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Research on the Development Pattern Optimization of China's Central Plains Urban Agglomeration from the Perspective of Historical and Cultural Resources

Guangyuan Feng, Jingxiang Zhang, Zhen Zhou, Handong Wang, Jiale Zu and Zeyu Zhou
School of Architecture and Urban Planning, Nanjing University, Nanjing 210093, China

Abstract: China is one of the countries with the longest history in the world. The protection and development of historical and cultural resources is an issue worthy of attention in the fields of economic geography and urban-rural planning at the present stage. This study takes the Zhongyuan Urban Agglomeration, which is rich in historical and cultural heritage, as a specific case, analyzes the characteristics of the spatial-temporal distribution pattern of its historical and cultural resources. The results show that the distribution structure of historical and cultural element resources within the Zhongyuan Urban Agglomeration presents significant regional agglomeration and combination characteristics. In response to the analysis results, the study formulates an optimization strategy for the regional development pattern supported by the protection and development of historical and cultural resources, and initially proposes a matching spatial development pattern plan and policy recommendations for coordinated development.

Key words: Historical and cultural resources, regional development pattern, point pattern analysis, central plains urban agglomeration.

1. Introduction[1]

China has a long history and splendid civilization, and the Central Plains region with Henan Province as the main body is the birthplace of the Chinese nation and Chinese civilization. Historically, from the Xia Dynasty to the Song Dynasty, the Central Plains has always been the political, economic and cultural center of China. More than 20 dynasties have established or moved their capitals here. Among the eight ancient capitals of China, Luoyang, Kaifeng, Anyang and Zhengzhou are four ancient cities in the Central Plains. It is the area with the largest number of dynasties, the longest history of capital establishment and the largest number of ancient capitals in China [1].

This study takes the Central Plains Urban Agglomeration approved by the State Council in 2016 as the research scope (Fig. 1), involving 5 provinces and 30 cities [2]. The Central Plains Urban Agglomeration, as the urban concentration area with the richest historical and cultural resources in China, is still lacking development work for its own historical and cultural value, and there are many problems to be solved. In recent years, the historical and cultural resources within the Central Plains Urban Agglomeration have been continuously destroyed, and the existing high-quality resources are decreasing. It is urgent to intervene and protect through planning.

Therefore, the following questions are raised: (1) What are the temporal and spatial distribution characteristics of historical and cultural resources in the Central Plains Urban Agglomeration? (2) How to give full play to the value of historical and cultural resources in regional development? At present, there is a relative lack of relevant research on this topic in the academic community, which has not attracted enough attention.

Corresponding author: Jingxiang Zhang, Ph.D., professor and PhD supervisor, research fields: urban regional development strategy, urban and rural spatial governance.

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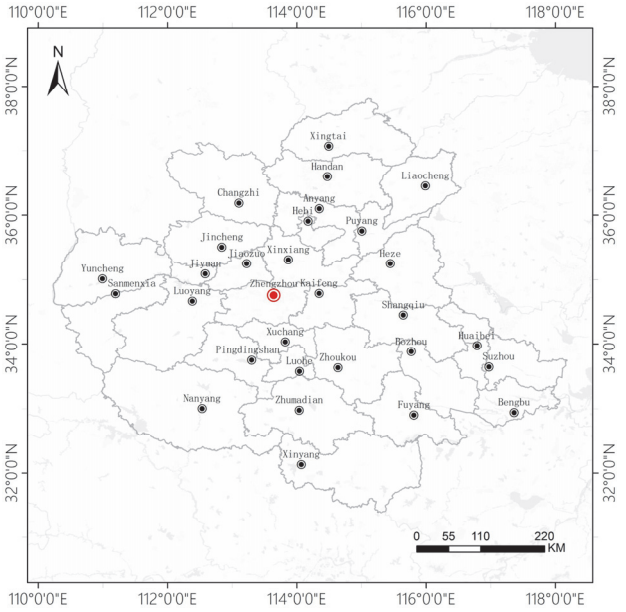

Fig. 1 Study area: the Central Plains Urban Agglomeration.

