

Spatial Distribution Characteristics and Formation Mechanisms of Cultural Resources in Xinjiang: A Case Study of Intangible Cultural Heritage (Postprint)

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Abstract

Intangible cultural heritage is rooted in specific living environments and bears witness to the development of human history; its spatial distribution is closely linked to human migration and the dissemination and diffusion of civilizations. Xinjiang served as a crucial node on the ancient overland Silk Road and a confluence point for ancient cultural and economic exchanges between East and West, boasting rich and diverse intangible cultural heritage; however, few scholars have investigated the relationship between natural and human factors and its spatial distribution. By employing ArcGIS spatial analysis functions, this study conducts a spatial analysis of 484 national-level and autonomous region-level intangible cultural heritage items in Xinjiang (including the Xinjiang Production and Construction Corps), and for the first time incorporates human migration and the ancient Silk Road into the analysis of spatial formation causes of intangible cultural heritage from a historical perspective. The results show: (1) The overall distribution of intangible cultural heritage in Xinjiang is agglomerated; traditional drama and quyi, primarily introduced through Central Plains culture, are sporadically distributed in individual areas, while traditional craftsmanship, traditional dance, and traditional music, which are closely related to daily life, are evenly distributed, forming multiple high-density areas; among these, folk literature, traditional music, and traditional dance exhibit spatial proximity, interdependence, and co-occurrence; along the edges of the Taklamakan Desert south of the Tianshan Mountains, major stations of the ancient overland Silk Road have become high-density areas where traditional craftsmanship, traditional music, and traditional dance are predominantly distributed. (2) The spatial distribution of intangible cultural heritage in Xinjiang is not only related to landforms and river distribution, but the ancient Silk Road and human migration also exert significant influence on the diffusion and development

of intangible cultural heritage, while the impact of economic development level is multifaceted. The research findings hold important reference value for the development of intangible cultural heritage and the coordinated development of national culture in cities along the Silk Road.

Full Text

Spatial Distribution and Cause of Cultural Resources in Xinjiang: Taking Intangible Cultural Heritage as an Example

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Abstract

Intangible cultural heritage is rooted in specific living environments and bears witness to the development of human history. Its spatial distribution is closely linked to human migration and the spread and diffusion of civilization. Xinjiang served as a crucial node on the ancient overland Silk Road and a convergence point for cultural and economic exchange between East and West, boasting rich and diverse intangible cultural heritage. However, few scholars have investigated the relationship between natural and human factors and its spatial distribution. By leveraging ArcGIS spatial analysis capabilities, this study examines 484 national and autonomous region-level intangible cultural heritage projects in Xinjiang (including the Xinjiang Production and Construction Corps) and, for the first time, incorporates human migration and the ancient Silk Road into the analysis of spatial formation from a historical perspective. The results reveal: (1) Xinjiang's intangible cultural heritage exhibits an overall cohesive distribution pattern. Traditional drama and folk art, primarily introduced from the Central Plains, are sporadically distributed in individual areas, while traditional skills, dance, and music—closely related to daily life—are evenly distributed, forming multiple high-density zones. Folk literature, traditional music, and traditional dance are spatially proximate, interdependent, and coexist. Along the edge of the Taklamakan Desert south of the Tianshan Mountains, ancient overland Silk Road post stations have become high-density areas for traditional skills, music, and dance. (2) The spatial distribution of Xinjiang's intangible cultural heritage is not only related to landforms and river distribution but also significantly influenced by the ancient Silk Road and human migration, while the impact of economic development levels is multifaceted. These findings offer important reference value for intangible cultural heritage development and the coordinated development of national culture along Silk Road cities.

Keywords: intangible cultural heritage; spatial distribution; ancient Silk Road; Xinjiang

Introduction

Human culture and environment share a reciprocal relationship. Each culture spreads and diffuses from its earliest “cultural source” to form distinctive “cultural regions.” Cultural landscapes should be studied as phenomena evolved from natural landscapes, as they represent forms added to natural landscapes through human activity. Intangible cultural heritage (ICH) constitutes the essence of human culture—not merely a record of historical culture but a continuation of memory fragments from historical contexts after vicissitudes, as well as a product and manifestation of human activity that interacts with natural geographical conditions. ICH distribution areas are mostly “cultural sources.” Therefore, analyzing the spatial manifestation characteristics of ICH from a spatial perspective can better explain its historical development and excavate the connotation of cultural-natural interactions.

