Article

An Analysis of the Spatiotemporal Distribution and Influencing Factors of National Intangible Cultural Heritage Along the Grand Canal of China

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Abstract: Intangible cultural heritage (ICH) reflects a region's history and culture, serving as a significant indicator of regional identity and cohesion. The Grand Canal Basin in China is rich in historical traditions, containing a rich array of ICH resources. Analyzing the spatiotemporal distribution characteristics and influencing factors of ICH within the Grand Canal Basin of China can provide a scientific basis for developing cultural industries and promoting sustainable regional economic growth. This study employed GIS-based spatial analysis methods, including kernel density estimation, the mean nearest neighbor index, and standard deviation ellipse, to investigate the spatiotemporal distribution of 504 national-level ICH items (including extensions) in the Grand Canal Basin of China. The results demonstrate the significant spatial clustering of ICH, with concentrations in high-density regions, particularly at the northern and southern ends of the canal. There is significant regional disparity in the distribution of ICH, with an uneven quantity and structure, predominantly featuring traditional skills and traditional drama categories. The average centroid shift of ICH exhibits a north-to-south oscillatory trajectory. However, overall, it demonstrates a southward-moving trend. This study also underscores the impacts of urbanization, population density, economic development, and transportation infrastructure on ICH distribution. Among these factors, urbanization exerts the strongest influence on the spatial distribution of ICH. The impact of the natural environment is relatively minor; however, it remains a significant element that cannot be overlooked during development. This research offers valuable data and insights for local governments and institutions to formulate evidence-based strategies for the protection and sustainable utilization of ICH resources, promoting sustainable cultural and economic development in the Grand Canal Basin.

Keywords: spatiotemporal patterns; ICH; Grand Canal of China; geographical detector; kernel density estimation

1. Introduction

Intangible cultural heritage (ICH) represents a unique category of cultural heritage with significant historical, cultural, artistic, and aesthetic value. It is a collective cultural treasure of humanity and carries profound ethnic markings, symbolizing ethnic identity, ethnic markers, and a sense of ethnic belonging [1,2]. The concept of intangible heritage was initially proposed in 1982 by the World Heritage Committee under UNESCO during the Mexico meeting. Subsequently, UNESCO adopted the "Convention for the Safeguarding of the Intangible Cultural Heritage" in 2003, which formally delineated the definition of "intangible cultural heritage". In 2005, the Chinese government issued the "Interim Measures for the Identification and Evaluation of National Representative Works of Intangible Cultural Heritage", characterizing ICH as "various traditional cultural expressions and cultural spaces that are passed down through generations among all ethnic groups and

are closely intertwined with the lives of the people" [3–5]. As a nation with over five thousand years of cultural legacy, China has cultivated a diverse range of traditional cultures, with ICH being an integral component of its esteemed cultural heritage. The preservation and transmission of ICH are of paramount importance for perpetuating historical and cultural heritage, reinforcing cultural confidence, fostering cultural exchange and mutual appreciation, and building a strong socialist cultural nation [6,7].

Scholarly research on ICH in Western countries began relatively early, initially focusing on the concept and connotations of ICH, its relationship with human life, utilization and value assessment, protection philosophy, and tourism development [8–10]. In recent years, foreign research on ICH has delved into the economic and social impacts of ICH, alongside its preservation in the context of tourism [11–13]. Current research has evolved from initial discussions on the concept and value of ICH to in-depth analyses of its human and social impacts. Domestic studies, initially focused on content, were primarily concentrated on the value assessment of ICH, tourism research, heritage inheritance, and protection [14–16]. Recent studies have started to address the spatial distribution characteristics of ICH; however, much of this research has focused on spatial distribution, with less attention paid to distribution characteristics across different historical periods. There are also studies based on a specific province or type of ICH; however, overall, research on large-scale regional ICH remains scarce [14,15]. In terms of regional scope, most research is conducted at the level of individual provinces, cities, or counties, with fewer studies addressing the scale of entire river basins or the nationwide scale. Considering research methodologies, qualitative approaches are frequently employed to describe the characteristics of the study areas, which may not provide a comprehensive analysis. Quantitative methods including kernel density estimation and spatial autocorrelation analysis within the ArcGIS 10.3 software are usually used for their research. Studies on ICH in the Grand Canal Basin mainly concentrate on the inheritance and protection of specific types of ICH. There is a gap in the research that holistically grasps the spatiotemporal distribution characteristics and influencing mechanisms of ICH. Therefore, in light of the current state of the research domestically and internationally, this study conducted a spatiotemporal distribution study of ICH across a large regional area. It comprehensively employed spatial analysis methods, such as kernel density estimation, the mean nearest neighbor index, and standard deviation ellipse, and used the geographical detector to analyze the impacts of various socioeconomic driving factors on the distribution of ICH projects, surpassing the limitations of earlier studies that focused solely on value assessment or a single province.

The Grand Canal of China, the longest and largest canal in the world, spans multiple provinces, including Beijing, Jiangsu, Hebei, Shandong, Henan, and Zhejiang, connecting the Haihe, Yellow River, Huai River, Yangtze River, and Qiantang River systems. It has witnessed the flourishing intersection of regional cultures, with the canal waters carrying vessels from the south to the north, nurturing the people and cities along its banks and giving rise to significant cultural heritage [16,17]. However, with the rapid development of modern society and the economy, the ecological environment has suffered damage, posing immense challenges to the canal's protection and utilization. Consequently, the Chinese government places high importance on the protection and transmission of the Grand Canal's cultural legacy [18–20].

This study collected and organized data on national-level ICH projects related to the Grand Canal by applying spatial analysis methods, such as the mean nearest neighbor index, kernel density analysis, standard deviation ellipse, and mean center, to systematically reveal the spatiotemporal distribution characteristics and classification features of the ICH in the Grand Canal Basin. Additionally, the geographical detector tool was employed to investigate the socioeconomic driving factors behind the spatial distribution of ICH. The aim was to provide local governments and relevant institutions with detailed information on the distribution of ICH resources, reveal the spatiotemporal patterns of these resources, and aid in understanding the aggregation trends and spatial differentiation characteristics of ICH projects in the Grand Canal Basin. This research offers essential data support for the

rational protection and development of ICH resources in the Grand Canal Basin, promoting sustainable development in the region's economy and culture.

2. Materials and Methods

2.1. Research Area

The Grand Canal of China, a significant and historically rich waterway, has profoundly influenced the economic, cultural, and social development of the regions it traverses. It serves as a vital artery for the transportation of goods between the northern and southern parts of China and is a pivotal medium for perpetuating cultural heritage. The Grand Canal Basin is replete with ICH, exemplifying the diversity of Chinese civilization, and is a key manifestation of regional cultural identity and solidarity [21–23].

