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Spatial pattern and influencing factors of intangible cultural heritage of music in Xiangxi, central China

Xianyong Zhang¹, Hui Xiang^{2*} and Rui Liu³

Abstract

Intangible cultural heritage of music (ICHM) is an important part of intangible cultural heritage (ICH), and research on ICHM has extremely important theoretical value and practical significance. In this study, we aimed to analyze the spatial distribution characteristics of ICHMs and explore the main factors affecting their distribution in Xiangxi, Central China. Methods such as the nearest neighbor index, kernel density estimation, and buffer analysis were used in this study. The main conclusions are as follows: (1) the numbers of traditional music, traditional dance, traditional drama and quyi are 26, 29, 28 and 14, respectively, indicating that quyi is relatively lacking in Xiangxi; (2) the distribution of ICHMs in Xiangxi have spatial heterogeneity, and the main trend is agglomeration. The national ICHMs, provincial ICHMs and municipal ICHMs are mainly concentrated in the south, the west, and the central and northern regions, respectively. The high-density areas of traditional music and traditional dance are located in the south, of traditional drama in the west, and of quyi in the north. (3) The distribution of ICHMs is affected by four factors: namely rivers, topography, GDP and transportation. The 0–3 km buffer zone of the rivers, with 100% of national ICHMs, 83.33% of provincial ICHMs and 84.52% of municipal ICHMs, is the centralized distribution area of ICHMs. 100% of the national ICHMs, 94.44% of the provincial ICHMs and 91.67% of the municipal ICHMs are distributed in hilly (200–500 m) and low mountain areas (500–1000 m). Highways have the greatest impact on the distribution of ICHMs, followed by railways and ordinary roads. The economy has a significant positive impact on ICHM programs; the more developed the economy, the more ICHM projects. The results of this study can provide useful references for the theoretical research and practice management of ICH.

Keywords: Intangible cultural heritage of music, Spatial pattern, Influencing factors, Xiangxi, Utilization and protection

Introduction

Cultural heritage has two forms: material and intangible [1, 2], and the latter is intangible cultural heritage (ICH). ICH has important social, history, aesthetics, artistic, science and cultural values [1], and it is the spiritual treasure and "living" representation of national culture [2, 3]. ICH of music (ICHM) is an important part of ICH, and

it has been formed in a specific historical period. Furthermore, it has the characteristics of times, uniqueness, nationality, regional, and so on. Moreover, its inheritance and protection are difficult due to its scarcity and uniqueness. Therefore, research on ICHM has extremely important theoretical value and practical significance. Such efforts include improving the relevant theories of cultural research and promoting the prosperity and rejuvenation of national culture.

With the increasing attention around the world to ICH, research on ICH has gradually become the core of academic circles [3–6]. Previous studies have examined ICH

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from the following three perspectives. First, the concept and categories of ICH have been clarified. ICH is the schematic diagram of lived practice, the creation of the heritage-maker [4]. Currently, ICH has been divided into 10 types [7] in China. These are folk literature, traditional music, traditional dance, traditional drama, quyi, folk custom, traditional art, traditional handicraft, traditional medicine, and sports recreation competition. Second, the research contents of ICH includes innovative educational interventions [8], protection modes [4], evaluation of value [9], incentive mechanisms and strategy choices [5]. Third, the research methods are diversified. For example, literature analysis [10], investigation and interview [4, 11], case demonstration [12], and scoring quantification methods [9]. Studies of ICH are conducive to the development and protection of ICH from the integrity. Nevertheless, they are unable to give local and subtle guidance to ICHM.

Scientific literature on ICHM has been scarce, a small number of studies have been carried out from the perspective of music culture or musical heritage. Wang [13] has discussed the role of Internet in protecting and promoting music culture through keyword search on the website. She found that Internet has played a vital role in popularizing music culture, promoting the new development of composers and musicians and generating considerable income. Uptis [14] has explored the interrelationship between musical heritage and technology through interviews. He didn't deny the importance of technology, but he also reminded the centrality of social participation. He argued that technology was important as it might enhance and even transform our inherited customs, while the effectiveness of the technology mainly depended on the participation of the public. Arno and Brandellero [15] have conducted a survey in Dutch museums and archives on popular music heritage. They found that the aim of museums and archives was to preserve popular music heritage. And they claimed that local sociocultural history has been present through archiving and displaying popular music from the past in museums and archives. At the same time, they also believed that museums and archives had limitations, such as ignoring the connection between music in different regions and the impact of immigrants on local culture. It can be seen that the existing studies have mainly looked into the impact of networks, social participation or museums and archives on music culture or musical heritage. Simultaneously, the main methods used in the literature were web search or field surveys, and the geographical methods and techniques were rarely addressed.

Some literature has investigated the spatial distribution and influencing factors of cultural heritage [16, 17] or ICH [18, 19]. Yao et al. [16] confirmed that world cultural

heritage was densely distributed along the Mediterranean coast in Europe, and relatively even in Asia and Africa; Liang et al. [17] argued that the number of cultural heritage sites in Europe and North America was much higher than that in Asia and the Pacific, and heritage sites were affected by many factors, such as global politics, policies and economic crises; Jiang et al. [18] confirmed that ICHs in Chongqing was more in the south and less in the north; Zhang et al. [19] argued that the uneven distribution of ICH in Shanxi was affected by landform, climate, economy and culture. Nevertheless, topics on the spatial pattern of ICHM is rare. Moreover, the spatial heterogeneity of ICHM has been affected by many complex factors such as nature, society and economy, while the influencing factors also have not been fully explored.

In view of this, we conduct an empirical research in Xiangxi, which is a mountainous area, a minority gathering area and a national cultural protection experimental area in China. The spatial pattern of ICHM and its influencing factors are explored by spatial analysis methods and geographic mapping models. For this purpose, this study is carried out as follows:

- (1) A structural analysis is done according to the statistical data of ICHM.
- (2) The distribution characteristics of ICHM are analyzed using geographic methods and techniques, such as geographic mapping, nearest neighbor index and kernel density estimation.
- (3) The influencing factors of ICHM are explored by buffer analysis, layer stacking and other methods.