The strategic planning at the national and regional levels has put forward new requirements for the development and protection of the historical resources of the Central Plains Urban Agglomeration. Therefore, it is urgent and necessary to study the overall development pattern of the Central Plains Urban Agglomeration from the perspective of historical and cultural resources.

2. Data Sources and Research Methods

2.1 Data Sources

The key data source is the POI (point of interest) of the historical and cultural resources of 30 prefecture level cities within the Central Plains Urban Agglomeration. The auxiliary analytical data mainly include: (1) The permanent population and GDP (gross domestic product) data of prefecture level cities; (2) City search index information flow data; (3) Traffic network and passenger transport frequency data of high-speed rail; (4) NDVI (normalized difference vegetation index), terrain (DEM: Digital Elevation Model) and water system data, land use data (ESA (European Space Agency) worldcover), soil texture types and precipitation related data.

2.2 Methodology

2.2.1 Research Concept

The development of historical and cultural resources is directly and indirectly influenced by many factors. Through summarizing relevant literature [3-5], this study extracted four key elements: urban system, social economy, regional transportation, and ecological pattern, and conducted a comprehensive analysis of the development of the Central Plains Urban Agglomeration under macro conditions and higher-level planning background.

2.2.2 Research Methods

(1) L-Function Method

A commonly used point pattern analysis method introduces spatial scale and generates statistical data for spatial clustering based on a certain search range radius. In this study, the L-function is introduced to determine the spatial distance of regional historical and cultural resource points in the maximum aggregation state, which is the characteristic scale of the spatial pattern of historical and cultural resources. The calculation formula is as follows:

$$L(d) = \sqrt{\frac{A\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N} k(i,j)}{\pi N(N-1)}} \tag{1}$$

In the formula, A is the area of the region, N is the number of points, d is the distance threshold, and $k(i, j)$ is the weight. When the distance between i and j is less than or equal to d, the given weight is 1, and when the distance is greater than d, the weight is 0.

$$f(x,y) = \frac{1}{nh^2}\sum_{i=1}^{n} w_j k(\frac{d_i}{h}) \tag{2}$$

In this expression, $f(x, y)$ is the density estimate of the spatial position at (x, y), h is the bandwidth or smoothing parameter, which can be set according to the scale $L(d)$ mentioned above, and d_i is the distance from the (x, y) position to the observation position; N is the observation value, $k(x)$ is the Gaussian kernel function, and w_j is the weight of level j.

(2) Geographic Network Model

The study uses geographic network to analyze the spatial combination of different types of historical and cultural resources, and uses correlation matrix to express it. The vertices in the network graph represent the center points of different types of historical and cultural resources, while the edges between the vertices represent the combination of different types of historical and cultural resources. The vertex set V of graph $G=(V,E)$ is an n-order correlation matrix, and the edge E is a constraint function.

$$G(V_{ij}) = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1m} \\ v_{21} & v_{22} & \cdots & v_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ v_{n1} & v_{n2} & \cdots & v_{nm} \end{bmatrix} \tag{3}$$

$$G_h(E_{ij}) = \begin{cases} 0 & (s > h) \\ \sum_{i=1}^{n} E_{ij} & (s \le h) \end{cases} \tag{4}$$

V_{ij} is the relationship between v_i and v_j, indicating the type of historical and cultural resources; E_{ij} is the actual number of interconnection edges between i nodes directly connected to j nodes, s is the distance between v_i and v_j, and h is the distance threshold.