The Grand Canal, which spans approximately 3200 km, comprises three sections: the Beijing–Hangzhou Grand Canal, the Zhejiang East Grand Canal, and the Sui and Tang Dynasties Grand Canal. This study focused on the cities along the Grand Canal as the research area, encompassing areas that flow through 7 districts of Beijing, 6 districts of Tianjin, 5 prefecture-level cities in Shandong Province, 5 in Hebei Province, 9 in Henan Province, 8 in Jiangsu Province, 5 in Zhejiang Province, and 2 in Anhui Province (see Figure 1). The basin is predominantly situated within the North China Plain and the middle and lower reaches of the Yangtze River Plain, featuring a flat terrain that descends from a higher western region to a lower eastern one. It sequentially traverses the Haihe, Yellow, Huai, Yangtze, and Qiantang River systems, creating an abundant network of water resources [21–23].
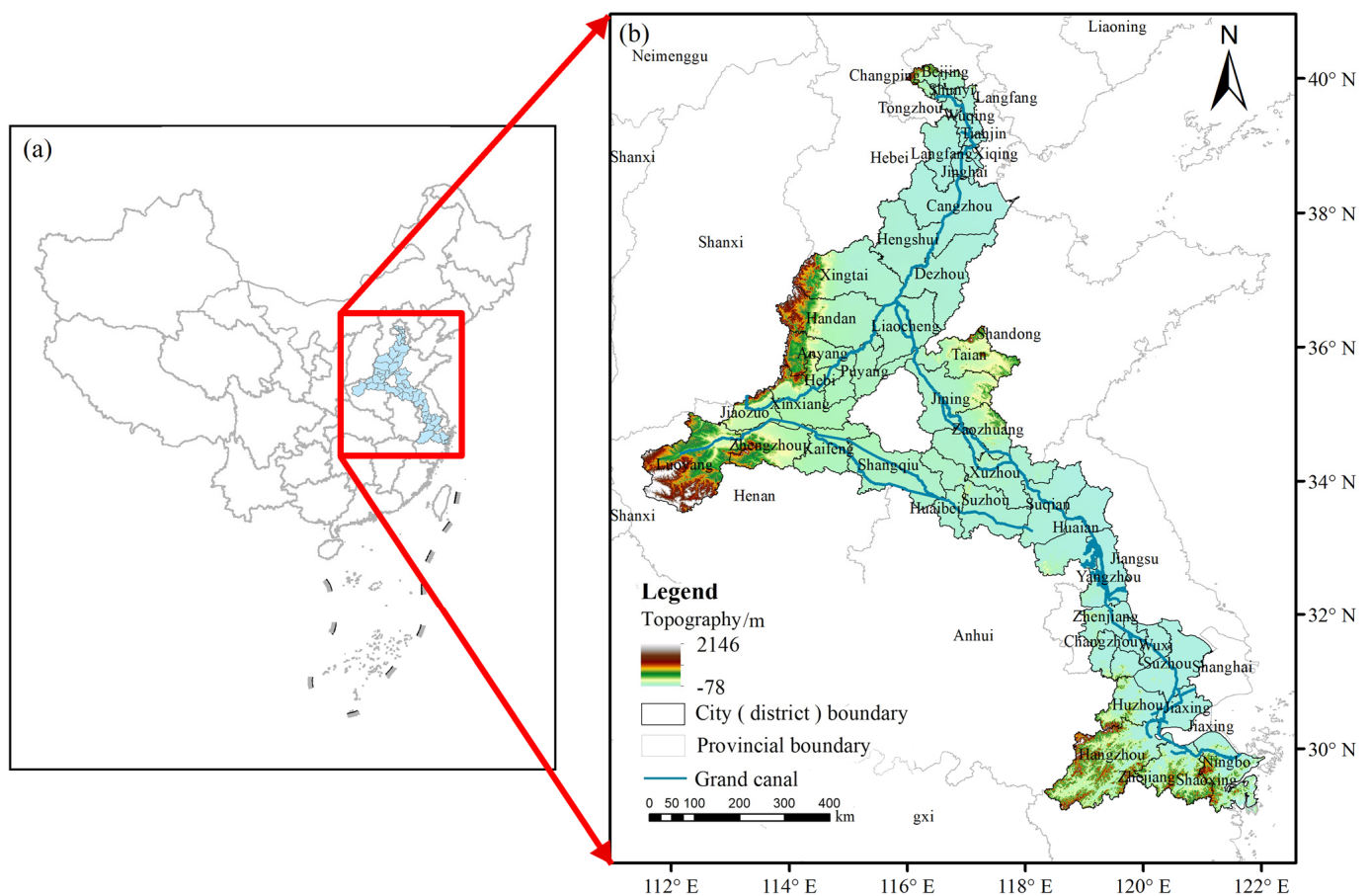

Figure 1. Research area: (**a**) China; (**b**) the Grand Canal of China.

The Grand Canal Basin encompasses economic and political centers such as Suzhou, Yangzhou, and Hangzhou, which exhibit advanced levels of economic development. Additionally, the basin is home to a multitude of ethnic minorities, each contributing to a profound cultural heritage that has facilitated the emergence and evolution of ICH within the region. The basin's favorable geographic location, combined with its profound historical and cultural context, has fostered the development of a diverse and abundant collection of ICH [24–26]. The study of the distribution patterns of ICH within the Grand Canal Basin is significant for the preservation and transmission of this cultural legacy.

2.2. Data Sources

2.2.1. National-Level ICH Dataset

The data on national-level ICH projects (including extended items) used in this study were derived from the first to fifth batches of the ICH inventories published on the China Intangible Cultural Heritage website. A total of 504 national-level ICH items within the study area were selected for analysis. These ICH items were categorized into ten major classes based on the national ICH inventory classification system. The geographical coordinates of the ICH were compiled into point-of-interest (POI) data based on the geographic locations of their respective protection units, with attribute tables including longitude and latitude. The generation of intangible cultural heritage occurs over time, and the attribute table of the data includes the periods when each type of heritage emerged, reflecting the long-term temporal nature of the data. All datasets were stored in Excel format for subsequent processing and analysis [27].

2.2.2. Basic Data on the City

The foundational data on the city characteristics, including the district boundaries, city names, capital cities, road networks, urban centers, etc., were provided by the Yangtze River Delta Science Data Center, the National Science and Technology Infrastructure of China, and the National Earth System Science Data Sharing Infrastructure (https://nnu.geodata.cn/index.html (accessed on 10 May 2024)) [27]. These data were stored in shapefile format for subsequent spatial analysis.

2.2.3. Natural and Socioeconomic Factor Data

The natural and socioeconomic data were sourced from the National Bureau of Statistics of China (NBS). The dataset included detailed information on the natural situation of the study area in 2022, as well as various socioeconomic indicators, such as population; GDP across primary, secondary, and tertiary industries; retail activity, living conditions; industry; agricultural performance; fixed assets investment; energy consumption; and construction [28]. This dataset was stored in Excel file format.

