecture, 30; Hainan Prefecture, 81; Haidong City, 245; Haixi Prefecture, 43; and Yushu Prefecture, 106. The ranking of prefecture-level cities by heritage site quantity is as follows: Haidong City, Yushu Prefecture, Xining City, Hainan Prefecture, Huangnan Prefecture, Haixi Prefecture, and Golog Prefecture.

Table 1 Administrative distribution of cultural heritage in Qinghai Province

Order number	City	Cultural heritage sites		Settlement						
		National	Provincial	National	A	A famous	Provincial	A famous	Provincial	Special
		Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade
1	Sining City	0	12	0	1	0	2	0	4	22
2	Tibetan Autonomous Prefecture of Huangnan	1	10	1	1	0	1	1	0	14
3	Tibetan Autonomous Prefecture of Golog	3	12	0	0	0	1	1	1	0
4	Tibetan Autonomous Prefecture of Hainan	1	10	0	1	0	2	0	0	0
5	Deqin City	16	120	0	0	1	2	1	10	20
6	Haidong City and Tibetan Autonomous Prefecture	1	27	0	0	0	1	0	0	0
7	Tibetan Autonomous Prefecture of Haibei	4	26	0	0	0	0	0	0	0
8	Tibetan Autonomous Prefecture of Yushu	2	10	0	1	0	1	2	0	22
9	Total	31	440	1	4	1	11	5	16	107

Figure 1 spatially locates cultural heritage sites in Qinghai Province using ARC GIS geographic information data, revealing distinct geographical distribution patterns between cultural resources and natural landscapes within the region.

Historical and cultural cities, towns, villages, and traditional villages predominantly cluster in basin and valley regions. The Hehuang Basin exhibits particularly high density, while valley areas along the Tongtian River (Yangtze River), Yellow River, and Zhaqu River (Lancang River) also serve as critical settlement zones for these heritage communities.

Protected cultural relics similarly concentrate in basin and valley terrain, with the Hehuang Basin remaining the most densely populated area. Substantial numbers of protected sites also line the river valleys of the Tongtian River, Yellow River, and Zhaqu River.

Scenic areas demonstrate strong correlation with mountainous and fluvial geomorphology, typically following mountain ranges and river courses. The Yellow River corridor hosts exceptionally high concentrations of scenic sites, with additional significant clusters in the Qilian Mountains and Kunlun Mountains regions.

The Qinghai section of the Silk Road cultural belt primarily extends through valley and basin zones, with the Hehuang Basin constituting its core distribution area and the Qaidam Basin serving as another key component.

The Qinghai-Tibet Railway cultural belt predominantly follows basin areas and railway corridors, maintaining high density in the Hehuang Basin while also exhibiting significant resource distribution along the Qinghai-Tibet Railway route.

The Tang-Tibet Ancient Road cultural belt similarly favors basin and valley topography, with the Hehuang Basin as its densest concentration zone and valley areas along the Tongtian River, Yellow River, and Zhaqu River forming additional critical distribution regions.

Other heritage remains broadly distribute across basin, valley, and transportation corridor zones, showing highest concentration in the Hehuang Basin while also appearing in valley areas along the Tongtian River, Yellow River, and Zhaqu River, as well as along the Qinghai-Tibet Railway.