3. Analysis of Spatial Pattern of Historical and Cultural Resources

3.1 Spatial Distribution Characteristics of Cultural Relics Protection Units

3.1.1 Overall Spatial Distribution Pattern

According to the weighted analysis of the core density of historical and cultural resources (Fig. 2), the spatial distribution pattern of cultural protection units in the Central Plains Urban Agglomeration is obtained. It is found that it has an obvious continuous accumulation trend, showing a "corridor multi-core" structure of "high in the West and low in the East, high in the North and low in the South". The "cross" shaped gathering corridor is composed of a vertical corridor from Liaocheng to Nanyang and a horizontal axis from Bozhou to Luoyang; The "1+3+N" agglomeration centers are the regional agglomeration centers formed in the northwest of the region, the three main local agglomeration centers of Zhengzhou-Kaifeng-Luoyang, Changzhi-Jincheng, Xingtai-Handan-Anyang, and several other general local agglomeration centers such as Yuncheng.

In order to determine the analysis scale of the regional spatial pattern, the Ripley's K function was used to analyze the characteristic scale of the spatial distribution pattern of the national key cultural relics protection units in the Central Plains Urban Agglomeration. It can be seen from Table 1 that the ObservedK curve of cultural protection units within 270 km is higher than the ExpectedK curve (high confidence interval), which explains the clustering distribution of cultural protection units. With the increase of distance, the ObservedK curve first gradually moves away from the ExpectedK curve, and then gradually moves closer. The DiffK enters the steady state at 130 km and reaches the maximum value, at which time the aggregation degree of spatial distribution reaches the maximum value. Therefore, 130 km is selected as the analysis scale of regional spatial pattern.

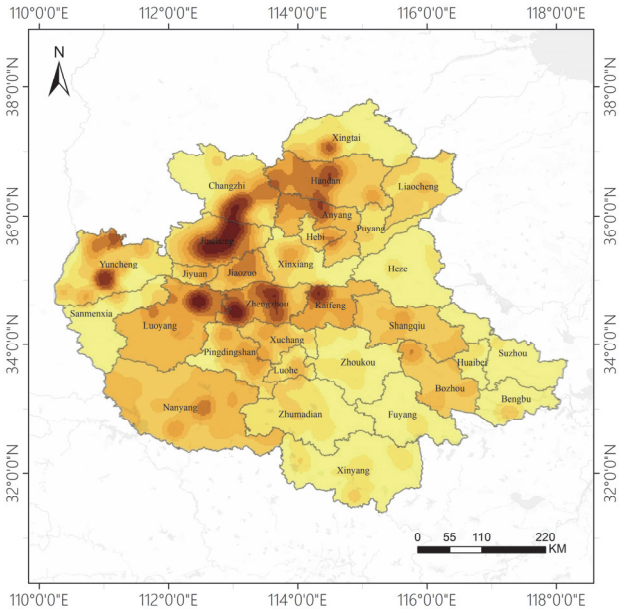

Fig. 2 Weighted density of historical and cultural resources.

Table 1 Value distribution of K-function related indicators.

ExpectedK (Unit: m)	ObservedK (Unit: m)	DiffK	LwConfEnv	HiConfEnv
101,000	140,511.6087	39,511.60873	92,465.77	95,509.41209
108,000	147,962.8297	39,962.8297	98,244.83037	101,567.8093
115,000	155,782.8747	40,782.8747	104,018.7387	107,698.1283
122,000	163,455.6772	41,455.67721	109,655.8373	113,746.2456
129,000	170,999.8268	41,999.82679	115,251.1781	119,594.3481
136,000	177,943.3985	41,943.39845	120,719.8595	125,453.6088
143,000	184,964.5703	41,964.5703	126,118.4569	131,445.9901
150,000	191,704.6239	41,704.62389	131,478.0376	137,096.9764

Taking 130 km as the threshold, the geographical network model of historical and cultural resources was established, and the connection structure based on spatial proximity was found. It was found that the connection in the northwest of the region was dense, and the connection to Nanyang, Zhumadian, Shangqiu, Huaibei, Liaocheng and other places was sparse linear.