2.3. Research Methods

2.3.1. Mean Nearest Neighbor Index Model

The mean nearest neighbor index (NNI) is a significant metric in spatial statistics used to measure the spatial distribution pattern of a set of point data. It analyzes the degree of deviation from a random distribution by comparing the average distance between the nearest neighbor items with the average distance in a randomly distributed pattern [29]. This study employed the NNI to conduct a spatial pattern analysis of ICH point data. The formula is as follows:

$$\text{NNI} = \frac{\sum_{i=1}^{N} \frac{mind_{ij}}{N}}{0.5\sqrt{\left(\frac{A}{N}\right)}} \tag{1}$$

where N is the number of ICH points, and A is the area of the study region. When $NNI > 1$, the ICH points tend to be evenly distributed; when $NNI = 1$, the ICH points show a random distribution; and when $NNI < 1$, the ICH points exhibit a clustered distribution.

2.3.2. Kernel Density Estimation Model

Kernel density estimation (KDE) is a non-parametric statistical method used to estimate the density distribution of spatial point features [30]. This technique applies a kernel function to each point feature, generating a smooth density surface that visually represents the spatial distribution of the points [31]. KDE reveals the points' local clustering characteristics and identifies potential hotspot areas in the space. In this paper, the KDE model was employed to pinpoint regions with high concentrations of ICH items, offering critical insights into the spatial distribution of cultural heritage and providing valuable guidance for preservation efforts. The mathematical model is as follows:

$$f(x) = \frac{1}{nh} \sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right) \tag{2}$$

where $f(x)$ is the density estimate at point x; n is the number of point features; h is the bandwidth parameter; K is the kernel function; and x_i is the position of point i.

2.3.3. Standard Deviational Ellipse Model

The standard deviational ellipse (SDE) is a spatial statistical method that quantitatively analyzes the spatial characteristics of geographical elements, revealing key information, such as the directionality, centroid of distribution, and extent of the spatial deviation. This study employed the SDE to analyze the spatial distribution trends in ICH projects in the Grand Canal Basin, using the ellipse's orientation and major axis to reflect the dominant direction and evolutionary trends in the overall spatial pattern and each historical period of the ICH. The shifting trajectory of the centroid illustrated the historical geographical process and highlighted the degree of developmental disparity in the evolution of ICH within the Grand Canal Basin [32].

2.3.4. Geodetector Model

The geographical detector is a statistical method used to analyze spatial heterogeneity, capable of quantitatively assessing the explanatory power of different factors for geographical phenomena [33]. The geographical detector can detect the correlations between variables and their impacts on spatial patterns by calculating the explanatory power of various influencing factors [34]. In this study, the geographical detector was applied to analyze the influencing factors of the distribution characteristics of the ICH in the Grand Canal Basin of China. The calculation formula for the statistical measure of the geographical detector is as follows:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2} \tag{3}$$

where q is the q statistic; L is the number of subregions; N_h is the number of samples in subregion h; σ_h^2 is the variance of subregion h; N is the total number of samples; and σ^2 is the overall variance. The range of the q statistic is [0, 1]. A higher value of the q statistic indicates a stronger explanatory power of the factor, while a lower value indicates a weaker explanatory power.
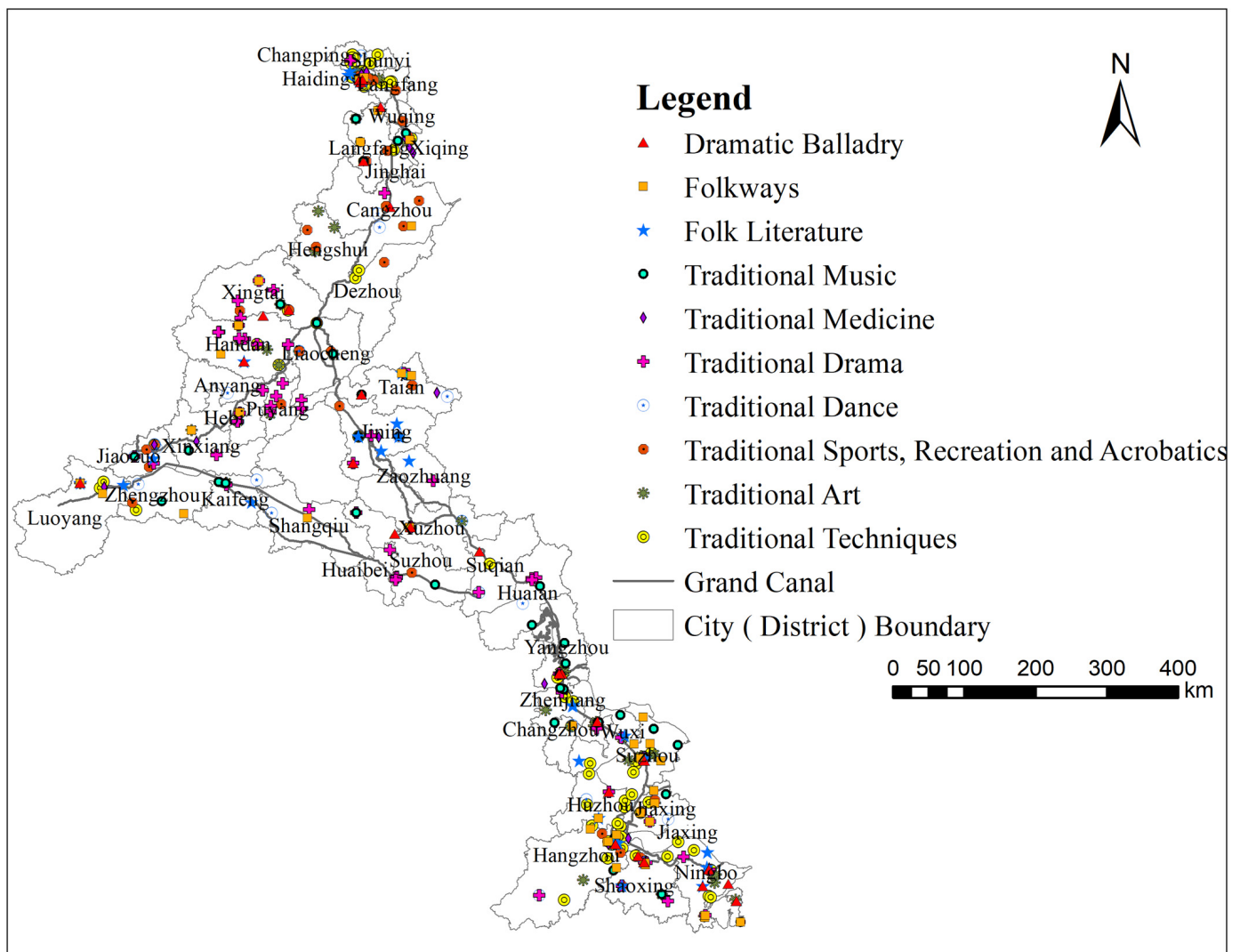
3. Results