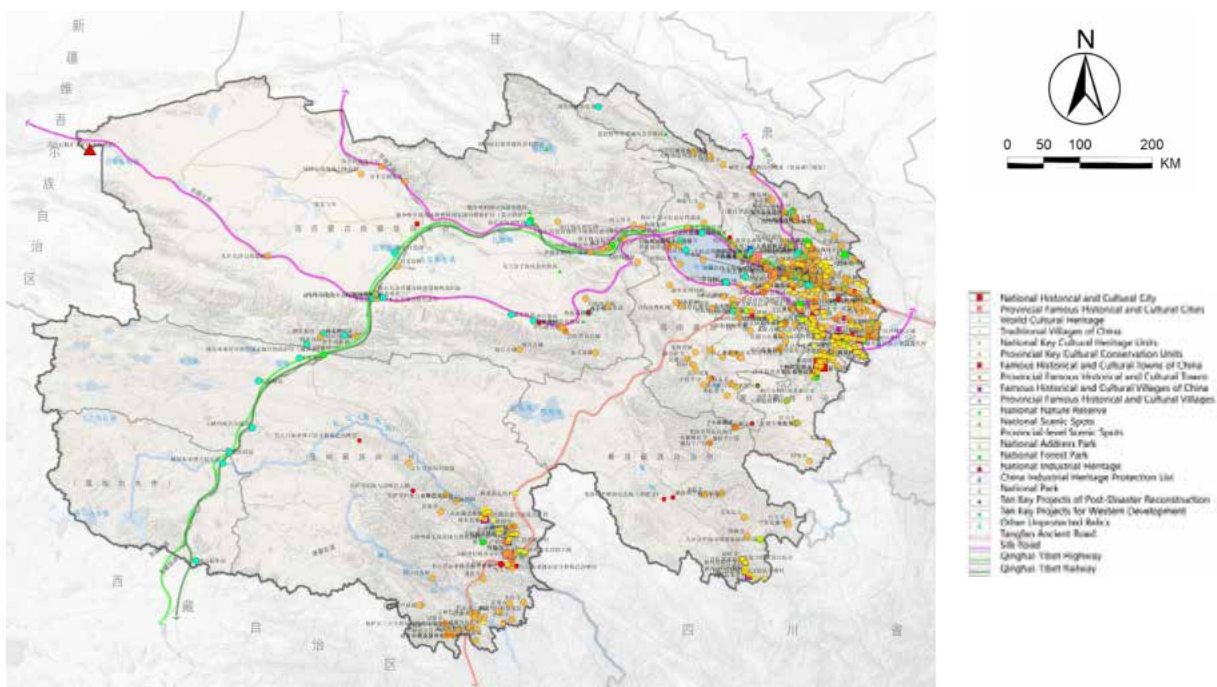


Figure 1 Distribution Map of Historical and Cultural Heritage Sites in Qinghai Province

2.3.2 Analysis of Cultural Heritage Conservation and Utilization Efficiency in Qinghai Province

An integrated analytical framework for historical and cultural heritage conservation-utilization efficiency was developed by synthesizing: (1) An integrated resistance surface model incorporating natural factors (elevation, slope, land use type, road proximity, river proximity) (2) Specialized assessments of heritage site vulnerability, environmental threats, and management efficacy. This framework enables the demarcation of five vulnerability tiers and the formulation of tiered conservation strategies.