In order to further simplify the network structure, the peak point extraction method on the gradient weighted kernel density map is used to screen the main cultural protection units located in the high value center of the weighted kernel density. Based on the selected cultural spots in the "peak area", the geographic network skeleton of cultural relics protection unit points was extracted with 130 km as the threshold; It is found that there are three main structural types, namely, the network area, the corridor connection area and the blank area. Then, the spatial connection structure in local areas was further explored at 65 km and 50 km respectively, and it was found in Zhengzhou-Kaifeng-Luoyang-Jincheng, Pingdingshan-Luohe-Zhoukou, Handan-Xingtai, Xinxiang-Hebi-Anyang-Puyang; Liaocheng, Sanmenxia, Changzhi and other regions have strong local ties.

3.1.2 Spatial Distribution Characteristics of Different Types and Historical Periods

A total of 751 cultural relics protection units in six batches were counted by type and age. In terms of types, there are six categories, including ancient buildings, ancient sites, ancient tombs, representative buildings of modern and contemporary important historical sites, cave temples and stone carvings, and others, of which ancient buildings and ancient sites are the main ones; In terms of time, it can be divided into seven categories: Pre-Qin, Qin and Han Dynasties, Wei Jin Southern and Northern Dynasties, Sui Tang and the Five Dynasties, Song and Yuan Dynasties, Ming and Qing Dynasties, and modern times, with the cultural protection units in Pre-Qin, Song and Yuan Dynasties, and Ming and Qing Dynasties as the main ones.

Using the peak point extraction method, the high value centers of nuclear density of the main types of cultural relics protection units and the main age cultural relics protection units were extracted (Fig. 3). There are 136 high-value centers by type and 133 high-value centers by age. The characteristic scale of the spatial distribution pattern of the national key cultural relics protection units in the Central Plains Urban Agglomeration is analyzed. The result is 80 km. Taking this as the threshold, the geographical network model of the peak point is established to find the contact structure based on spatial proximity by type and age.

Using a geographic network analysis method with a threshold of 80 km, different types of cultural resource spatial connection matrices and spatial combination relationships were obtained. In terms of overall connection strength, ancient architecture has formed the closest connection with other types of historical and cultural resources, especially the connection between ancient architecture and grotto temples. This is related to the large number of stone carvings in ancient architecture

and grotto temples, as well as their widespread distribution; The connections between ancient tombs and sites are relatively limited. In terms of the spatial combination of historical and cultural resources by age, from the perspective of overall connection strength, the historical and cultural resources of the Ming and Qing dynasties, Song and Yuan dynasties, Sui Tang and the Five Dynasties formed the closest connections among them; The historical and cultural resources of modern times are relatively isolated. From a spatial perspective, the combination of cultural resources is mainly distributed in the northwest and central parts of the region.

3.2 Spatial Distribution Characteristics of Other Historical and Cultural Resources

In addition to material cultural resources, the Central Plains Urban Agglomeration also has rich intangible cultural heritage. Currently, there are 310 intangible cultural heritages which belong to 10 major categories, including traditional drama, folk art, and folk customs. Through nuclear density analysis, it was found that high-density areas are mainly concentrated in the northern part of the region, with significant agglomeration zones of Changzhi-Jincheng-Jiaozuo-Luoyang, Xingtai-Handan-Puyang-Heze, and Yuncheng (Fig. 4).