3.1. Spatial Distribution Patterns
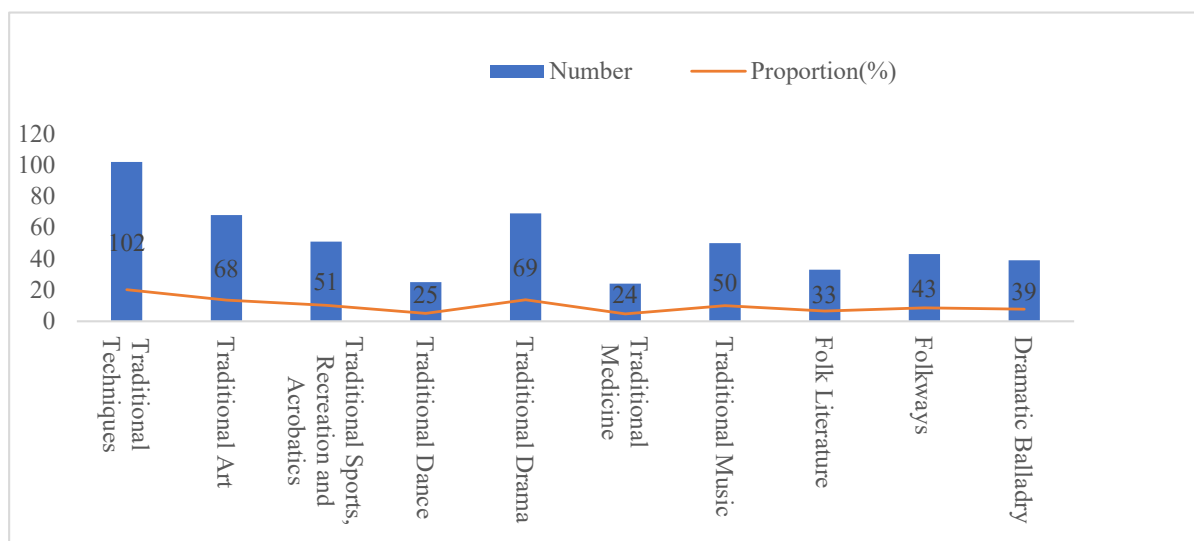
3.1.1. Spatial Distribution Structure Patterns of ICH

This study classified the national-level ICH items within the Grand Canal Basin into 10 categories based on the national representative project directory and conducted a visual

analysis of their spatial distribution (Figure 2) and numerical prevalence (Figure 3). Traditional craftsmanship constituted the largest share, with 102 entries, representing 20.24% of the total ICH. This was followed by traditional drama, with 69 entries (13.69%), and traditional visual arts, with 68 entries (13.49%). Traditional sports, games, and acrobatics, and traditional music, were also significantly represented, accounting for 10.12% and 9.92% of the total, respectively. The categories of folklore, dramatic balladry (a form of traditional Chinese performing arts), folk literature, traditional dance, and traditional medicine were less prevalent, comprising 8.53%, 7.74%, 6.55%, 4.96%, and 4.76% of the total, respectively. In summary, the national ICH of the Grand Canal Basin was predominantly characterized by traditional craftsmanship, traditional drama, and traditional visual arts. Spatially, the distribution of ICH items considerably varied along the Grand Canal, with a notable concentration along the canal's route and distinct high-agglomeration areas at the southern and northern termini.

Figure 2. The distribution of national ICH in various categories of cities along the Grand Canal Basin.

Figure 3. Type structure diagram of national ICH projects.

3.1.2. Spatial Distribution of ICH Types

The nearest neighbor index (NNI) model can be employed to explore the spatial distribution patterns of samples, assessing whether they exhibit characteristics of clustering, dispersion, or random distribution. This study utilized the spatial analysis tools in ArcGIS 10.2 to calculate the nearest neighbor index (NNI) for the national-level ICH items within the Grand Canal Basin (Table 1). It is generally accepted that NNI values of less than, equal to, and greater than one indicate clustered, random, and uniform distributions, respectively. The results indicate that the overall NNI for the 504 ICH items in the Grand Canal Basin was 0.254, demonstrating a distinct pattern of clustered spatial distribution. However, the distribution patterns among various ICH types noticeably differed. The NNI values for traditional skills; traditional sports, games, and acrobatics; traditional drama; traditional music; traditional arts; folk literature; folklore; and dramatic balladry ranged from 0.32 to 0.81, all showing a clustered spatial distribution [35]. Traditional arts and skills ICH exhibited a pronounced clustering characteristic, while the NNI for traditional dance ICH was 0.811, indicating a weaker clustering tendency and a distribution leaning toward randomness.

Table 1. Average nearest neighbor index values of national ICH in the Grand Canal Basin.

Category	NNI	Z-Value	*p*-Value	Agglomeration
Overall ICH projects	0.254	−32.019	0.000	Aggregation
Traditional techniques	0.323	−13.077	0.000	Aggregation
Traditional art	0.398	−9.501	0.000	Aggregation
Traditional sports, recreation, and acrobatics	0.501	−6.811	0.000	Aggregation
Traditional dance	0.811	−1.811	0.590	Aggregation
Traditional drama	0.487	−8.145	0.000	Aggregation
Traditional medicine	0.440	−5.245	0.000	Aggregation
Traditional music	0.559	−5.971	0.000	Aggregation
Folk literature	0.416	−6.422	0.000	Aggregation
Folkways	0.500	−6.270	0.000	Aggregation
Dramatic balladry	0.478	−6.236	0.000	Aggregation

3.1.3. Density Distribution Patterns of ICH

The kernel density model provides a clear representation of the spatial distribution characteristics of research samples. This section of this study utilized the kernel density

