SPATIAL DIFFERENTIATION CHARACTERISTICS AND FUNCTIONAL CLASSIFICATION OF TOURISM AND LEISURE RURAL AREAS IN CHINA

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Abstract. *Understanding the spatial analysis and functional classification of tourism and leisure rural areas is of great significance for China. Therefore, based on the nearest neighbor index, geographic concentration index, and kernel density formula, the article comprehensively adopts methods such as ArcScene 3D terrain map and Kriging interpolation function (normal distribution QQ map test and trend analysis) to analyze the spatial differentiation characteristics and functional classification of tourism and leisure rural areas in China. Research has found that: According to the formula for calculating the nearest neighbor index, China's tourism and leisure rural areas exhibit a significant agglomeration distribution pattern. From the perspective of geographical concentration index, China's tourism and leisure rural areas are in an uneven distribution state at the provincial and regional levels. From the application law of the kernel density formula, China's tourism and leisure rural areas show a significant spatial distribution difference pattern at the junction of the Yangtze River Delta region in the coastal region and the three provinces of Chongqing, Sichuan, and Guizhou. According to the Kriging interpolation function, after selecting the Log transform, the normal distribution QQ chart follows the normal distribution test. In addition, in the trend analysis function, the X-axis, Y-axis, and Z-axis each have their own significance. The functional classification of tourism and leisure rural areas in China can be divided into five types: rural agricultural sightseeing, rural agricultural experience, rural leisure vacation, rural cultural inheritance, and rural science popularization education. These provide necessary reference and strong practical significance for the study of spatial differentiation characteristics and functional classification of tourism and leisure rural areas in China.*

Keywords: *China; tourism and leisure rural area; spatial differentiation characteristic; functional classification; ArcGIS spatial analysis*

Introduction

In February 2023, the State Council has proposed the "Opinions on Doing a Good Job in the Key Work of Comprehensively Promoting Rural Revitalization in 2023" highlighting that rural catering, shopping, cultural and sports, tourism, and leisure services should be developed. The next key task is to support the creation of strong agricultural industrial towns, modern agricultural industrial parks, and advantageous characteristic industrial clusters, as well as cultivate new rural industries and formats. Therefore, in constructing rural tourism and leisure areas in China, it is essential to improve the efficiency of various agricultural formats and tap into the benefits of diverse

industries in rural areas. Finding a meaningful way to expand new industries and formats in rural areas is also crucial. In addition, by relying on a good ecological environment and cultural advantages, developing tourism and leisure villages according to local conditions with favorable rural resources, and transforming existing rural resources, ecology, and cultural status into products, industries, and economic advantages, China can promote the high-quality development of rural industries.

In this context, vital issues are seizing national policy opportunities, developing related leisure rural tourism industries, and promoting sustained economic, cultural, and political growth in building China's tourism and leisure countryside. Hence, this study analyzes the spatial differentiation problems that Chinese rural tourism and leisure areas face and proposes a classification model of rural tourism and leisure functions in combination with their current situation. Finally, suggestions for further developments are provided.

Related research progress

There is a lack of research on tourism and leisure in rural areas, a relatively new concept. Most scholars have only described the research methods for leisure and tourism and the rural nature of leisure research. Some studies focus on the relationship between leisure lifestyles and the rural welfare economy, rural tourism activities, and other aspects (Jenkins, 2000; Edwards and David, 2011; Hjalager, 2004; Figueiredo and Raschi, 2013). Some scholars have conducted studies on leisure and rural tourism. Huang et al. (2023) constructed a double difference using a quasi-natural experiment selected by the "National Leisure Agriculture and Rural Tourism Demonstration County" to empirically evaluate the causal relationship between rural tourism development and the urban-rural income gap. Yang and Wang (2013) analyzed the provincial advantages of rural tourism and leisure agriculture in terms of longevity culture themes, natural ecological environments, longevity culture heritage, and longevity status. Zhang et al. (2019) used structural equation modeling (SEM) to explore how urban resident tourists under multidimensional pressure can enhance their happiness by traveling to rural areas for leisure activities. Tan et al. (2010) explored the relationship between perceived life stress, leisure adjustment strategies, and health among rural tourism tourists and empirically tested it using SEM. Huang et al. (2022) conducted a "quasi-natural experiment" using the policies of national demonstration counties for leisure agriculture and rural tourism to empirically test the impact, mechanisms, and limiting factors of leisure agriculture and rural tourism development on farmers' income growth. Li et al. (2020) used the PSM-DID method to evaluate the economic effects of demonstration counties, analyzed the dynamic effects and marginal benefits of policy impact, tested the robustness of the model, and elucidated the impact mechanism of leisure agriculture development. Li (2020) contended that for developing rural tourism, attention should be paid to three development strategies: the need for leisure enthusiasm, the enhancement of competitiveness, and the feasibility analysis. Wang et al. (2023) used the landscape transfer matrix and landscape index method to analyze the evolution law of leisure agriculture landscape patterns. Lin et al. (2019) elaborated on the participation behavior, degree, and effectiveness of community villagers in rural leisure tourism at the micro level. Mao (2009) analyzed the types and spatial distribution of rural leisure tourism destinations in tourist areas and established an evaluation model for the resource attribute characteristics of rural leisure tourism destinations. Pang (2008) argued that strengthening the exploration of market positioning, resource