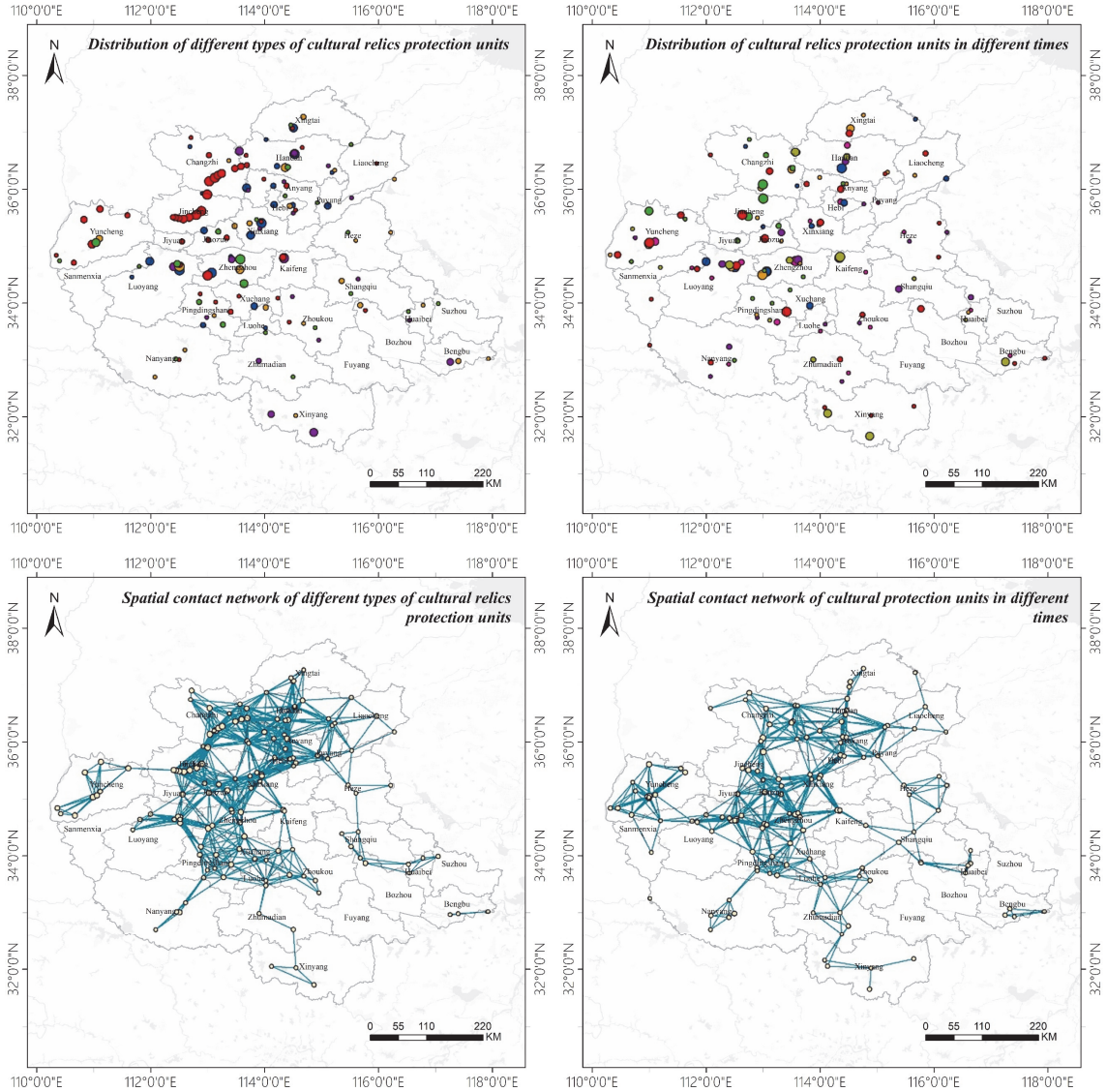

Fig. 3 Distribution of cultural relics protection units and spatial connection network.