analysis method to examine the national-level ICH projects within the Grand Canal Basin, yielding kernel density distribution maps for the overall ICH and its various categories (Figure 4). Figure 4a reveals that the distribution of ICH in the Grand Canal Basin exhibited a spatial pattern described as "largely dispersed with small clusters". A high-density core area was formed, centered around the Haidian District, Jing'an District, and Chaoyang District of Beijing. A secondary density core area was centered around Hangzhou City in Zhejiang Province. As the capital of China, Beijing has been a significant economic, political, and cultural center since the Tang Dynasty, possessing a long-standing history and abundant cultural heritage. It has nurtured numerous traditional crafts that have thrived and flourished throughout history.
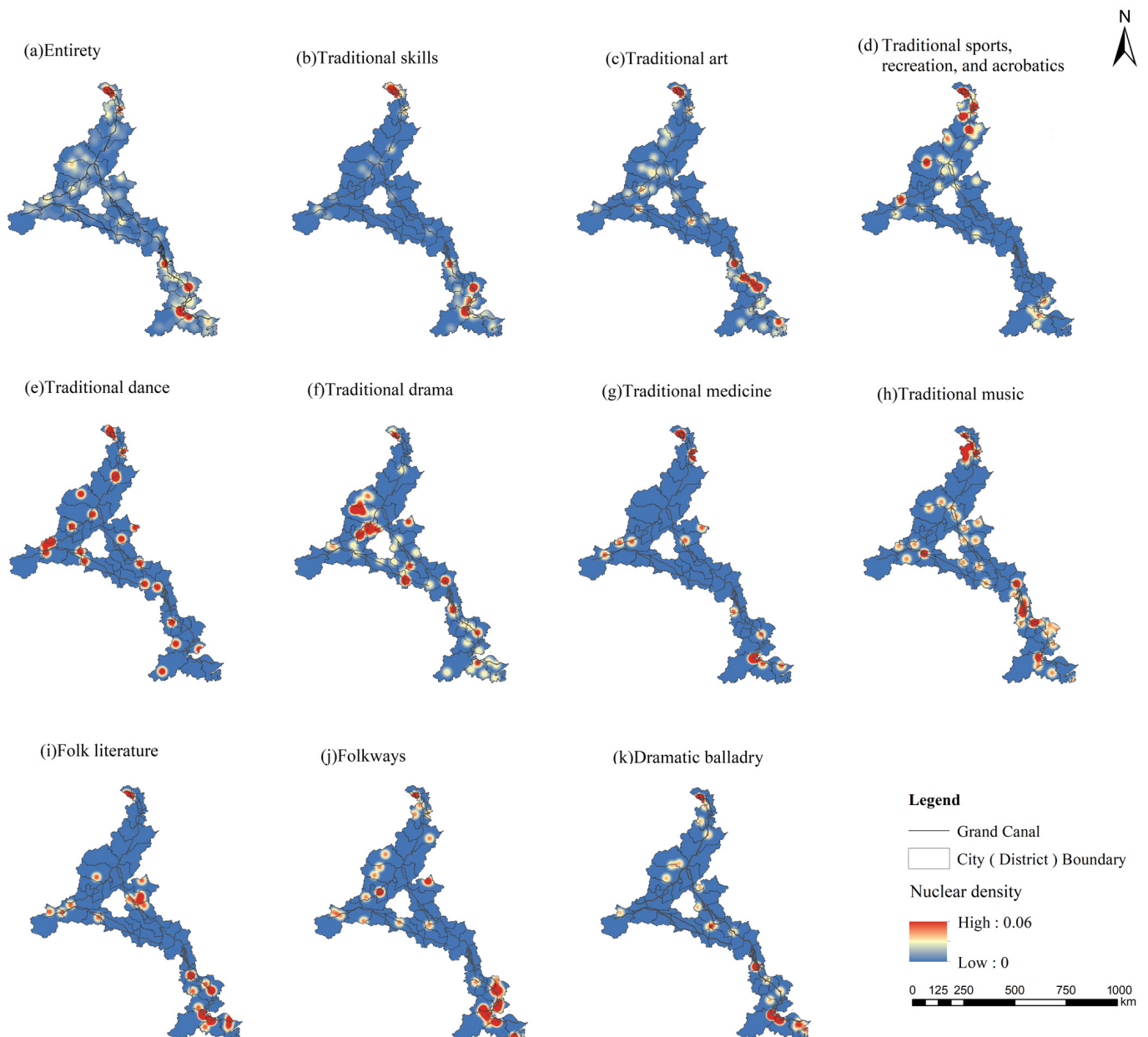
Figure 4. Nuclear density maps of various ICH types: (**a**) the entirety of ICH; (**b**) traditional skills ICH; (**c**) traditional art ICH; (**d**) traditional sports, recreation, and acrobatics ICH; (**e**) traditional dance ICH; (**f**) traditional drama ICH; (**g**) traditional medicine ICH; (**h**) traditional music ICH; (**i**) folk literature ICH; (**j**) folkways ICH; and (**k**) dramatic balladry ICH.

Figure 4b–k illustrate that various ICH categories exhibited distinct aggregation zones. The distribution was uneven and significantly varied in scope due to differences in the preservation environments, regions of origin, participation ease, dissemination velocity, and range. Specifically, ICH related to traditional craftsmanship, traditional visual arts, traditional sports, games and acrobatics, and traditional medicine were most densely concentrated at the junction of the Haidian, Jing'an, and Chaoyang districts in Beijing. Folk literature and dramatic balladry ICH were predominantly found at the borders of the Haidian, Jing'an, and Chaoyang districts in Beijing, as well as at the intersection of Hangzhou and Shaoxing in Zhejiang Province. Traditional music ICH was richest at the boundary between Langfang City in Hebei Province and the cities of Yangzhou and Zhenjiang in Jiangsu Province, with additional clusters in the Haidian, Xicheng, and Chaoyang districts along the Grand Canal in Beijing; the Beichen and Xiqing districts in Tianjin; Changzhou in Jiangsu Province; and Hangzhou in Zhejiang Province. Traditional drama ICH was most concentrated at the intersection of Handan City in Hebei Province; Hebi City, Puyang City, and Anyang City in Henan Province; and Suzhou and Huaibei City in Anhui Province, with further concentrations along the Grand Canal in Suzhou, Yangzhou, and Huai'an in Jiangsu Province and Shaoxing in Zhejiang Province. Folklore ICH was most densely clustered at the junction of Suzhou, Jiaxing, Shaoxing, and Huzhou in Zhejiang Province. The analysis indicates that, generally, the intensity of ICH aggregation was higher in areas centered around the Haidian, Xicheng, and Chaoyang districts in Beijing, and Hangzhou and Shaoxing in Zhejiang Province.

3.2. Temporal Distribution Patterns

The Grand Canal Basin boasts a long and storied history. This study categorized the Grand Canal's origin and the emergence of ICH into seven historical periods: the Pre-Qin era (Xia, Shang, and Zhou dynasties); the Qin and Han dynasties; the Wei, Jin, and Northern and Southern dynasties (including the Three Kingdoms, Jin, and Southern and Northern dynasties); the Sui and Tang dynasties (including the Five Dynasties and Ten Kingdoms period); the Song and Yuan dynasties; the Ming and Qing dynasties; and the modern era (Table 2) [36]. Grasping the distribution characteristics of ICH from a temporal perspective aids in uncovering the historical factors influencing the origin of ICH and their mechanisms of action. The quantitative changes across different historical periods reflect the rise and fall of various cultural heritages, with their centroids and trajectories recording the influencing factors. Each historical phase of the ICH along the Grand Canal has its own characteristics, reflecting the economic and cultural landscape of the time.