This research attempts to add the spatial information of ICHM, outline ways to preserve and utilize ICHM, and realize the interdisciplinary research of geography, culture and art. On one side, geographical methods are used to study ICHM, novel and of academic interest, which can provide a method reference for other scholars; on the other side, it may give useful suggestions for the development and protection of ICHM, and contribute to cultural revitalization.

Materials and methods

Research area

Xiangxi (the full name is Xiangxi Tujia and Miao Autonomous Prefecture) lies in Hunan Province, central China (Fig. 1), covering a total area of 15,462 km². It is located at longitudes 109°10'–110°22' E and latitudes 27°44'–29°38' N. There are eight administrative units, and the center is Jishou. The highest and lowest points in Xiangxi are 1742 m and 67 m, respectively. According to its cultural and natural settings, it is a special area with a distinct minority culture. Xiangxi is an ethnic minority area, with

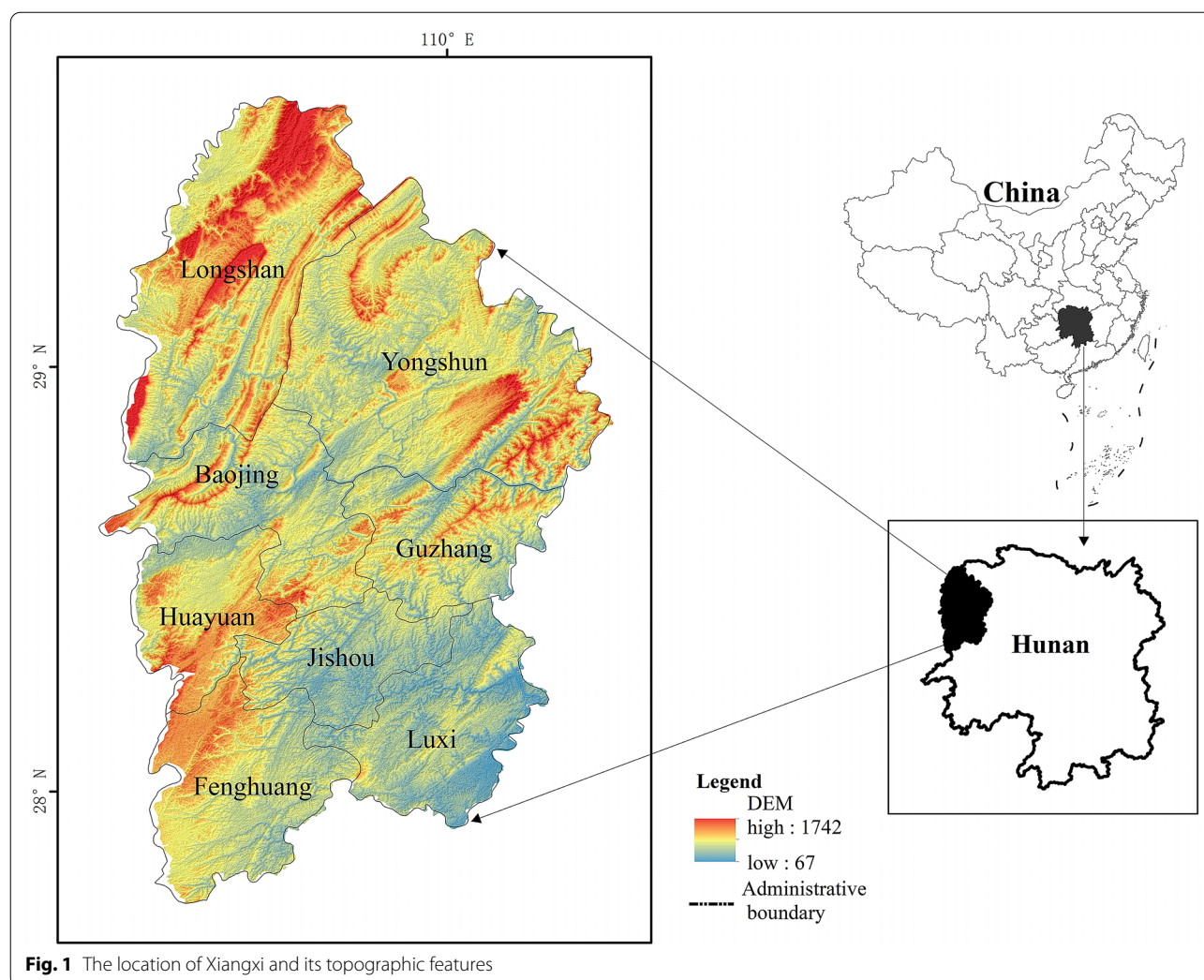


Fig. 1 The location of Xiangxi and its topographic features

more than 90% of the population being ethnic minorities and a long history of minority culture. It is also a national cultural protection experimental area and plays an extremely important role in the protection of ICH. In addition, it is a mountainous area, and the spread of minority culture is blocked by the closed natural environment.

Therefore, the distribution pattern and influencing factors of ICHMs in Xiangxi are different from those in other regions. Moreover, it is representative and typical as a study area, which can provide scientific references for the cultural development of similar regions.

Data sources

The natural datasets (digital elevation model, i.e., DEM, water system) and socioeconomic datasets (administrative boundaries, ICHMs, transportation and GDP) were included in this paper. Among the natural datasets, DEM with a spatial resolution of 30 m was collected from the

Resource and Environmental Science Data Center of the Chinese Academy of Sciences (<http://www.resdc.cn/>). The water system data were obtained from Google Map (<http://www.gugeDitu.Net/>). In the socioeconomic datasets, the administrative boundaries and traffic lines were derived from the national earth system science data sharing platform (<http://www.geodata.cn/>). ICHMs dataset were obtained from the China intangible cultural heritage network (<http://www.ihchina.cn>) and Xiangxi Cultural Tourism Bureau (<http://whlygdj.xx.gov.cn>). The GDP database was from the statistical yearbook in Xiangxi (2019).

Research methods

Graphic visualization of ICHMs

Excel 2016 and ArcGIS 10.2 were used to realize graphic visualization of ICHMs. First, excel 2016 was used to count the batch, longitude, latitude and other attributes of ICHMs in Xiangxi. Second, the longitude and latitude

dataset of ICHMs were transformed into maps based on ArcGIS 10.2. Third, color rendering was realized according to the attribute differences.