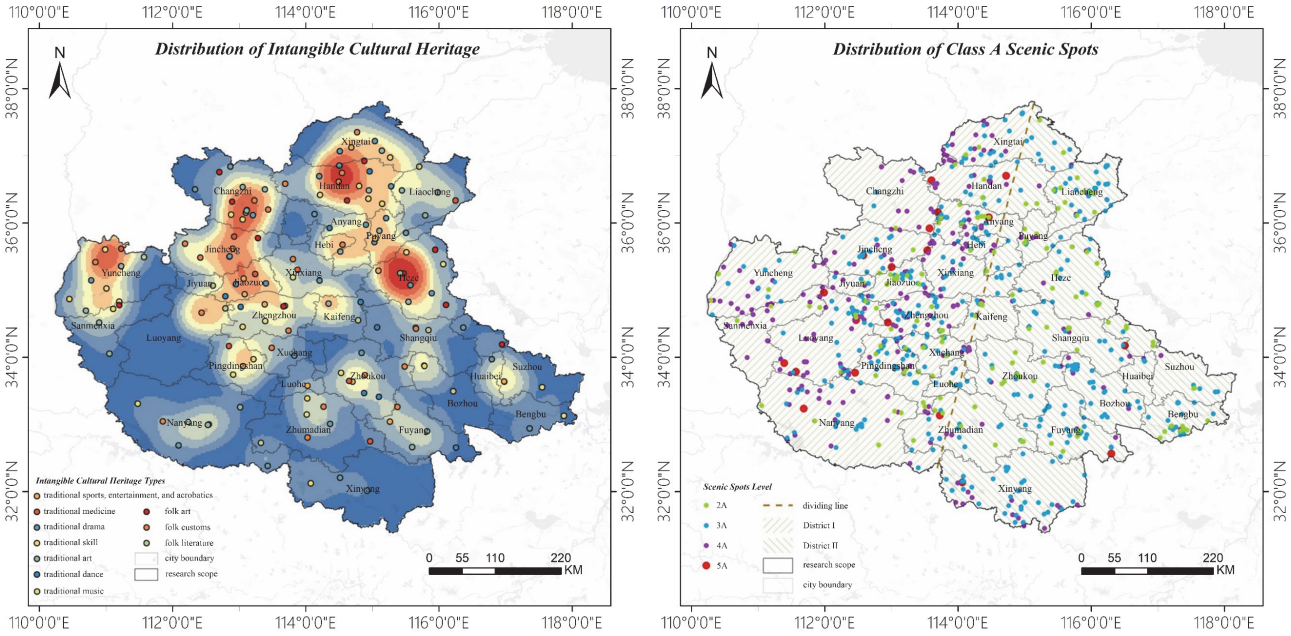

Fig. 4 Distribution of intangible cultural heritage and class A scenic spots.

After analyzing the current tourism resources, it was found that they are unevenly distributed in space from east to west. A dividing line from Xingtai in the north to Xinyang in the south divides the Central Plains urban agglomeration into two parts. To the west of the dividing line, tourism resources are abundant, covering 85% of 5A level scenic spots, 77% of 4A level scenic spots, more than half of 2A and 3A level scenic spots with 52.5% of the area. The high-density areas are mainly concentrated in the central part of the area, namely the core area of Jincheng-Jiaozuo-Zhengzhou-Luoyang-Pingdingshan, while other areas have lower density and several point like clusters. Based on this, the spatial distribution pattern of tourism resources in the Central Plains Urban Agglomeration can be divided into three levels of hotspots: (1) the core area is a first level hotspot; (2) Kaifeng, Hebi-Anyang, Liaocheng, Xingtai-Handan, Fuyang, Bozhou and Bengbu are second level hotspots; (3) the remaining areas are third level hotspots.

4. Optimization Strategies for Development Pattern of the Central Plains Urban Agglomeration

4.1 Overall Development Goal of the Region Guided by History and Culture

4.1.1 The Comprehensive Prosperity of the Historical and Cultural System

Fully leverage the advantages of historical and cultural resources in the Central Plains Urban Agglomeration, vigorously promote the excavation, integration, and utilization of related resources, and establish a sound system and system for the protection and inheritance of cultural heritage.

4.1.2 High-Quality Coordinated Development of Industrial Economy

Establish and improve the economic development network structure of "one core and five zones", with a focus on enhancing and developing historical cultural and creative industries and related industries.