ICH research spans numerous disciplines, primarily involving arts and humanities (approximately 26.61% of total ICH research), social sciences (24.46%), and computer science (9.74%). International ICH research focuses on ethnic ICH cultural industry management (including regional history, specialized subjects, and original ecological identification), inheritance innovation and protection policy research (including communication expression and sustainable development protection), and cultural tourism research (including symbolic regions, local arts, and spatial market analysis). Studies concentrate on ICH concept, connotation, and characteristic definition, as well as ICH theory construction and discussion. Research on ICH evolution and protection explores relational themes from tangible heritage, intellectual property rights, and cultural rights perspectives, examining ICH’s relationship with human life, resource utilization and value assessment, particularly tourism development. From tourism demand experience and development models, existing research provides a historical, gradual, and relational three-dimensional overview. With ICH research transitioning toward practice, emphasis has shifted toward using digital methods to solve protection problems, focusing on resource description, aggregation, services, dissemination, and development and utilization. Research covers different spatial scales from villages, provinces, and nations to entire continents. Methodologies include historical literature retrieval, sample surveys, case analysis, and quantitative model construction. Geospatial analysis often employs ranking methods, hotspot clustering, point pattern analysis, and spatial autocorrelation, with geographical spatial and locational perspectives gradually gaining attention in recent years. Due to the interdisciplinary nature involving cultural studies, sociology, and geography, the number of researchers is limited, and research literature is scarce, particularly geography-based new regional geography ICH research.

1.1 Data Sources and Processing

The ICH evaluation system classifies ICH into international (world) level, national level, provincial level, municipal level, and county level. The State Council has published five batches of national ICH project catalogs. Xinjiang has 127 national-level ICH projects (including international-level projects) and 357 autonomous region-level projects (excluding extension items), totaling 484 items. Given that the same ICH project may be distributed across different regions, this study splits projects distributed across different geographical spaces according to their distribution, totaling 492 items. Since some autonomous region-level projects may become national-level projects in the second year (with identical names and application regions), duplicate geographical projects were removed, resulting in 484 sample points for analysis. Due to varying degrees of completeness in ICH work across districts and counties, ICH project statistics are incomplete; this study does not include county-level ICH projects.

Administrative boundaries were obtained from the National Basic Geographic Information Center's 1:4 million national basic geographic information database. The spatial locations of ICH projects (points) were sourced from Google Maps. Based on Silk Road traffic routes documented by the Institute of Historical Geography, relevant post stations within China's territory were annotated to identify major post stations along the Xinjiang section of the Silk Road.

1.2 Research Methods

Excel was used to organize the geographical coordinates of Xinjiang's national (including international) and provincial ICH projects, converting latitude and longitude to decimal degrees. Types, ethnic groups, levels, and batches were organized and coded. ArcGIS 10.3 was then used for data analysis and visualization. Layer overlay intuitively reflects basic information on ICH spatial distribution, transportation location, and spatial agglomeration, including administrative districts, ICH, water resources, and ancient Silk Road post stations, to determine distribution types. Kernel density was used to measure the concentration and dispersion characteristics of Xinjiang ICH spatial distribution.

1.2.1 Nearest Neighbor Index

According to the ICH application region or unit, projects can be abstracted as "points" in geographical space. The nearest neighbor index (NNI) is used to determine and analyze three types of point features: random, uniform, and cohesive. The calculation formula is:

$$rE = 1/(2\sqrt{D}) = 1/(2\sqrt{n/A})$$

$$R = \bar{r}/rE$$

Where: rE is the theoretical nearest neighbor distance of ICH (km); A is the area of the ICH region (km^2); D is the density of ICH projects (items/km^2); n is the

number of ICH application locations; R is the nearest neighbor index; $\bar{r}_1$ is the average actual nearest neighbor distance (km). The observed R value determines the distribution type of ICH in a geographical space ($R = 1$ is random; $R > 1$ is uniform; $R < 1$ is cohesive).

1.2.2 Measurement of Spatial Agglomeration Areas

Kernel density estimation was selected to measure spatial agglomeration. The basic principle uses ICH sample points as centers to form circular neighborhoods, with density decreasing from the center outward, indicating the probability of regional point concentration. The calculation formula is:

$$f_n(x) = (1/(nh)) \sum_{i=1}^n k((x-x_i)/h)$$

Where: $f_n(x)$ is the kernel density value at spatial location x ; n is the number of ICH items within the analysis range; k is the kernel function; h is the bandwidth (search radius). After multiple calculations, the kernel density distribution pattern of Xinjiang's ICH (including national and autonomous region levels) was generated with a bandwidth of 1.5 decimal degrees.

2.1 Analysis of Distribution Types of Xinjiang ICH

Based on project application regions, nearest neighbor analysis was used to calculate the spatial structure types of ICH projects in various geographical spaces. The nearest neighbor index is shown in Table 1. The results indicate that Xinjiang's ICH is primarily distributed in two types: uniform and cohesive. South of the Tianshan Mountains is mainly cohesive, while north of the Tianshan Mountains (except for Ili Kazakh Autonomous Prefecture and Bortala Mongol Autonomous Prefecture) exhibits uniform distribution characteristics. The overall regional nearest neighbor index for Xinjiang is 0.67, indicating a cohesive distribution pattern with approximately 99% confidence after z-test verification.