The nearest neighbor index

The nearest neighbor index tool of ArcGIS 10.2 was used to delimit the spatial distribution types of ICHMs (discrete, random, agglomeration), and it included two steps. First, the nearest distance was calculated according to the longitude and latitude of ICHMs [20]. Second, Z and P tests were carried out to verify the reliability of the model. The nearest neighbor index (NNI) was calculated as follows [21]:

$$NNI = \frac{\overline{D_o}}{\overline{D_e}} \quad (1)$$

$$\overline{D_e} = \frac{0.5}{\sqrt{n/A}} \quad (2)$$

In the above formulas, the spatial points are discrete distribution if NNI is greater than 1, randomly distributed equal to 1, and agglomeration distribution less than 1; $\overline{D_o}$ is the actual average nearest neighbor distance; $\overline{D_e}$ is the expected average distance; n represents the number of observation points; A is the total area of the study area.

The formula for Z test is as follows:

$$Z = \frac{\overline{D_o} - \overline{D_e}}{SE_{d(ran)}} \quad (3)$$

$$SE_{d(ran)} = \frac{0.26162}{\sqrt{n^2/A}} \quad (4)$$

In the above formulas, when $-1.96 < Z < 1.96$, it indicates that it has not passed the significance test [20]; when $Z > 1.96$ or $Z < -1.96$, it is considered that the result is significant.

Kernel density estimation

Kernel density estimation has the advantages of three-dimensional, intuitive, simple and high precision [22–24], and it has been widely used in many fields [25–28]. Consequently, kernel density estimation is adopted to evaluate the density of ICHMs, and its calculation formula is as follows:

$$P_i = \frac{1}{n\pi R^2} \times \sum_{j=1}^n K_j \left(1 - \frac{D_{ij}^2}{R^2}\right)^2 \quad (5)$$

where P_i is the density of point i ; K_j is the weight of observation point j ; D_{ij} is the distance between point i

and observation point j ; R is the smoothing constant or bandwidth; $R > D_{ij}$; and n is the number of observation points within R [29, 30].

Buffer analysis

To reveal the spatial distribution relationship between the ICHMs and the rivers, 1 km, 3 km and 5 km buffer zones of the rivers are established by using the buffer analysis function of ArcGIS 10.2. The formula is as follows:

$$B_i = \{x : d(x, U_i) \leq R\} \quad (6)$$

where: B_i is the buffer zone; x is the observation point; U_i is the river i ; d is the distance from x to the rivers; and R is the radius.

Results and analysis

The structure of ICHM in Xiangxi

Music can refer to general music (i.e., vocal music, dance, drama, and quyi) and special music (i.e., vocal music). This study uses the first definition, and therefore, we divided ICHMs into four categories (i.e., traditional music, traditional dance, traditional drama, quyi). By the end of August 2020, the national, provincial and municipal ICHMs in Xiangxi were 9, 18 and 84, respectively (Table 1).

The national ICHMs are mainly composed of traditional music and traditional dance, while traditional drama and quyi are relatively rare. The numbers of traditional music and traditional dance are 5 and 3, accounting for 55.56% and 33.33% of the total, respectively. The quantities of traditional drama and quyi are 1 and 0, accounting for 11.11% and 0%, respectively.

The structures of provincial and municipal ICHMs are similar; that is, they are dominated by traditional music, traditional dance and traditional drama. For the provincial ICHMs, the numbers of the three are 5, 6,

Table 1 The statistics of ICHMs in Xiangxi (items)

| Categories | National ICHMs | Provincial ICHMs | Municipal ICHMs | The total |
|-------------------|----------------|------------------|-----------------|-----------|
| Traditional music | 5 | 5 | 23 | 26 |
| Traditional dance | 3 | 6 | 25 | 29 |
| Traditional drama | 1 | 5 | 24 | 28 |
| Quyi | 0 | 2 | 12 | 14 |
| The total | 9 | 18 | 84 | 97 |

There are overlaps in some ICHMs, for example, A is not only a national ICHM, but also a provincial ICHM. According to the existing research [17–19] and official websites of China intangible indigenous cultural heritage network (<http://www.ihchina.cn>) and Xiangxi Cultural Tourism Bureau (<http://whlygdj.xx.gov.cn>), the overlaps are handled as follows: they are removed as counting the number of all ICHMs (including all national, provincial and municipal items); not removed, counting that of a single level. Therefore, the number of ICHMs in the fifth column is not the sum of national, provincial and municipal ICHMs

and 5, accounting for 27.78%, 33.33% and 27.78% of the total, respectively. The rest 11.11% (2 items) are quyi; For the municipal items, the quantities of the dominant three are 23, 25, and 24, and the proportions are 27.38%, 29.76 and 28.57%, respectively. The number of quyi is 12, accounting for only 14.29% of the total.

On the whole, traditional music, traditional dance and traditional drama are abundant (the quantities are 26, 29 and 28, and the proportions are 26.80%, 29.90% and 28.87% of the total), while quyi is relatively lacking (the quantity is 14, while the proportion is 14.43%). The reason is that the inheritance of quyi mainly depends on teaching from mouth to mouth among individuals, which is prone to loss, resulting in its scarcity. As a result, further excavation and in-depth protection are needed.

The spatial distribution characteristics of ICHM in Xiangxi

The spatial distribution types

According to Table 2, the main spatial distribution trends of ICHMs in Xiangxi are agglomeration. Among them, the values of *NNI*, *Z* and *P* for national ICHMs are 1.6802, 3.9039 and 0, respectively, indicating that they are typical discrete types. The *NNI* of provincial ICHMs was less than 1 (0.8020), but it did not pass the significance test (*P* was -1.670 , and *Z* was 0.1080). The above data show that the provincial ICHMs tend to be randomly distributed. The *NNI* of municipal ICHMs is less than 1 (0.5543), and it passes the significance test (*P* and *Z* were -7.8153 and 0, respectively), indicating that the spatial distribution of the municipal ICHMs has a typical agglomeration characteristic.

The *NNIs* of traditional music, traditional dance and traditional drama are less than 1 (between 0.4 and 0.7), and all have passed the significance test, indicating that the above three are concentrated distributions. The *NNI* of quyi is greater than 1 (1.1480), but it does not

pass the significance test, indicating that it is a random distribution.