4.1.3 The Transportation Network Promotes Resource Linkage

Build an intensive and compact transportation network within the region, forming a "Central Plains Urban Agglomeration Traffic Circle" throughout the entire area. Comprehensively upgrade and update intercity railways, water transportation, aviation and other facilities; fully implement the guiding ideology of "internal connectivity and external smoothness, interconnection and intercommunication".

4.1.4 Establish a Harmonious and Symbiotic Ecological Pattern and Resilient Security System

Comprehensively realize the diversified construction of ecological networks, creating an ecological barrier and collaborative system of "one axis and three areas", and promote the formation of a cultural ecological pattern of coordinated development of historical and cultural industries and ecological environment protection.

4.2 Optimization of Spatial Support System for Historical and Cultural Resources

4.2.1 Enhance Economic Synergy System

Overall, it is necessary to build an economic development network of "one core and five zones", with cities such as Zhengzhou and Kaifeng still serving as core urban areas, accelerating the development of emerging industries and modern service industries.

In the western and northern regions, such as Yuncheng-Sanmenxia, Changzhi-Jincheng, and Handan-Anyang, zones with a focus on the protection and development of historical and cultural resources should be constructed; Meanwhile, build collaborative demonstration zones in the eastern and southern regions, such as Heze-Shangqiu and Nanyang-Zhumadian, with organic coordination of functions and integrated development within and outside the region as the main functions, to undertake advanced industries at home and abroad, further synergize with historical and cultural resources, and form a cross regional industrial network [6].

4.2.2 Optimize Comprehensive Transportation System

It is necessary to coordinate the historical and cultural structure of the region and construct a multi-level transportation network system; Building an intercity railway and aviation network to achieve linkage of regional historical and cultural resources will also play an important role; And the government should also improve the collaborative governance system of transportation and promote the exchange of regional historical and cultural resources.

4.2.3 Build Ecological Protection System

It is suggested to build an ecological barrier system of "one axis and three sections". One axis is the Yellow River Ecological Corridor, adhering to the coordinated planning of upstream and downstream, main and tributary, left and right banks, and constructing ecological corridors along the Yellow River according to local conditions; The three areas, namely Taihang Mountain Ecological Protection Zone, Funiu Mountain Ecological Protection Zone, and Tongbai-Dabie Mountain Ecological Protection Zone, which is aimed to enhance the water source conservation, soil and water conservation, and ecological diversity protection functions of the ecological protection zones. The goal is to form a collaborative network pattern of cultural and ecological integration, emphasizing the combination of ecological and cultural elements, and creating a cultural and ecological pattern of harmonious coexistence between historical culture and ecological environment.

4.2.4 Improve Resilience and Safety System

At the regional level, it is necessary to strengthen the defense line of large-scale facilities, coordinate disaster warning and disposal, build a R-CAS (regional complex adaptive resilience system), implement the new concept of regional resilience security, promote the construction of a regional security network with the development of historical and cultural resources as the main line, improve the regional linkage and collaborative disaster prevention, reduction and emergency response capabilities.

At the urban level, relevant departments need to improve the layout of resilient facilities and enhance awareness of cultural heritage protection. At the same time, it is essential to optimize the networked connection and coordination of the facility system, promote the networked integration of rainwater regulation and storage facilities, integrate ecological blue-green spaces, cultural exhibition spaces, and disaster resilience spaces.

5. Conclusion and Discussion

In response to the spatial and temporal distribution characteristics of historical and cultural resources, as well as their value and role in regional development, this article takes the Central Plains Urban Agglomeration as an example for a certain degree of research and exploration, and proposes optimization strategies for the relevant spatial support system. In urban and rural areas with abundant historical and cultural resources, the following points should also be noted in actual planning and construction work: (1) Strengthening the top-level design and functional integration of cultural management; (2) Accelerating the pace of integrated development of cultural tourism; (3) Protecting historical and cultural resources comprehensively and digitally; (4) Developing industrial clusters based on the convergence of historical and cultural resources.

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