ICH originating from the Pre-Qin era comprised 69 items, primarily traditional skills, traditional sports, games, and acrobatics, and traditional music, mainly distributed in the northern part of the Grand Canal, namely, the Beijing area. ICH from the Qin and Han periods totaled 32 items, with a focus on traditional skills and traditional arts, predominantly found in the southern section of the Grand Canal. ICH from the Wei, Jin, and Northern and Southern dynasties amounted to 30 items, characterized by folk literature and traditional music, also mainly located in the southern part of the Grand Canal. ICH from the Sui and Tang dynasties included 61 items, with traditional skills and traditional arts being the predominant categories, and it was primarily distributed in the southern section of the Grand Canal. ICH from the Song and Yuan periods comprised 60 items, featuring traditional skills and folklore, and was largely concentrated in the southern section of the Grand Canal. The Ming and Qing periods exhibited the highest number of ICH items, with 238 entries, accounting for 47.22% of the total, led by traditional drama and traditional skills, followed by traditional sports, games, and acrobatics, and dramatic balladry. The distribution of ICH during this era was mainly in the northern and southern ends of the Grand Canal, that is, in Beijing and the Jiangsu and Zhejiang regions, indicating a highly prosperous culture with the emergence of various artistic and cultural forms. ICH from the modern era consisted of 14 items, primarily traditional skills, and was mainly found in the southern section of the Grand Canal. The Ming and Qing periods had the highest

number of ICH items, followed by the Pre-Qin, Sui and Tang, Song and Yuan, Qin and Han, Wei, Jin, and Northern and Southern dynasties, and the modern era. This reflects that the political stability and cultural vibrancy of the Ming and Qing periods led to a proliferation of ICH; meanwhile, the politically turbulent and war-ridden Wei, Jin, and Northern and Southern dynasties saw a relative dearth of ICH, demonstrating a close correlation between the flourishing of ICH and the political and cultural environment of the era [37,38].

From the Pre-Qin era to the modern period, the centroid trajectory of ICH in the Grand Canal Basin exhibited a north-to-south oscillatory pattern, with an overall southward trend (Figure 5). This was specifically manifested in the following historical centroids: the centroid was located in Zaozhuang City during the Pre-Qin period; in Xuzhou City during the Qin and Han dynasties; in Huai'an City during the Wei, Jin, and Northern and Southern dynasties; in Suzhou City during the Sui and Tang dynasties; returned to Xuzhou City during the Song and Yuan periods; in Jining City during the Ming and Qing dynasties; and in Suqian City in the modern era. This pattern suggests that the migration of the ICH centroid was likely intimately connected with the fluctuations in regional political, economic, and cultural configurations throughout various historical periods.
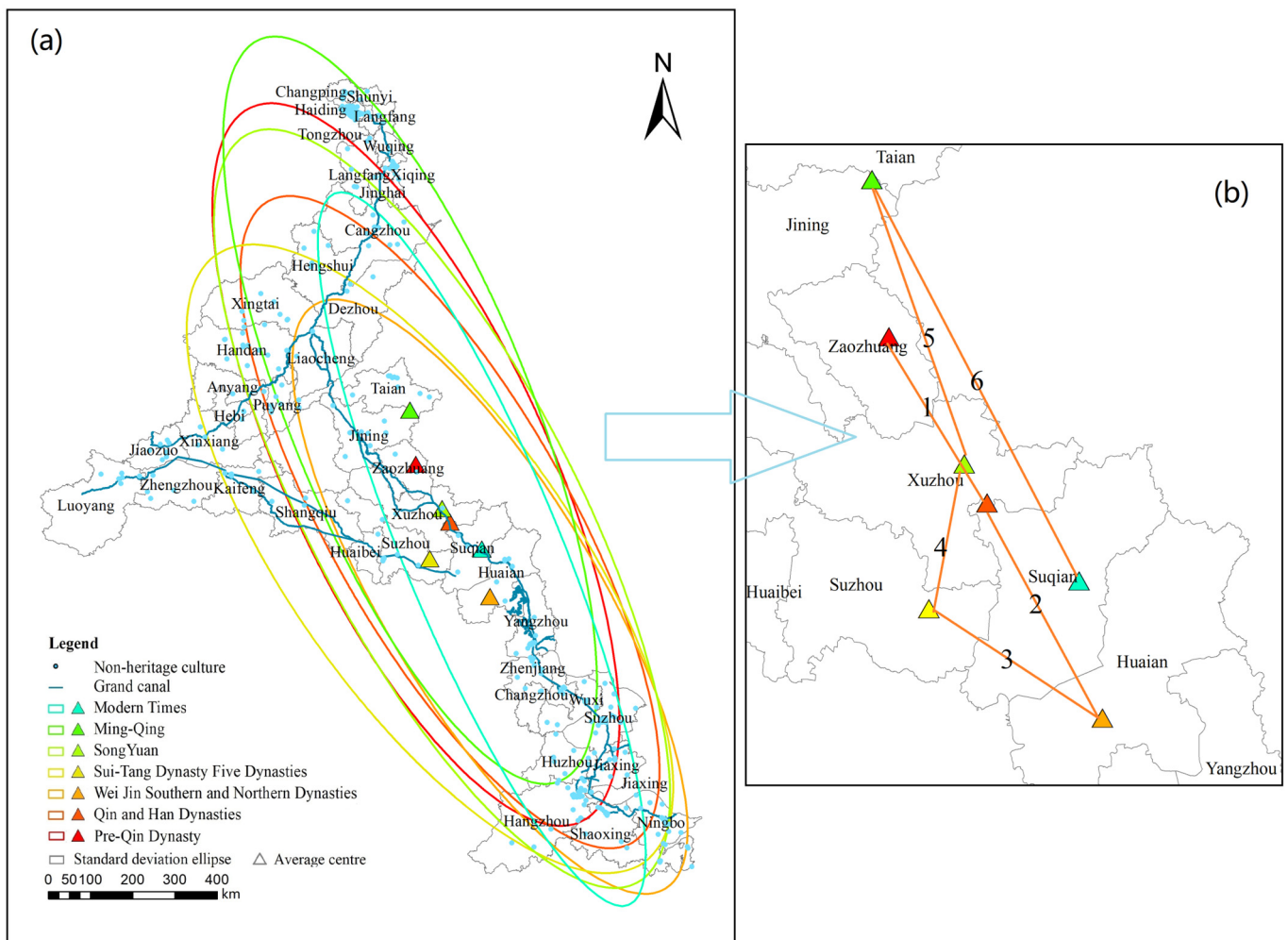
Figure 5. The average centroid migration trajectory of ICH in different periods: (**a**) the SDE; (**b**) the mean center. (the number shows the timeline).

Table 2. The number distribution table of ICH types in each historical period in the Grand Canal Basin.

Category	Pre-Qin	Qin and Han	Wei and Jin	Sui and Tang	Song and Yuan	Ming and Qing	Modern Times
Traditional skills	16	9	3	14	15	40	5
Traditional art	10	6	5	17	8	21	1
Traditional sports, recreation, and acrobatics	10	2	4	2	4	28	1
Traditional dance	2	1	0	4	3	15	0
Traditional drama	1	3	0	3	7	49	6
Traditional medicine	6	0	0	0	2	16	0
Traditional music	6	5	7	2	4	26	0
Folk literature	9	4	8	7	1	3	1
Dramatic balladry	8	2	3	8	11	11	0
Folkways	1	0	0	4	5	29	0
Total	69	32	30	61	60	238	14
Proportion/%	13.69	6.35	5.95	12.10	11.90	47.22	2.78

3.3. Influencing Factors of ICH Distribution

The formation and spatial distribution of ICH are influenced by the interplay between the natural environment and socioeconomic development, with topography, climate, transportation conditions, and population being significant factors [39,40]. This study referred to the research of relevant scholars and combined the specific circumstances of the Grand Canal to analyze the influential factors of ICH's spatial distribution from two dimensions—natural environmental factors and socioeconomic factors—encompassing ten specific indicators, including topography, vegetation, climate, economic development level, urbanization, population, nation, and traffic conditions. Subsequently, the geographical detector method was employed to calculate the impact of each indicator on the spatial distribution of the ICH in the Grand Canal Basin.