The spatial distribution differences

According to Fig. 2, we find that the distribution of ICHMs in Xiangxi is highly heterogeneous.

(1) The national ICHMs are mainly concentrated in the south.

The main parts of the first national ICHMs are traditional dance, and there are five projects, four in Jishou and one in Luxi, all located in the south (Fig. 2a). All items of the second national ICHMs are traditional music, and there are three items in all, which are scattered throughout the region. The remaining item of the fourth national ICHM is distributed in Jishou. Overall, Jishou, the administrative center of Xiangxi, is the enrichment area of national projects. AS for the reasons, Jishou has a relatively developed economy, and it has more sufficient funds for the inheritance and protection of ICHMs.

(2) The provincial ICHMs is dense in the west and sparse in the east.

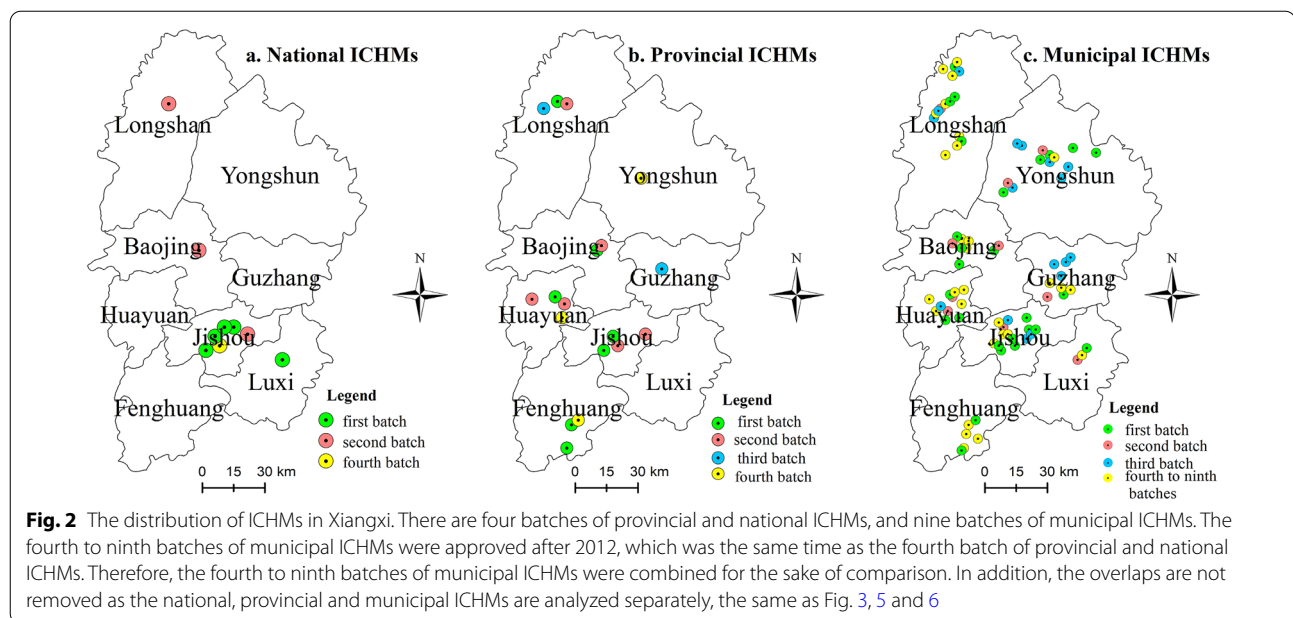
The first batch of provincial ICHMs, with a total of 7 items, are mainly composed by traditional music and traditional drama, and scattered in five administrative units of the west (Fig. 2b). The main components of the second provincial ICHMs are traditional dance, with a total of 6 projects distributed in the northwest and central areas of Xiangxi. The third batch are consisted of traditional drama and traditional dance, one for each, located in Guzhang and Longshan, respectively. There are three types of the fourth batch (traditional drama, traditional music and quyi), one for each, distributed in Yongshun, Huayuan and Fenghuang respectively (Fig. 2b). On the whole, Jishou and Huayuan have the most provincial ICHMs (4 projects each), followed by Baojing, Longshan and Fenghuang (2–3 projects), while Yongshun, Guzhang and Luxi have the least (0–1 project).

(3) Municipal ICHMs are concentrated in the central and northern regions.

Table 2 The nearest neighbor indexes and distribution types of ICHM in Xiangxi

| Categories | The observed value (m) | The expected value (m) | <i>NNI</i> | <i>Z</i> | <i>P</i> | Distribution types |
|-------------------|------------------------|------------------------|------------|-----------|----------|--------------------|
| National ICHMs | 0.1641 | 0.0977 | 1.6802 | 3.9039 | 0.0000 | D |
| Provincial ICHMs | 0.0855 | 0.1066 | 0.8020 | -1.6070 | 0.1080 | R |
| Municipal ICHMs | 0.0328 | 0.0591 | 0.5543 | -7.8153 | 0.0000 | A |
| Traditional music | 0.0385 | 0.0865 | 0.4448 | -6.1018 | 0.0000 | A |
| Traditional dance | 0.0589 | 0.0878 | 0.6708 | -3.6725 | 0.0002 | A |
| Traditional drama | 0.0643 | 0.0904 | 0.7113 | -3.0244 | 0.0025 | A |
| Quyi | 0.1333 | 0.1161 | 1.1480 | 1.0594 | 0.2893 | R |

D is the discrete abbreviation, R is random and A is agglomeration



The first batch of municipal ICHMs mainly focus on traditional music, traditional dance and traditional drama, with a total of 27 projects. Except for 2 items distributed in the southeast (located in Guzhang and Luxi), the other 25 items are all distributed in the north and west (Fig. 2c). The main parts of the second municipal ICHMs are traditional music and traditional dance, with a total of 10 items scattered throughout the region. The third municipal ICHMs, with traditional dances accounting for the largest proportion and a total of 17 items, are concentrated in the central and northern areas of Xiangxi. There are 30 items from the fourth to the ninth batch, which are concentrated in the western region of Xiangxi. In addition, there is little difference in the number of traditional music, traditional dance, traditional drama and quyi (6–8 items). Overall, Fenghuang and Luxi (in the southern area of Xiangxi) are sparse areas of municipal ICHMs, while other administrative units (mainly located in the northern and central parts of Xiangxi) are dense areas.