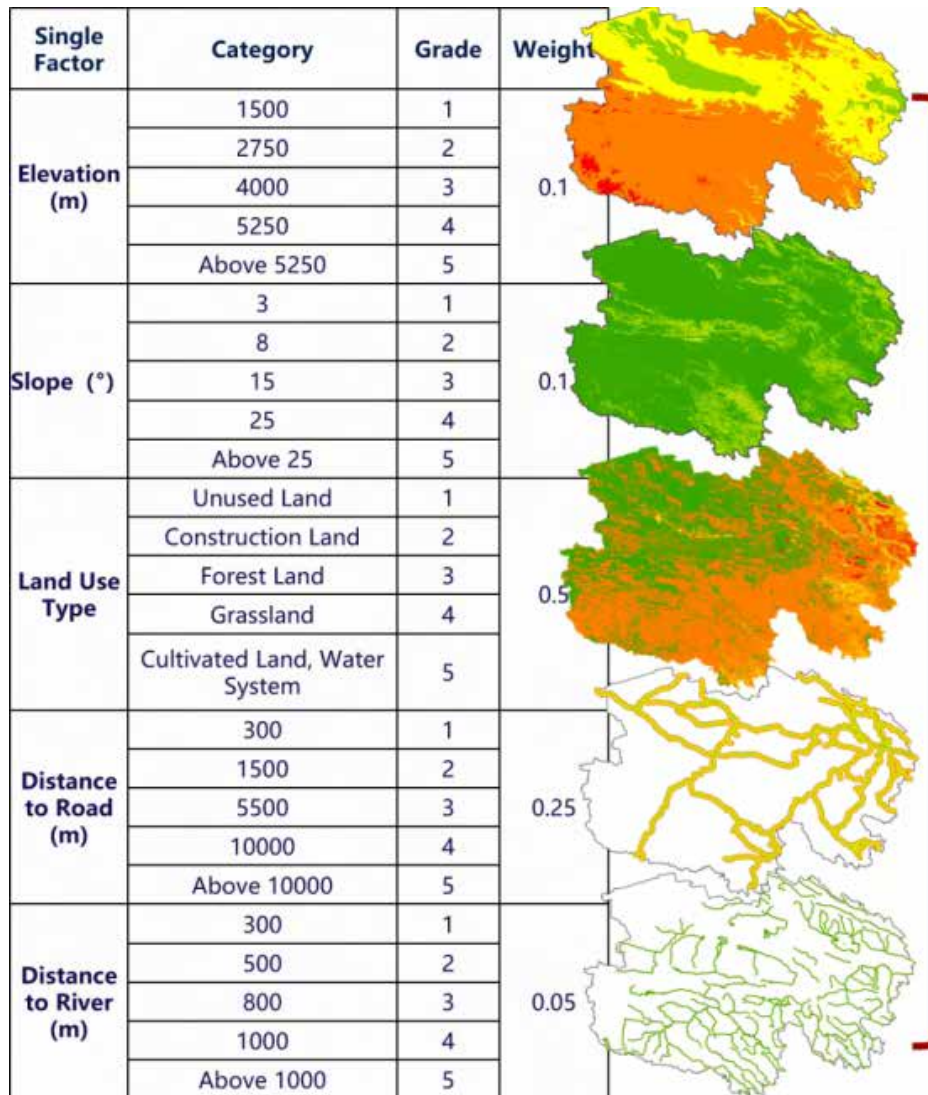


Figure 2 Comprehensive resistance surface model diagram

(1) Cultural Heritage Vulnerability Assessment and Tier Classification

Through the integration of natural factor resistance surfaces with specialized assessments (heritage asset vulnerability, environmental risks, management performance), a five-tier vulnerability classification system for Qinghai's cultural heritage sites was established (Table 2). This tiered structure clarifies conservation priorities and management focuses across different vulnerability levels.

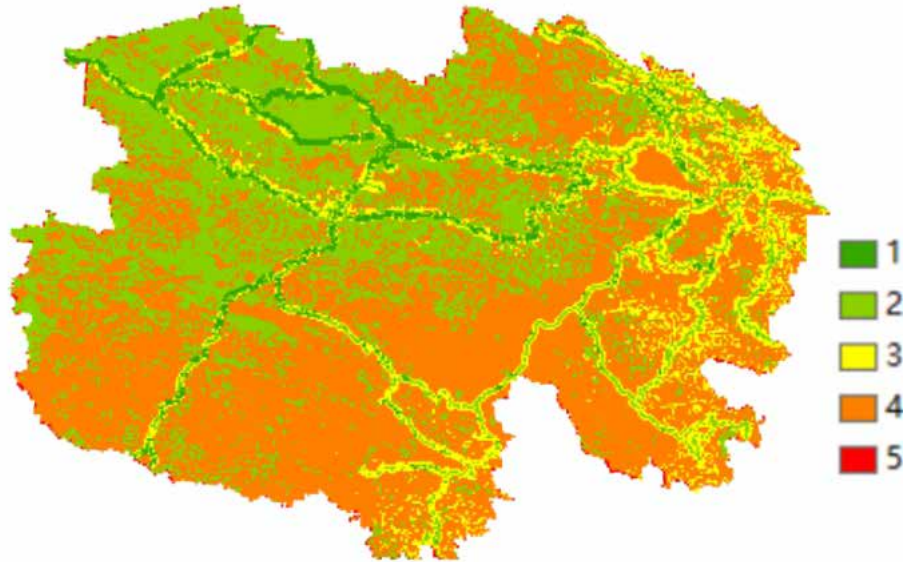


Figure 3 Cultural Heritage Vulnerability Assessment and Grading Diagram

Vulnerability Level	Natural Resistance Characteristics	Preservation Status of the Object	Environmental Threat	Management Efficacy	Typical Case
Level I (Slightly Vulnerable)	Low-resistance area	The object is intact, with a disease rate <5%	Low risk of natural disasters, weak human activity interference	High protection level, monitoring coverage >90%	Dongguan Mosque in Xining, Zhenda Temple
Level II (Mildly Vulnerable)	Lower-resistance area	Slight disease (5%-15%)	Relatively low risk of natural disasters, controllable human activity interference	Relatively high protection level, monitoring coverage 70%-90%	Kumbum Monastery murals in Haidong
Level III (Moderately Vulnerable)	Medium-resistance area	Structural stability decline (disease rate 15%-30%)	Moderate risk of natural disasters, significant human activity interference	General protection level, monitoring coverage 50%-70%	Zongri Site in Hainan Prefecture
Level IV (Severely Vulnerable)	Higher-resistance area	Endangered state (disease rate >30%)	High risk of natural disasters, strong human activity interference	Low protection level, monitoring coverage <50%	Jia Mani Stone Carvings in Yushu Xinzai
Level V (Extremely Vulnerable)	High-resistance area	Urgent need for rescue protection (disease rate >50%)	Extremely high risk of natural disasters, severe human activity damage	No effective management measures	Red Army Long March Inscription in Golog

(2) Integrated Conservation-Utilization Analysis

Superimposing cultural heritage vulnerability tiers onto the integrated resistance surface model reveals spatial patterns of conservation-utilization efficiency, categorized into five levels:

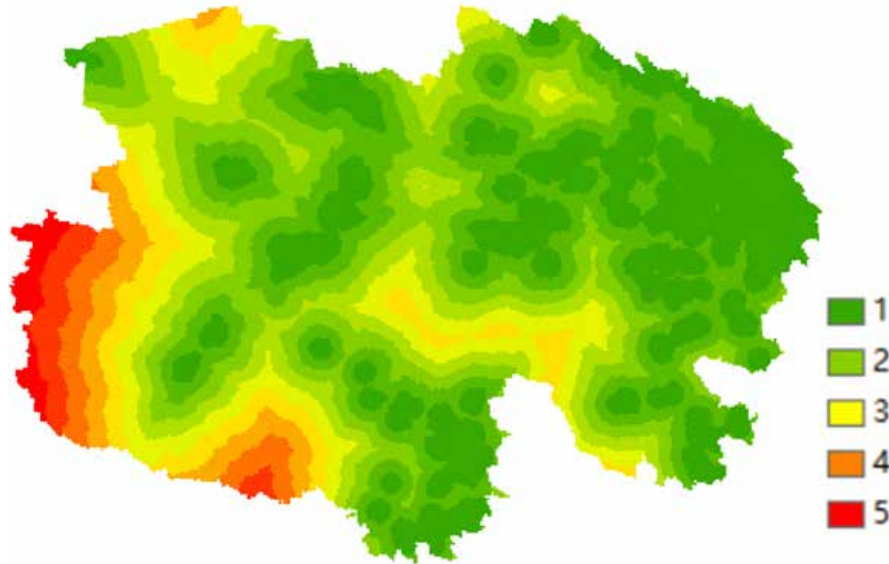


Figure 4 Comprehensive protection and utilization degree analysis diagram

Priority Conservation Zones (Tiers I-II): Predominantly located in the Hehuang Valley and eastern agricultural regions characterized by low natural resistance and minimal-to-mild heritage vulnerability. Strict in-situ preservation measures and development controls are mandatory. **Stringent Conservation Zones (Tier III):** Concentrated in the Loess Plateau-Qinghai-Tibet Plateau transition zone with moderate natural resistance and medium heritage vulnerability. Visitor capacity limits and enhanced monitoring/maintenance protocols are required. **Conservation-Oriented Utilization Zones (Tier IV):** Dispersed across the Three-River Source core zone and periphery, marked by high natural resistance and severe heritage vulnerability. Limited cultural experience projects may be permitted under stringent construction intensity controls. **Moderate Development Zones (Select Tier V Areas):** Restricted to rare areas with extremely low natural resistance and extreme heritage vulnerability. Digital exhibition formats represent potential conservation modalities.

Cautious Development Zones (Most Tier V Areas): Characterized by high natural resistance and extreme heritage vulnerability, these zones prohibit development in principle, restricting access to scientific research and emergency conservation activities.

(3) Spatial Adaptability and Management Recommendations

Qinghai's cultural heritage conservation-utilization efficiency exhibits a spatial pattern of "concentrated protection in the east, prudent utilization in the west," necessitating differentiated management strategies aligned with regional realities.

① Hehuang Valley: Living Heritage Preservation in Cultural Hubs

As Qinghai's most densely populated heritage region, the Hehuang Valley hosts national-level protected sites like the Lajia Ruins and Machangyuan Ruins, alongside intangible heritage such as Regong Arts and Hehuang Hua'er folk songs. Conservation priorities include: **Living Heritage and Community Engagement:** Transitioning from isolated preservation to mass participation, as demonstrated by the Huangzhong District "Eight-Petal Lotus" ICH Experience Center. Programs like Xining's "ICH in Schools" initiative (recognized as a national best practice) enhance community involvement.

Ecomuseum Model: Expanding the Regong Arts Ecological Protection Zone concept across heritage-rich areas, integrating cultural landscapes, traditional villages, and natural environments while resisting over-commercialization.

Digital Conservation and Dissemination: Leveraging digital technologies for heritage documentation and exhibition, exemplified by digital archives for 128 historic structures and traditional villages, coupled with online ICH dissemination platforms.

② Three-River Source Region: Ecological-Cultural Synergy

As China's "water tower," this region's heritage intertwines with alpine ecosystems (e.g., Qumalai alpine nomadic systems, Gesar epic traditions). Conservation strategies emphasize: **Eco-Friendly Utilization:** Balancing heritage preservation with ecosystem integrity, such as Qumalai County's integration of pasture resources through ecological livestock cooperatives, merging traditional nomadism with modern management to restore grasslands.

Traditional Knowledge Databases: Documenting nomadic cultural lexicons, proverbs, and ecological ethics (e.g., "The grassland is our mother; livestock are our children") to strengthen cultural identity through educational outreach.

Eco-Management Integration: Incorporating heritage conservation into the Three-River Source National Park's ecological management framework, training herders as dual cultural-ecological stewards through "cultural ranger" positions.

③ Southern Qinghai Plateau: Emergency Conservation in High-Vulnerability Zones

Regions like Golog and Yushu face challenges from high natural resistance and management difficulties (e.g., fading Red Army slogans, aging Gesar epic custodians). Interventions include: **Emergency Documentation and Restoration:** 3D scanning of endangered rock art and stone inscriptions, coupled with conservation laboratories for weathered artifacts.