The q-values of the influencing factors were obtained using the geographical detector (Table 3). In the geographical detector, the Q-value was used to measure the explanatory power of the independent variable for the dependent variable. The larger the Q-value, the stronger the explanatory power of the independent variable for the dependent variable. The *p*-value represented the significance level of the factor for the outcome. The smaller the *p*-value, the higher the significance of the variable for the outcome. A *p*-value of less than 0.05 indicated a significant difference, while a *p*-value greater than 0.05 indicated no significant difference. The driving factors were ranked by their explanatory power as follows: urbanization (0.465) > population (0.282) > level of economic development (0.257) > transportation conditions (0.256) > slope (0.170) > mean annual temperature (0.132) > NDVI (0.121) > aspect (0.116), with DEM, ethnicity, and annual precipitation having a lesser impact on ICH. The influences of different dimensions and indicators on the spatial distribution of ICH in the Grand Canal Basin varied, with socioeconomic factors having a stronger impact than natural environmental factors. Based on the *p*-value test results, only four factors—GDP, urbanization rate, population, and highway mileage—passed the significance test, indicating their statistical significance. Urbanization (0.465), population (0.282), and the level of economic development (0.257) were the three most influential indicators. The level of urbanization reflects cities' development and economic prosperity, the level of economic development reflects the region's economic strength, and the population reflects the concentration of people in the area. This suggests that ICH represents a higher-level cultural pursuit after economic conditions have matured and basic material needs have been met. With the acceleration of urbanization, the social structure, lifestyle, and values of the Grand Canal Basin have significantly changed, directly affecting the inheritance and development of ICH.

Table 3. Geographical detector results of influencing factors of ICH.

Factor Type	Impact Factor		Q-Value	*p*-Value
Natural environmental factor	Topography	Topography (X1)	0.069	0.713
		Gradient (X2)	0.170	0.404
		Aspect (X3)	0.116	0.407
	Vegetation	Vegetation cover (X4)	0.121	0.415
	Climate	Annual average temperature (X5)	0.132	0.750
		Annual mean precipitation (X6)	0.066	0.789
Socioeconomic factor	Economic development level	GDP(X7)	0.257	0.041
	Urbanization	Urbanization rate (X8)	0.465	0.013
	Population	Population (X9)	0.282	0.042
	Nation	Population of ethnic minority (X10)	0.053	0.726
	Traffic condition	Highway mileage (X11)	0.256	0.042

4. Discussion

ICH is a vital expression of regional culture. Its distribution characteristics, patterns of spatiotemporal evolution, and methods of dissemination are influenced by several factors within the sociocultural ecological context. The ICH distribution is primarily affected by three dimensions: natural, social, and economic factors. A more detailed exploration of these influencing factors can be undertaken by examining both natural environmental indicators and socioeconomic indicators [41,42].

4.1. Distribution Patterns and Evolution of ICH

The ICH in the Grand Canal Basin exhibited significant spatial clustering, with concentrations observed in high-density core areas along the canal. Specifically, these concentrations were evident in the northern part (with the Haidian, Xicheng, and Chaoyang districts of Beijing at the center) and the southern part (with Hangzhou and Shaoxing in Zhejiang Province at the core). The ends of the Grand Canal, serving as high-density core areas for ICH distribution, were centered around Beijing in the north and Hangzhou and Shaoxing in the south. Historically, these regions have been major political, economic, and cultural hubs with a deep cultural heritage. As a vital transportation artery connecting the north and south, the Grand Canal has historically fostered the cultural prosperity of these areas. Consequently, the concentrated distribution of ICH items in these regions indicates that these cultural centers have formed pivotal nodes for cultural communication and exchange along the canal.

There was an agglomeration of traditional arts and skills ICH, whereas traditional dance ICH showed weaker clustering, exhibiting a spatial pattern characterized by "large dispersion with small agglomerations." The dense concentration of ICH items such as traditional skills, arts, and drama in these core areas suggests that these regions' rich economic and cultural history provides robust support for the preservation and development of ICH. Additionally, different types of ICH displayed varied distribution patterns. For instance, traditional dance tended to be more dispersed, reflecting diverse inheritance conditions and regional differences between ICH types. Traditional music was most abundant at the junction of Langfang City in Hebei Province and Yangzhou and Zhenjiang in Jiangsu Province; traditional drama ICH was most concentrated at the intersection of Handan City in Hebei Province, Hebi, Puyang, and Anyang in Henan Province, and Suzhou and Huaibei in Anhui Province. The cultural core belts formed along the north and south ends of the canal drive widespread cultural diffusion across the larger region. Meanwhile, "small agglomerations" reflect the unique characteristics and influence of specific regional cultures. Distinctive types of ICH have developed in different cultural zones along the canal, such as drama, calligraphy, and painting in the north and handicrafts and traditional skills in the south.

The centroid trajectory of ICH in the Grand Canal Basin oscillated from north to south but, overall, showed a southward shift. This trajectory reflects the rise and fall of various

cultural heritages over time, with their centroids and trajectories recording the influencing factors. The Ming and Qing dynasties demonstrated the highest number of ICH items, accounting for approximately 47.22% of the total, which reflects the relatively stable politics and prosperous culture during these periods. Following these, the Pre-Qin, Sui, and Tang dynasties and the Song and Yuan periods also featured numerous ICH items, indicating notable cultural diversity and regional characteristics. The comparatively fewer ICH items from the Wei, Jin, and Northern and Southern dynasties suggest a close relationship between the flourishing of ICH and the era's political and cultural environment.

4.2. Natural Influencing Factors of ICH Distribution

Different natural geographical environments foster diverse cultural forms, leading to varied manifestations of ICH. The natural environment necessitates and facilitates the distribution of ICH. The influence coefficients for topography, vegetation, and climate were $q = 0.069$, $q = 0.170$, $q = 0.116$, $q = 0.121$, $q = 0.132$, and $q = 0.066$, respectively. In terms of geomorphological features, the Grand Canal Basin is predominantly composed of plains and hills, with a minimal plateau distribution. The overall topographical variation across the region is relatively minor. This terrain is conducive to cultural production and exchange and has promoted the emergence and dissemination of ICH. In terms of vegetation, higher coverage contributes to the protection and restoration of the ecological environment along the Grand Canal, as well as the advancement of cultural tourism. This, in turn, facilitates the display and transmission of ICH elements and creates additional opportunities for the commercialization of ICH. Furthermore, ICH can be considered a product of people's direct perception of the climate [41–43]. The Grand Canal Basin spans a vast area, traversing six provinces and cities including Beijing, Tianjin, Hebei, Shandong, Jiangsu, and Zhejiang, and connects major river systems such as the Haihe, Yellow River, Huai River, Yangtze River, Taihu Lake, and Qiantang River. The region north of the Huai River is characterized by a warm, temperate, semi-humid monsoon climate, while the south belongs to a subtropical, humid monsoon climate. The presence of this climatic transition zone reflects the complexity and diversity of the climatic zones within the Grand Canal Basin. Favorable climatic conditions can lead to regional development and population aggregation, which, in turn, fosters cultural genesis. Therefore, the ICH distribution in the Grand Canal Basin is more concentrated in the southern areas.