The spatial aggregation characteristics of ICHMs

(1) The spatial aggregation characteristics of different levels.

For the national ICHMs, there are a high-density circle in the south (located in Jishou) and two subhigh-density circles in the center and north (located in Baojing and Longshan) (Fig. 3a). For the provincial ICHMs, there is a high-density area in the center (between Jishou and Huayuan) and two subhigh-density areas in the north (located in Longshan) and the south (located

in Fenghuang) (Fig. 3b). The only high-density area of municipal ICHMs, which is a long strip, is in the center (between Jishou and Huayuan), and two subhigh-density areas are in the north (located in Yongshun and Longshan) (Fig. 3c).

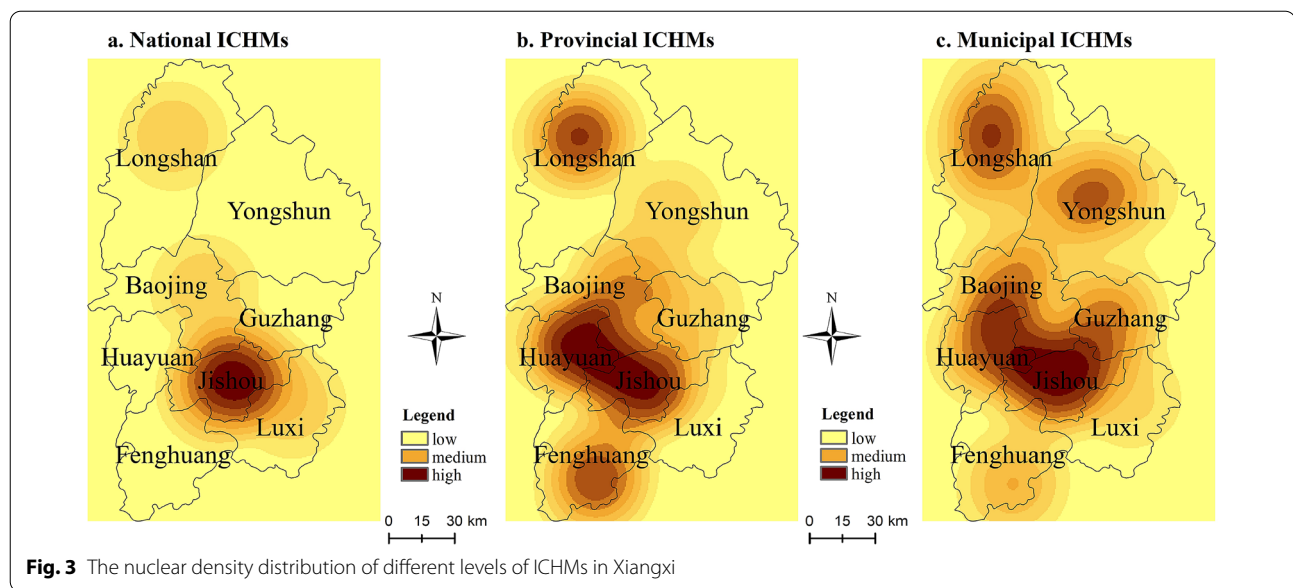
(2) The spatial aggregation characteristics of different types.

The density of traditional music is characterized by three subhigh-density areas (located in Longshan, Yongshun and Fenghuang) surrounding one high-density area (located in Jishou) (Fig. 4a). Traditional dance is concentrated in the south, and the density of which is consistent with the former, and the only one high-density area is located in Jishou and its surrounding areas (Fig. 4b). Traditional drama is concentrated in western Xiangxi, with two high-density areas and two subhigh-density areas. Among them, the two high-density areas are located in Longshan, the junction of Huayuan and Baojing, and the remaining two subhigh-density areas are located in Yongshun and Fenghuang (Fig. 4c). Quyi is concentrated in the north, and the two high-density areas are located in Yongshun and Longshan. The three subhigh-density areas are distributed in the centre and south, located in Guzhang, the junction of Baojing and Huayuan, and Fenghuang (Fig. 4d).

The influencing factors of ICHMs' spatial distribution

The influence of rivers on the distribution of ICHMs

According to Fig. 5, ICHMs are concentrated near the rivers, indicating that rivers are important factors affecting the spatial distribution of ICHMs in Xiangxi. For



national ICHMs, 3 items (accounting for 33.33%) are distributed within the 0–1 km of the river, and 6 items (accounting for 66.67%) are distributed within the 1–3 km (Table 3). The numbers of provincial ICHMs within 0–1 km, 1–3 km and 3–5 km of rivers are 7, 8 and 3, accounting for 38.89%, 44.44% and 16.67%, respectively (Table 3). The numbers of municipal ICHMs within the above three buffer zones are 30, 41 and 13, accounting for 35.71%, 48.81% and 15.48%, respectively (Table 3). In conclusion, the 0–3 km of the river is the centralized distribution area of ICHMs, with 100% national ICHMs, 83.33% provincial ICHMs and 84.52% municipal ICHMs.

The influence of topography on the distribution of ICHMs

Xiangxi is a typical mountainous area with insufficient plain areas, and the ICHMs are mainly concentrated in hilly (200–500 m) and low mountain areas (500–1000 m). Combined with Table 4, the national ICHMs are mainly concentrated in hilly areas, with 7 items, accounting for 77.78% of the total. One item is located in the low mountainous area, accounting for 11.11% of the total. As for provincial ICHMs, 10 items are located in hilly areas and 7 items are located in low mountainous areas, accounting for 94.44% of the total. In addition, 41 projects of municipal ICHMs are located in hilly areas, and 36 projects are located in low mountainous areas, accounting for 91.67% of the total. As a whole, the distribution of ICHMs has the directivity of low altitude, and the numbers in different terrains varies significantly, which decrease with the increase of altitude.