Custodian Support Programs: Increasing stipends for ICH custodians and offering subsidies for apprenticeship training (e.g., Qinghai's ¥10,000 annual grants to provincial-level custodians).

Cross-Regional Collaboration: Joint protection mechanisms with Tibet and Sichuan for trans-regional heritage (e.g., Gesar culture), including shared databases and cooperative frameworks.

④ Policy and Institutional Safeguards

Regulatory Enhancement: Revising the Qinghai Provincial Intangible Cultural Heritage Protection Regulations to clarify rights/responsibilities and strengthen enforcement. **Dynamic Monitoring System:** Establishing a heritage spatial database for real-time environmental (seismic, flood) and anthropogenic threat monitoring, with vulnerability tiers subject to dynamic adjustment. **Diversified Funding:** Supplementing fiscal allocations with social capital participation, such as ICH protection funds and heritage lottery programs.

2.3.3 Kernel Density Analysis of Cultural Heritage and Spatial Network Construction for Heritage Conservation in Qinghai

(1) Kernel Density Analysis of Heritage Distribution

Based on the spatial distribution characteristics, significance, and internal relationships of historical and cultural heritage, kernel density analyses were conducted for six categories: historical and cultural cities, towns, and villages; traditional villages; protected cultural relics; scenic areas; revolutionary heritage sites; and cultural route heritage sites. These analyses revealed the comprehensive spatial distribution patterns of provincial historical and cultural resources. Key findings include: an absolute concentration zone in the Hehuang Basin, which benefits from favorable natural conditions and transportation accessibility; secondary density belts along

the valleys of major rivers such as the Tongtian River, Yellow River, and Zhaqu River; aggregation zones along transportation corridors (e.g., Qinghai-Tibet Railway, historical Silk Road Qinghai section, Tang-Tibet Ancient Road) and connected basins like the Qaidam Basin; and a distinct distribution pattern for scenic areas, which primarily align with mountain ranges (Qilian Mountains, Kunlun Mountains) and river courses, particularly the Yellow River. Overall, basins, valleys, and transportation arteries are identified as the three critical geographic factors shaping Qinghai's cultural heritage spatial structure.