4.3. Socioeconomic Influencing Factors of the Distribution of ICH

ICH arises from human activities, and its transmission and preservation heavily rely on human efforts. Socioeconomic behaviors significantly affect the development of ICH [44,45]. There was a positive correlation between socioeconomic factors and the spatial distribution of ICH, with the following ranking of influencing factors: urbanization (0.465) > population (0.282) > level of economic development (0.257) > transportation conditions (0.256) > ethnicity (0.053). Urbanization had the most pronounced influence on the spatial distribution of ICH in the Grand Canal Basin. Areas with high urbanization levels, such as Beijing, Suzhou, and Yangzhou in Jiangsu Province, Hangzhou and Ningbo in Zhejiang Province, and Zhengzhou in Henan Province, tended to form clusters of ICH. Since ancient times, cities such as Beijing and Suzhou have held significant positions in the history of China. Having served as the capital for multiple dynasties, Beijing possesses a rich urban heritage. Consequently, it has a substantial number of preserved ICH items. As urbanization has progressed, urban agglomerations have emerged in many cities along the Grand Canal, driving urban vitality and revival, industrial transformation, and economic prosperity. This also provides more platforms for the transmission and development of ICH. Population density also plays a significant role in the spatial distribution of ICH. Regions with higher population densities often experience increased cultural exchanges, which benefit the transmission and development of ICH. One of the challenges facing ICH preservation is the aging of its practitioners and a lack of interest among younger generations in traditional skills. In this context, areas with high population densities are more likely to attract and

cultivate new practitioners, enhancing the transmission of ICH to broader populations. Transportation infrastructure has also significantly impacted the spatial distribution of ICH in the Grand Canal Basin. As a water–land transportation corridor connecting the northern and southern regions, as well as the inland and maritime Silk Roads, the Grand Canal plays a pivotal role in water conservancy and shipping. Its fluidity and connectivity provide extensive opportunities for the dissemination and exchange of ICH along its route, promoting cultural diversity and richness. Finally, the influence of ethnicity on the spatial distribution of ICH is comparatively minor in this region.

The formation of ICH in different regions is closely related to their historical evolution. From the perspective of traditional music, Langfang and Yangzhou possess an abundant historical culture and unique artistic forms and values. Yangzhou, located near the Yangtze River and the Beijing–Hangzhou Grand Canal, enjoys a superior geographical position and served as a national economic and cultural hub during the Qing Dynasty. This facilitated a wealth of folk-art creations, laying the groundwork for the prosperity of musical ICH. From the perspective of traditional drama, Henan has historically been a political, economic, and cultural center for multiple dynasties in China, developing a rich regional culture. The origins of Henan opera can be traced back to the pre-Qin period, with the prevalence of song and dance at the time leading to the significant development of drama. During the Song Dynasty, the public's fondness for theater further promoted the development of dramatic arts.

5. Conclusions

This study analyzed the spatial structure and influencing factors of 504 national-level ICH items in the Grand Canal Basin, leading to the following conclusions:

(1) There was a significant regional disparity in the distribution of national-level ICH along the Grand Canal Basin, which was mainly distributed along the canal and concentrated at the southern and northern ends. The quantity and structure of ICH types were uneven, with a predominance of traditional skills and traditional drama categories.

(2) The ICH projects in the Grand Canal River Basin generally exhibited a clear pattern of clustered distribution, presenting a spatial structure characterized by "large dispersion, small aggregation." All ICH categories also showed a clustering trend, with traditional arts and traditional skills ICH demonstrating stronger aggregation. The aggregation areas for each type of ICH varied. However, overall, the regions centered on Haidian District, Xicheng District, and Chaoyang District in Beijing, and Hangzhou and Shaoxing in Zhejiang Province were high-density core areas for most ICH types.

(3) The migration trajectory of the average center of ICH in the Grand Canal Basin oscillated from north to south; however, overall, it showed a southward-moving trend. The quantity changes in different historical periods reflect the rise and fall of the history of various cultural heritages, and their average centers and trajectories record the influencing factors. The largest number of ICH items originated from the Ming and Qing dynasties, which may reflect the relatively stable politics and active culture during the Ming and Qing periods. By contrast, there were relatively fewer ICH items during the politically turbulent and war-prone Wei and Jin periods.

(4) There were differences in the influences of various factors on the spatial distribution of the ICH in the Grand Canal Basin. Among socioeconomic factors, urbanization, the economic development level, and population significantly impacted the spatial distribution of ICH, with urbanization having the strongest determining power. The impact of natural environmental factors was relatively smaller but remained an indispensable factor in the development of ICH.

This study employed various spatial analysis methods to reveal the agglomeration trends in ICH, demonstrating the combined effects of historical, cultural, economic, and policy factors, and highlighting the unique cultural value and status of the canal regions in the process of ICH protection, inheritance, and development. As urbanization accelerates,

ICH faces opportunities for development alongside numerous challenges in terms of inheritance and protection, requiring the joint efforts of the government and society. Firstly, the government must strengthen the exploration and protection of cultural heritage, improve the digital construction of cultural heritage archives, establish inventories, and enhance societal cooperation. Secondly, it is essential to fully leverage the demographic advantages of the local population to increase societal attention to the canal culture, thereby fundamentally deepening the recognition and understanding of ICH. Lastly, regional differences that give rise to diverse cultures result in ICH variations. The government should focus on integrating the development of the Grand Canal's culture with the tourism industry, develop canal characteristic tourism according to local conditions, and promote the prosperity of the canal cultural belt. This study revealed an uneven ICH distribution along the Grand Canal, with higher concentrations at the northern and southern extremities compared with the central regions. To address this disparity, efforts should focus on bolstering cultural collaboration and exchange, particularly in the central areas. Enhancing the sharing and promotion of cultural resources could elevate the influence and visibility of ICH in these less-represented regions. Adopting customized protection and inheritance strategies, integrated with tourism and cultural creative industries, could augment the economic value and social impact of ICH. Moreover, the protection and inheritance of ICH should be recognized as cultural responsibilities and integral components of the educational system, particularly promoting ICH education in schools along the Grand Canal, to foster a sense of recognition and belonging to traditional culture among the younger generation, thereby ensuring the continuation of ICH culture.

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