The influence of transportation on the distribution of ICHMs

Transportation, which promotes population agglomeration [31, 32] and has an important impact on human production and life [33, 34], is an important factor affecting the distribution of ICHMs. According to Fig. 6, the distribution of ICHMs in Xiangxi has traffic directivity. National ICHMs are distributed at the intersection of or along the main highways (Fig. 6a). The distribution of most provincial ICHMs is consistent with the national ICHMs, that is, at the intersection of or along the main highways, while a small amount is distributed along the railways (Fig. 6b). Municipal ICHMs are also distributed along traffic lines (highways, ordinary roads or railways), and they are particularly dense at the intersections of traffic lines (Fig. 6c). On the whole, highways have the greatest impact on ICHMs distribution, followed by railways and ordinary roads.

The influence of economy on the distribution of ICHMs

According to Fig. 7 (the abscissa is the quantity of ICHMs, and the ordinate is GDP), the economic development level of Xiangxi is closely related to the spatial distribution of ICHMs. Jishou, Yongshun and Longshan, in the first quadrant, belong to “double high” areas; that is, the number of ICHMs and GDP, which are positively correlated, are greater than the regional average level. Luxi, Baojing and Guzhang, with backward economies and fewer ICHMs in the third quadrant, are “double low” areas; that is, the number of ICHMs and GDP are both lower than the regional average level. Fenghuang in the