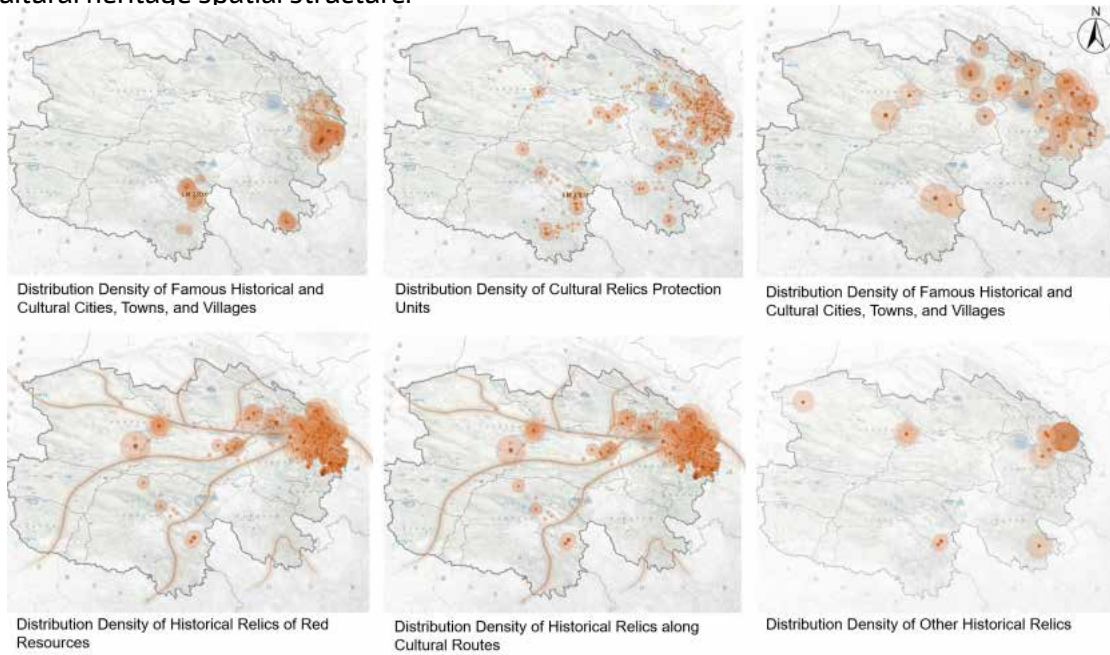


Figure 5 Analysis diagram of kernel density by type

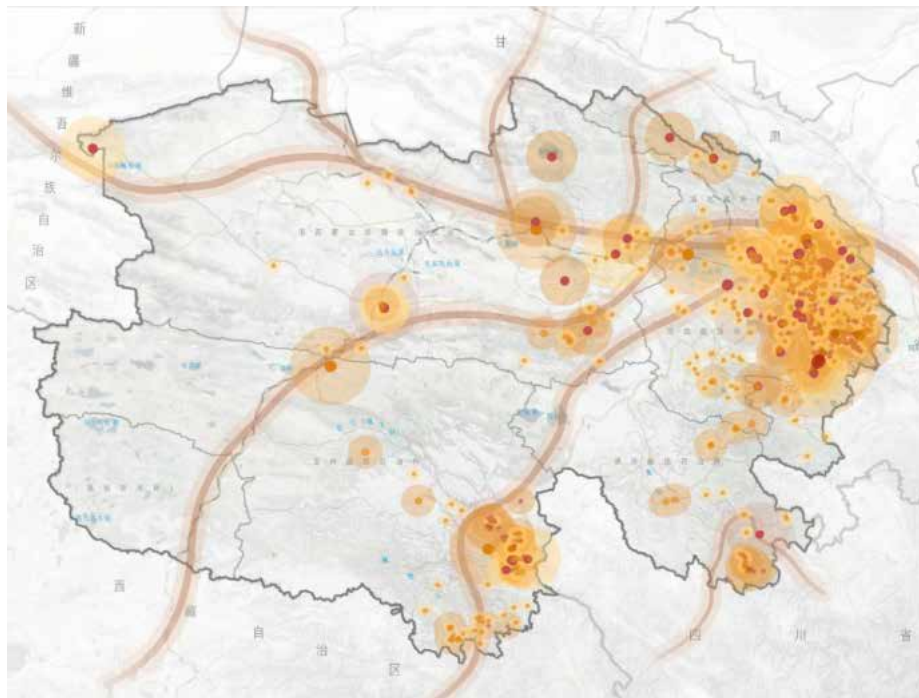


Figure 6 General diagram of nuclear density analysis

(2) Construction of the “Three Cores, Three Corridors” Heritage Conservation Spatial Network
Based on kernel density analysis results and the intrinsic connections among heritage sites, a spatial conservation network was constructed.

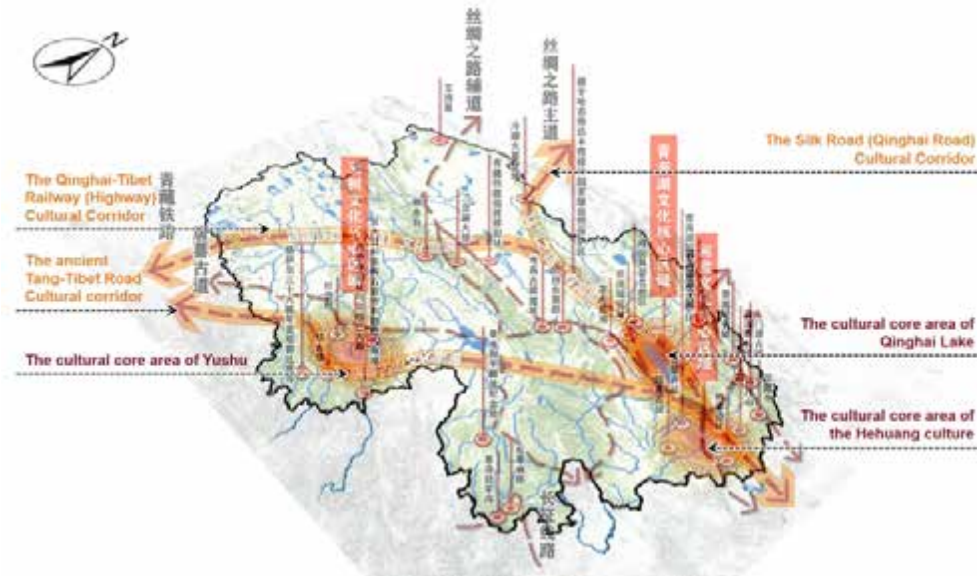


Figure 7 Spatial network structure diagram for Heritage protection

This network integrates the natural and cultural geographic patterns, historical and cultural context elements, and provincial heritage value priorities. It comprises three cultural cores and three cultural corridors: the three cores include the Hehuang Cultural Zone (encompassing Xining, Haidong, Haibei, and Huangnan prefectures), the Qinghai Lake Cultural Zone (including Haiyan, Gonghe, Tianjun, and Gangcha counties), and the Yushu Cultural Zone (covering Yushu Prefecture); the three corridors include the Tang-Tibet Ancient Road Cultural Belt (along National Highway 214), the Qinghai-Tibet Railway Cultural Belt (along National Highway 109), and the Silk Road (Qinghai Route) Cultural Belt (along National Highway 315).