ICH projects reflect human production and life, forming cultural landscapes through human-natural interaction and recording human civilization in historical development. The overall nearest neighbor index for various ICH types in Xinjiang is 0.76, also indicating cohesive distribution. However, by ICH project type (Table 1), folk literature, traditional music, traditional drama, and folk art show cohesive distribution with smaller ranges, mainly concentrated in individual regions, while other types exhibit uniform distribution.

2.2 Measurement of Spatial Agglomeration Areas of Xinjiang ICH

ArcGIS 10.3's Spatial Analyst tools were used for kernel density estimation. After multiple trials, a bandwidth (search radius) of 1.5 decimal degrees was selected to generate the kernel density distribution pattern of Xinjiang's ICH (including national and autonomous region levels) (Figure 1).

Traditional skills, with intangible cultural connotations of craftsmanship and spirit as well as physical carriers, are closely related to economic development. Their inheritance and diffusion range is extensive, with the Silk Road's economic exchanges providing excellent cultural diffusion effects. High-density areas centered on Kashgar and Kizilsu Kirghiz Autonomous Prefecture (Kizilsu) have formed, with secondary density areas around Urumqi, Korla, and Turpan, and three density areas around Tacheng, Ili, and Aksu.

Traditional dance and traditional music emerge together, forming high-density areas around Kashgar, Urumqi, and Ili, with secondary density areas in Aksu, Hami, and Kizilsu, distributed across multiple geographical spaces. Traditional drama and folk art, primarily disseminated from the Central Plains and fused with local culture, are mainly distributed in the economically developed and accessible northern Tianshan slope economic belt, scattered in distribution.

Traditional medicine is mostly distributed in valleys and basins with abundant rainfall, such as the Ili Valley and rich glaciers in the Tianshan Mountains, which provide fertile soil for medicinal herbs. High-density areas centered on Urumqi and Ili have formed, with secondary high-density areas in Korla, Turpan, Kashgar, and Hotan.

Folk literature is mainly concentrated in political and economic centers: Urumqi, Ili (location of the Western Regions Protectorate), Bayingolin Mongol Autonomous Prefecture (destination of Mongol migration), and Kizilsu (where ancient 三大文明, 三大宗教, and 三大语系 converged).

Customs have formed distinctive regional characteristics through unique terrain conditions, traditional nomadic and farming practices, ethnic migration, and religious introduction. The Kazakh customs of Ili form the core, merging with secondary density areas in Bortala and Tacheng to become the first high-density cluster. A second high-density area centers on Korla, connecting Urumqi, Changji, Turpan, and Haman, widely distributing Mongolian and Uyghur folk customs. Kizilsu and Kashgar jointly form a belt-shaped secondary density area, particularly featuring distinctive Uyghur and Tajik folk characteristics.

2.3 Analysis of Spatial Distribution Characteristics and Causes of Xinjiang ICH

Cultural emergence and development depend on specific natural and social environments. Cultural differences stem from humans transforming and adapting to their natural and social environments. ICH represents the sedimentation of human culture, intertwining with other cultures from its formation, continuously transforming, flourishing, and declining through the combined effects of geographical and human factors. Xinjiang's ICH distribution is shaped by geographical environmental factors and historical context.

2.3.1 Topography and Landforms Shaping ICH Spatial Zoning

Culture is a product of human activity, which is often promoted or constrained by natural conditions. Rich topography and landforms influence cultural evolution by facilitating or hindering population aggregation and cultural exchange, ultimately affecting ICH spatial distribution. Xinjiang's three major mountain ranges (Altai, Tianshan, and Kunlun) form natural barriers, creating relatively closed regions that hinder intra- and inter-regional cultural exchange and diffusion, forming rich and unique cultural areas where ICH formation and evolution are relatively closed. The desert zones of the two basins are not conducive to human survival and hinder human mobility. However, rich water sources formed between mountains and deserts nourish oasis belts suitable for human survival. As shown in Figure 2, Xinjiang's ICH distribution mainly concentrates in areas between deserts and mountains, forming three semi-circular belts. High-density ICH areas are zones where these three belts intersect: Urumqi and surrounding regions.