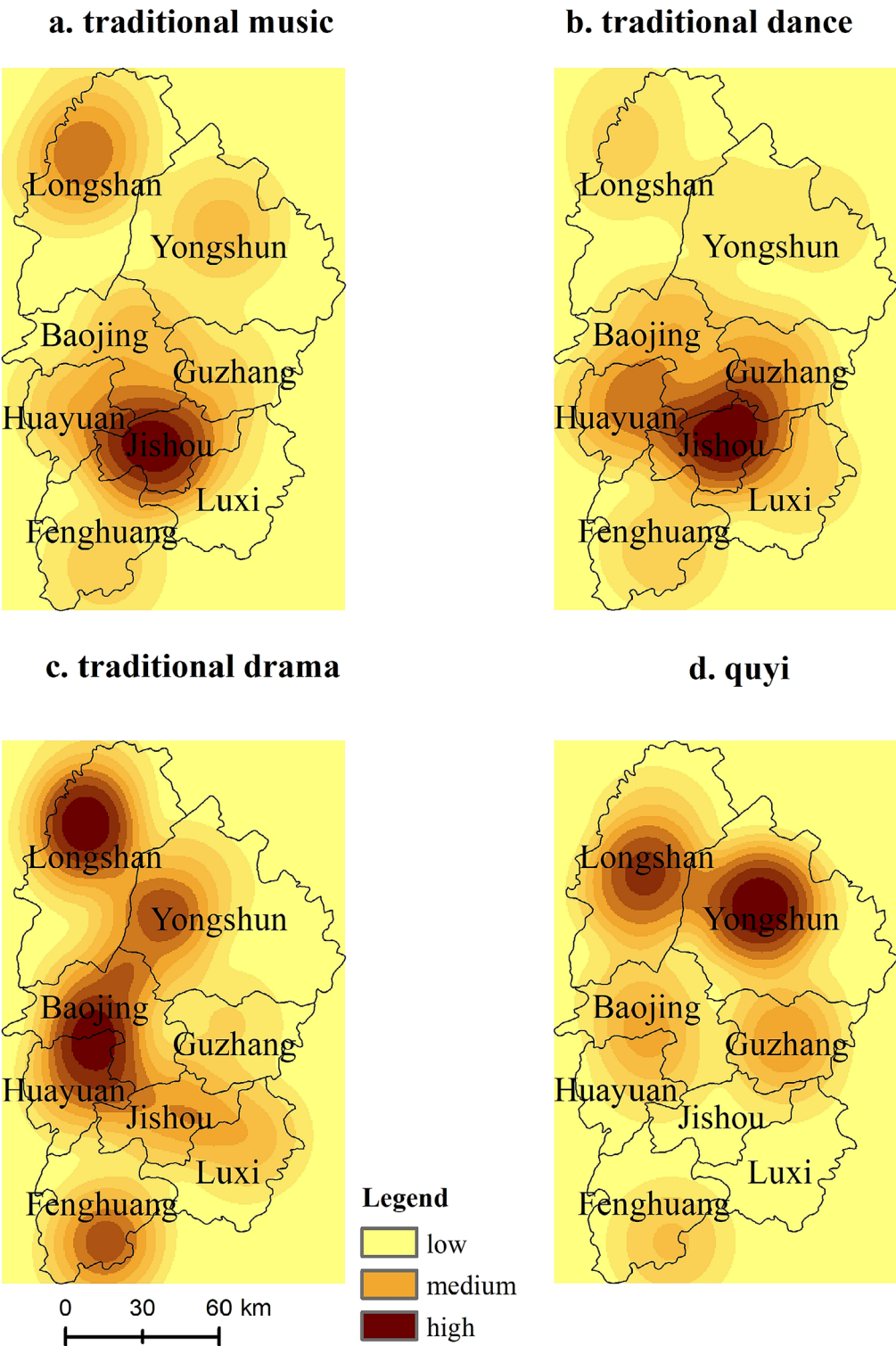


Fig. 4 The nuclear density distribution of different types of ICHMs in Xiangxi

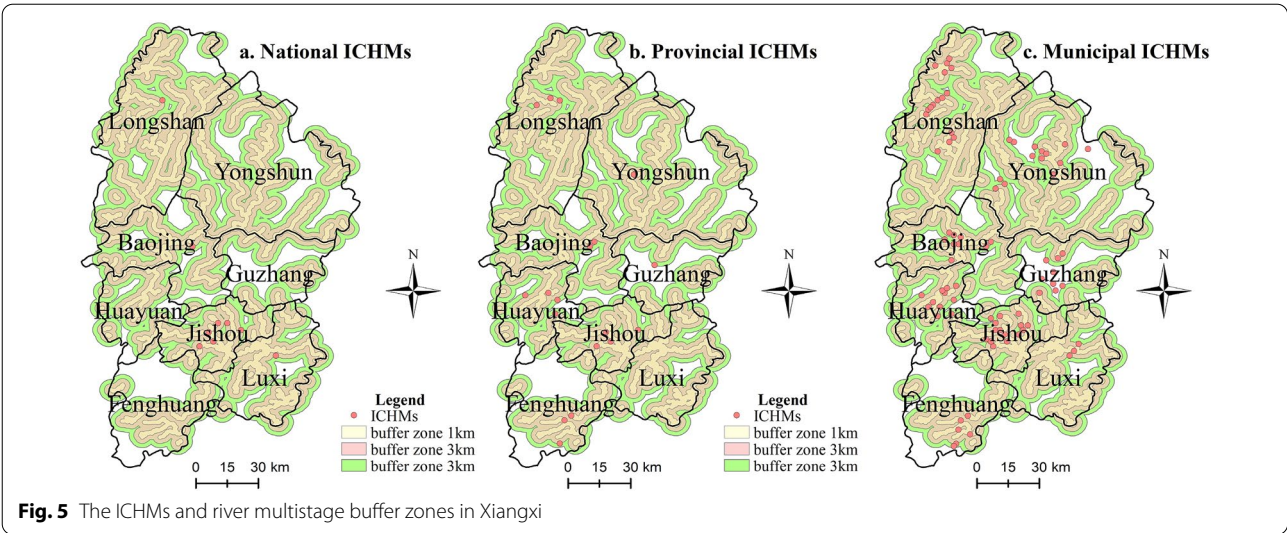


Fig. 5 The ICHMs and river multistage buffer zones in Xiangxi

Table 3 The ICHMs statistics of multilevel buffer zones in Xiangxi

| Buffer zones | National ICHMs | | Provincial ICHMs | | Municipal ICHMs | |
|--------------|----------------|----------------|------------------|----------------|-----------------|----------------|
| | quantity | proportion (%) | quantity | proportion (%) | quantity | proportion (%) |
| 0–1 km | 3 | 33.33 | 7 | 38.89 | 30 | 35.71 |
| 1–3 km | 6 | 66.67 | 8 | 44.44 | 41 | 48.81 |
| 3–5 km | 0 | 0 | 3 | 16.67 | 13 | 15.48 |

Table 4 The ICHMs statistics of various terrains in Xiangxi

| Terrains | National ICHMs | | Provincial ICHMs | | Municipal ICHMs | |
|-----------------|----------------|----------------|------------------|----------------|-----------------|----------------|
| | quantity | proportion (%) | quantity | proportion (%) | quantity | proportion (%) |
| Plain | 1 | 11.11 | 1 | 5.56 | 3 | 3.57 |
| Hill | 7 | 77.78 | 10 | 55.56 | 41 | 48.81 |
| Low mountain | 1 | 11.11 | 7 | 38.88 | 36 | 42.86 |
| Middle mountain | 0 | 0 | 0 | 0 | 4 | 4.76 |

0–200 m is plain, 200–500 m is hill, 500–1000 m is low mountain and 1000–3500 m is middle mountain

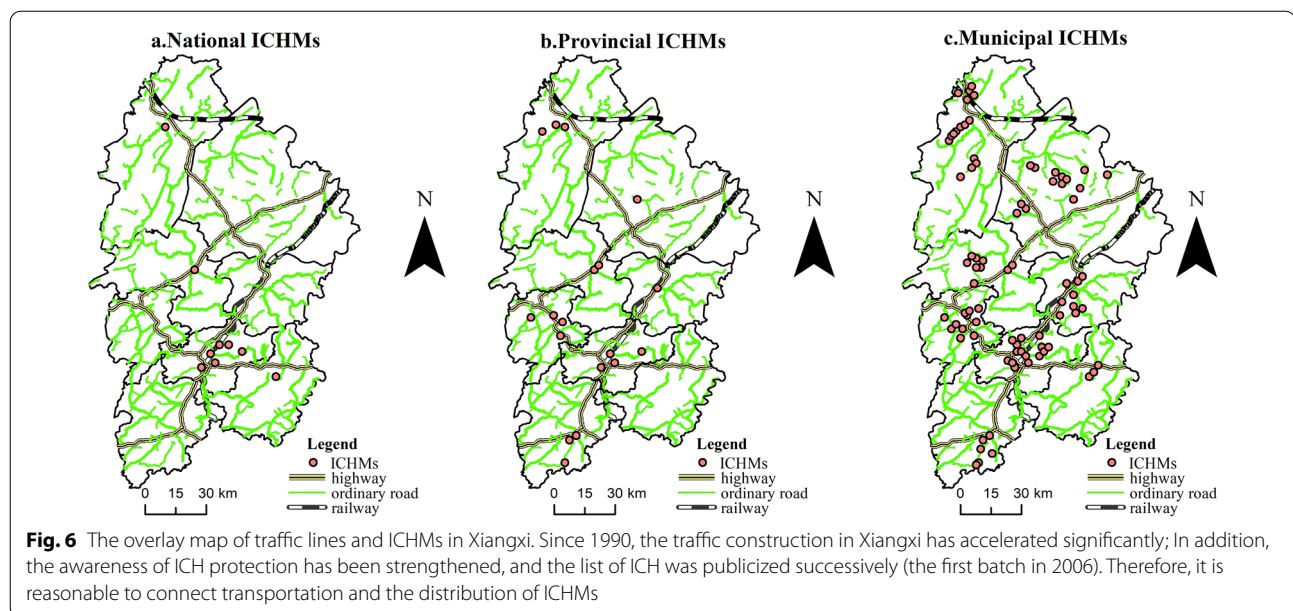
second quadrant and Huayuan in the fourth quadrant are the type of one high while another low; in other words, the economic development level of the two regions is negatively correlated with the number of ICHMs. In general, the empirical tests of the most administrative units (75%) show that the more developed the economy, the more ICHM projects, and vice versa. Therefore, the economy has a significant positive impact on ICHM programs.