3 Cultural Heritage Conservation Strategies for Qinghai within Complex Systems

For a prolonged period, the field of historic urban conservation has been trapped in a monolithic mindset, excessively focusing on conservation methodologies themselves while relentlessly pursuing technical perfection and flawless planning outputs. However, insufficient attention and research have been directed toward understanding the fundamental attributes and inherent operational mechanisms of historical-cultural heritage carriers. This fragmented approach has hindered our ability to comprehensively examine conservation and development issues within historic cities under the macroscopic framework of spatial complex systems.

In practical implementation, these limitations manifest prominently. During urban renewal processes, drastic demolition-and-reconstruction approaches have severely disrupted the traditional urban fabric, gradually eroding historical values and cultural functions. Conversely, when formulating conservation plans, an overemphasis on preservation controls often neglects the developmental and renewal needs of historic cities, resulting in planning frameworks that struggle to adapt to evolving realities and urban growth dynamics.

Confronting this dilemma, the heritage conservation community faces a critical challenge: how to respect the fundamental characteristics of historic cities while adhering to general urban development patterns, thereby identifying viable pathways for their conservation and evolution. Fortunately, this discourse is gaining increasing global attention.

The 2005 Vienna Memorandum offers valuable insights, particularly through its exploration of World Heritage conservation and historic landscape preservation amid rapid urbanization—a document commended by the 29th session of the World Heritage Committee. It explicitly identifies the paramount challenge of balancing modern development, urban transformation, and socio-economic harmony when introducing new constructions into historic environments. The memorandum underscores the necessity of prioritizing cultural and historical factors in such contexts, ensuring the integrity and authenticity of heritage structures while achieving synergistic outcomes for both conservation and urban advancement.

The 2011 UNESCO Recommendation on the Historic Urban Landscape further deepens our comprehension of historic city conservation, asserting that historic urban areas represent humanity's richest and most diverse cultural heritage expressions—critical testaments to collective human endeavors and aspirations. Simultaneously, urban heritage constitutes not merely social, cultural, and economic assets but also bridges connecting past and future. That same year's Valletta Principles for the Conservation and Management of Historic Cities, Towns and Urban Centres positions heritage as a vital component of urban ecosystems, emphasizing that conservation entails not only preservation, protection, reinforcement, and management but also harmonious integration with contemporary life.

These international instruments provide crucial theoretical frameworks and practical guidance for exploring effective models of historic city conservation and development. Moving forward, deeper inquiry into the fundamental attributes and intrinsic mechanisms of historic cities is essential to adopt a more holistic, scientific perspective in addressing conservation and development challenges.