2.3.2 Rivers Driving the Formation of Human Civilization

Rivers are often the source and cradle of human civilization, where the richest ICH emerges. In China, long-standing developed agricultural economic zones and relatively lagging nomadic economic zones have existed. Different production modes and economic forms created a relatively closed Central Plains civilization that was prosperous yet often defensive, while surrounding nomadic peoples developed aggressive cultures through continuous migration. Xinjiang's rivers originate from mountains, converging into surface water systems like the Tarim River, Kongque River, and Ili River. Early Kazakh, Mongolian, and other nomadic peoples "followed water and grass," forming human gathering areas with diverse grassland cultures. Kashgar, Hotan, and other areas formed settled agricultural cultural zones around the Tarim River, where ICH is relatively well preserved.

2.3.3 Ethnic Migration as Spatial Trajectory of ICH Dissemination

Most ethnic groups in the world have migration histories, with more frequent migration activities in earlier eras. Whether due to war, politics, livelihood, natural disasters, or disease, migration determines historical changes in ethnic distribution. In the mid-18th century, the Qing government successively relocated Xibe, Daur, Solon, and Chahar Mongolian officers and their families from Northeast Shengjing to the Ili River area in Xinjiang, forming concentrated Xibe ICH areas. The Torgut tribe's eastward return, with Ubashi's followers finally settling in the Zhunggar Basin (present-day Bayingolin), demonstrates how migration processes are also processes of cultural exchange and diffusion, forming Xinjiang's current ICH spatial distribution pattern.

2.3.4 Ancient Silk Road Promoting Belt-shaped Distribution of ICH

The ancient overland Silk Road (abbreviated as “Silk Road” in figures) started from Chang’ an (present-day Xi’ an) and Luoyang, passed through Gansu, and extended from Xinjiang to Central and West Asia and the Mediterranean coast. The Silk Road was not only a trade route but also a path for cultural convergence, breaking China’ s relatively closed geographical space before the Han Dynasty. Merchants from different Western countries began traveling to the Central Plains, strengthening spiritual and cultural communication. Music relics along the Silk Road demonstrate richness, continuity, and exemplarity, embodying the artistic spirit of the Chinese nation. Technologies such as silk, lacquerware, iron casting, and gold/silver craftsmanship also spread through exchanges with Central and West Asian countries after the Han Dynasty opened the Western Regions, with many crafts now becoming local skills. Figure 2 shows that high-density areas of traditional skills, traditional medicine, and traditional dance are mainly distributed in major ancient Silk Road post stations: Urumqi, Ili, Kashgar, and Hotan.

2.3.5 Bidirectional Influence of Economic Development Level on ICH Spatial Distribution

Since its emergence, culture has continuously migrated and diffused with human activities, exchanging, integrating, and 更迭 with other cultures. Economic development has a tremendous impact on traditional culture. Economically developed regions with accessible transportation not only provide important foundations for economic development but also conditions for continuous cultural influx. Based on geographical environments, humans gradually differentiated economic development levels. For example, towns along the ancient Silk Road in Xinjiang—Urumqi, Ili, and others—have higher economic development levels, cultural convergence, and richer ICH distribution. Modern economic development and the influx of Central Plains culture have impacted Xinjiang’ s historically accumulated ICH. Xu Baicui et al. analyzed China’ s ICH spatial distribution, revealing a high-low distribution between ICH numbers and GDP, noting that while Xinjiang’ s economic development is relatively slow due to location and other reasons, it has large minority populations where cultural collisions generate abundant ICH. Regional economic development levels influence ICH protection material investment and affect ICH application and management attention, with more economically developed regions showing greater protection efforts and attention. Some ICH projects were applied for by Xinjiang’ s economic and political center, Urumqi, which does not completely match the projects’ places of origin.

Conclusion

This research is based on the historical context of ICH emergence, examining geographical environmental factors of human culture formation and reviewing

ICH development processes to incorporate historical factors such as human migration and major historical events into the analysis, particularly emphasizing the ancient Silk Road's role in ICH formation, development, and diffusion. The analysis demonstrates that examining ICH distribution patterns requires reviewing historical development processes and dynamically analyzing formation mechanisms. While this study provides in-depth discussion combining ICH with geographical environmental and human conditions, several limitations remain for future research. First, ICH spatial distribution has strong historical causes, so ethnic migration and Silk Road factors could be further studied to deduce temporal and spatial evolution processes and characteristics, exploring mutual influences between Xinjiang ICH and other Chinese provinces or important Central Asian countries along the Silk Road. Second, this study did not analyze influence mechanisms and intensities among ICH distribution factors, which could be further discussed in future research.

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Figure 1 [Figure 1: see original paper] Kernel density analysis of different kinds of municipal-level intangible cultural heritages in Xinjiang

Figure 2 [Figure 2: see original paper] Distribution of national-level and provincial-level intangible cultural heritages in Xinjiang

Note: Figure translations are in progress. See original paper for figures.

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