Discussion and conclusions

Discussion

Comparison with previous studies

In this study, we aim to analyze the spatial distribution characteristics of ICHMs and explore the main factors affecting their distribution in Xiangxi, Central China. Xiangxi is chosen as an empirical case, as it is an ethnic minority area, a mountainous area and a national cultural protection experimental area; moreover, it contains



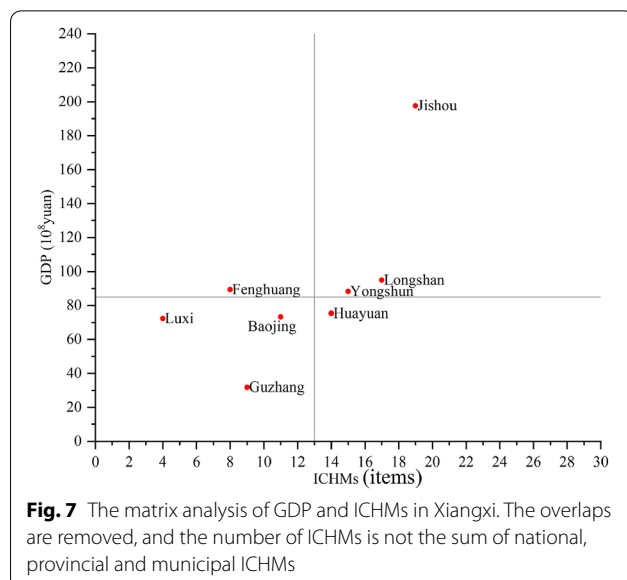
rich ICH resources. Methods such as the nearest neighbor index, kernel density estimation, and buffer analysis are used to ensure that the aforementioned problems are comprehensive and deeply explored.

The structure of ICHMs reflects that there is a lack of high-level ICHMs and quyi in Xiangxi. The quantities of national, provincial and municipal ICHMs in Xiangxi are 9, 18 and 84, respectively, implying that the higher the level, the lower the quantity, and vice versa. The results of this research are consistent with those of Bsa et al. [35]. At the same time, quyi is the type of the least number, with 14 items in total, accounting for less than 13% of the

total. The reason is that the expressive, demonstrative, experiential, and participation of quyi are not as good as other types of ICHM; as a result, its inheritance and protection are more difficult.

The results signify that the distribution of ICHMs has strong spatial heterogeneity, which is consistent with the results of Yao et al. [10] and Marzeion and Levermann [36]. In the research of Yao et al. (2021) [10], 81.9% of Christian cultural heritage is concentrated in Europe, while investigators [36] have confirmed that world cultural heritage sites are concentrated near the coasts. In this study, most ICHMs are concentrated distributions, and a few are scattered distributions or random distributions. Meanwhile, the national ICHMs, provincial ICHMs and municipal ICHMs are mainly concentrated in the south, west, and central and northern regions, respectively. In addition, there are spatial differences in the density of various ICHMs. For example, the density of traditional music is characterized by three subhigh-density areas surrounding one high-density area.

In terms of the main influencing factors, topography, rivers, transportation and GDP have the most profound impact on the distribution of ICHMs; this outcome is consistent with the results of previous studies [16, 36–38]. In the research of Cho and Sung [37] and Marzeion and Levermann [36], ICHs are mainly concentrated in areas with flat terrain and sufficient water sources, such as coastal areas or plains. The results of Yao et al. [10] show that there is a certain correlation between economic development and the distribution of ICH. They have argued that the protection of ICH certainly requires financial support, and the more developed the economy,



the more sufficient the financial support. In addition, it is well known that economic development is closely related to traffic accessibility [39], and they have a significant positive correlation [40]. Therefore, traffic accessibility is also an important factor affecting the distribution of ICH [38].

In general, the results of this study are consistent with the findings reported by previous research, and they are also scientific and reasonable.

Theoretical contributions and practical implications

The results of this study provide a reference for future theoretical research on ICH. Geographic methods, such as spatial analysis and spatial mapping, can realize the visual expression of spatial information and have been widely used in many fields [41–44]. At present, the application of geographical methods in the research of ICHs is still lacking. To this end, geographic methods are used to explore the spatial distribution characteristics and influencing factors of ICHMs in this study. The research belongs to the cross research category of geography, culture and art, and the approaches used in this study can provide an effective tool for related research.

This study provides references for the management and protection of ICH. On the one hand, the results show the sparsity of quyi, so it is of great importance for its rational protection and effective utilization. On the other hand, economic development contributes to the protection of ICH. At the same time, ICH is also an important tourism resource. The development of ICH tourism is an important direction that can not only realize the sustainable development of the economy but also promote the protection of ICH.

Future research

Xiangxi is a minority area, and the ethnic composition of each research unit varies little (the proportion of ethnic minorities for all units is greater than 85%), so this study does not consider the impact of ethnic composition on the distribution of ICHM. Nevertheless, there are 56 ethnic groups in China, and the ethnic composition varies greatly in different regions. Therefore, the applicability of the results of this study in nonminority areas remains to be verified. Therefore, the comparison between ethnic minority areas and nonethnic minority areas to explore the impact of ethnic composition on the distribution of ICH is an important direction of in-depth research in the future.

Conclusions

The main conclusions of this study are as follows: (1) traditional music, traditional dance and traditional

drama are abundant, while quyi is relatively lacking in Xiangxi. The numbers of traditional music, traditional dance, traditional drama and quyi are 26, 29, 28 and 14, respectively, and the number of quyi is less than half that of other categories. (2) The distribution of ICHMs in Xiangxi has spatial heterogeneity, and the main trend is agglomeration. The national ICHMs, provincial ICHMs and municipal ICHMs are mainly concentrated in the south, the west, and the central and northern regions, respectively. The high-density area of traditional music is located in the south, of traditional drama in the west, and of quyi in the north. (3) The distribution of ICHMs is affected by four factors: namely rivers, topography, GDP and transportation. The 0–3 km buffer zone of the rivers, with 100% of national ICHMs, 83.33% of provincial ICHMs and 84.52% of municipal ICHMs, is the centralized distribution area of ICHMs. 100% of national ICHMs, 94.44% of provincial ICHMs and 91.67% of municipal ICHMs are distributed in hilly (200–500 m) and low mountain areas (500–1000 m). Highways have the greatest impact on ICHM distribution, followed by railways and ordinary roads. The economy has a significant positive impact on ICHM programs; the more developed the economy, the more ICHM projects.

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Authors' contributions

XYZ was responsible for conceptualization, data collection and quality, and formal analysis; HX was responsible for interpretation, visualization and methods. RL was responsible for editing the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors of this article declare no potential competing interest.

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