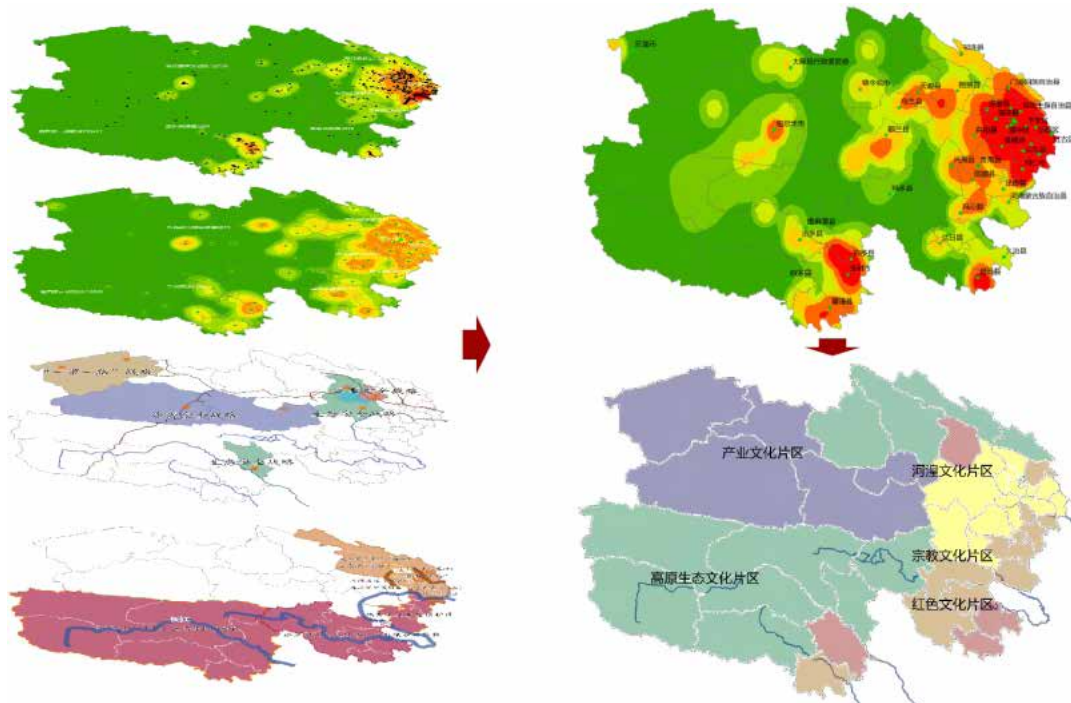


Figure 8 Path of revitalization and utilization of cultural heritage

4 Conclusions

The integrity of protection and transmission urgently needs strengthening. The work of protecting and transmitting urban and rural historical culture lacks overall provincial coordination and vertical linkage. A

provincial-level historical and cultural value system has yet to be established, resulting in unclear direction and focus for protection and transmission efforts. A collaborative protection mechanism between the province and cities/counties is absent, leaving the specific responsibilities, missions, and priorities of different cities and counties undefined, preventing the formation of a unified provincial effort ("playing chess as one province"). The coverage of protection work urgently needs expansion. Currently, Qinghai Province possesses only 1 National Famous Historical and Cultural City, 10 Famous Chinese Historical and Cultural Towns/Villages, and 4 Historical and Cultural Districts, significantly lagging behind other provinces. In reality, many urban and rural heritage sites bearing important historical and cultural value remain unlisted for protection. Heritage resources reflecting historical memories and values from key periods like the 100th anniversary of the CPC, the 70th anniversary of the PRC, and the 40th anniversary of Reform and Opening-up have not been fully explored or protected. Cross-regional and cross-jurisdictional historical and cultural corridors and routes, such as the Tang-Tibet Ancient Road and the Qinghai-Tibet Railway, lack integrated protection.

The scientific rigor and rationality of protection and transmission urgently need enhancement. There is a widespread tendency to focus on protecting individual heritage buildings or historical structures while neglecting the preservation and continuity of the overall urban/rural landscape pattern, traditional regional character, and cultural environment. In some urban construction projects, the destruction of original topographic features and the overall setting of historical and cultural heritage has occurred, damaging the protection of overall townscape, height control, and visual corridors, resulting in "bonsai-style" protection (isolating relics from their surroundings). Protection and renewal efforts in some historical and cultural districts or areas have severed the original social fabric and living networks.

In the contemporary era, urban and rural cultural heritage, as a vital component of a complete cultural ecosystem, is experiencing continuous expansion and deepening of its connotation and extension. It is no longer confined to singular cultural elements or physical carriers but extends to the complex interactions between different cultures, and between culture and the natural environment, along with their profound impacts. This comprehensive expansion endows urban and rural cultural heritage with diversified values, encompassing profound historical value, unique cultural value, captivating aesthetic value, significant social value, and potential economic value, among other dimensions.

Given the richness and complexity of urban and rural cultural heritage values, protective actions have far surpassed the scope of traditional cultural relics preservation, evolving into a complex social systems engineering project involving multiple domains such as politics, economy, society, culture, and management. This necessitates comprehensive, multi-level expansion and exploration in our protection efforts.

Cognitively, we need to re-examine the value and significance of urban and rural cultural heritage, deepening our understanding of its cultural essence and ecological value.

Theoretically, a more robust theoretical system for the protection of urban and rural cultural heritage should be constructed to provide scientific guidance for practice.

Technically and methodologically, innovative conservation techniques and methods must be continuously developed to enhance the scientific rigor and effectiveness of protection work.

In terms of implementation and strategy, long-term, systematic protection plans need to be formulated to ensure the continuity and stability of conservation efforts.

Simultaneously, the protection of urban and rural cultural heritage must transcend the singular concept of space and be considered within a broader cultural-ecological context. This implies a shift from specialized technical fields towards integrated domains where society, economy, politics, and culture intersect, requiring interdisciplinary and cross-sectoral collaboration.

To achieve this goal, we need to conduct comprehensive and in-depth integrated surveys and assessments of value, current status, and management, accurately grasping the situation and challenges of urban and rural cultural heritage. Based on this, establish a core-value-based protection system for urban and rural cultural heritage to ensure targeted and effective conservation work.

Furthermore, urban and rural cultural heritage protection should emphasize a people-oriented philosophy, focusing on strengthening the formulation and implementation of public policies. By establishing coordination mechanisms involving multiple departments and public participation, we can fully mobilize the initiative and proactiveness of all stakeholders – government, enterprises, social organizations, and the public – fostering a positive atmosphere of collective participation and protection. Only in this way can we steer urban and rural cultural heritage protection towards a dynamic, proactive, inclusive, and diverse path of sustainable development.

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