categories, product development, and other aspects of rural leisure tourism should guide and regulate the development of the industry. Tang (2023) proposed that cultural landscape design was a crucial way to promote the development of the rural leisure tourism industry. Lin (2011) pointed out that rural tourism resources were usually referred to as rural landscapes and divided into two categories: rural natural landscapes and rural cultural landscapes. Wei et al. (2019) proposed a structural statistical analysis of leisure agriculture and rural tourism policy documents released by relevant departments and analyzed the evolution process and characteristics of China's leisure agriculture and rural tourism policies. Gu and Yan (2014) constructed a development model for rural leisure tourism complexes by improving the welfare of farmers based on the goal of new urbanization and applying the theory of welfare economics. Ulan (2018) argued that promoting the coordinated development of leisure agriculture and rural tourism could create a new development space for supply-side structural reform and high-quality development of the rural economy. Wang (2018) established a digital poverty alleviation mechanism for leisure agriculture and rural tourism to upgrade the tourism industry. Chen et al. (2023) constructed a panel model to examine the impact and mechanism of agricultural tourism integration on agricultural labor productivity. Guo et al. (2002) proposed the themes of sightseeing, leisure agriculture, and rural folk tourism and conducted special reports and discussions on six main themes: rural folk customs, cultural tourism, and rural agricultural economic development. From the perspective of supply-side reforms, Zhu (2016) observed the transformation and upgrading of China's leisure agriculture and rural tourism industry structures.

In summary, little research has been conducted on tourism, leisure, and rural areas, either domestically or internationally. However, a certain degree of collaboration between leisure and rural tourism has been observed in China. A few research methods have been used to examine the spatial distribution characteristics of China's tourism, leisure, and rural areas. Therefore, this study analyzes the spatial differentiation characteristics and functional classification of rural tourism and leisure areas in China, thus providing a necessary reference basis with strong practical significance for future research.

Research methods

Nearest Neighbor Index

Taking China's rural tourism and leisure areas as point elements, the nearest neighbor index was used to determine the spatial distribution pattern of these areas. We proceeded as follows:

$$T=\overline{u_1}/\overline{u_v}\ ,\quad \overline{u_v}=\frac{1}{2\sqrt{n/Q}} \qquad (1)$$

Where T is the nearest neighbor index. $\overline{u_1}$ is the average nearest neighbor distance, $\overline{u_v}$ is the theoretical closest distance, and Q is the area of China's tourism and leisure countryside, where N denotes the number of tourists and leisure villages. T>1 indicates that China's tourism and leisure villages are evenly distributed, while T=1 indicates that China's rural tourism and leisure areas are randomly distributed. If T<1, China's rural tourism and leisure areas show a clustering distribution trend.

Geographical concentration index

The geographic concentration index reflects the agglomeration status of China's tourism and leisure rural areas nationwide. It reads as follows:

$$K=100\times\sqrt{\sum_{i=1}^{n}\left(A_i/M\right)^2} \qquad (2)$$

Where K denotes the geographical concentration index. The larger the value of K, the more concentrated the distribution of tourism and leisure villages in China. Conversely, the smaller the K value, the more dispersed the distribution of tourism and leisure villages in China. A_i represents the number of tourism and leisure villages distributed in the ith province. M is the total number of tourism and leisure rural areas in China, where N is the number of tourists and leisure villages in the province or city.

Kernel density

A kernel density analysis can further explore the concentrated distribution blocks of tourism and leisure in rural areas throughout the country. The mathematical formulation reads as follows:

$$p(x)=\frac{1}{nz}\sum_{i=1}^{n}d\left(\frac{x-x_i}{z}\right) \qquad (3)$$

where p(x) represents the estimated density function value of rural tourism and leisure areas at x, and n is the number of tourism and leisure villages in China. X_i represents the coordinate position of point i, and z is the bandwidth. D is a weight function used to estimate the number and availability of data points.

Analysis of spatial differentiation features and functional classification

Spatial differentiation characteristics of tourism and leisure villages in China

- Distribution characteristics of the number of tourism and leisure villages in China

According to statistics, in 2023, 256 beautiful leisure villages exist in China (Only refers to Chinese Mainland). The distribution of tourism and leisure villages is shown in Figure 1. The distribution of each province is shown in Table 1.

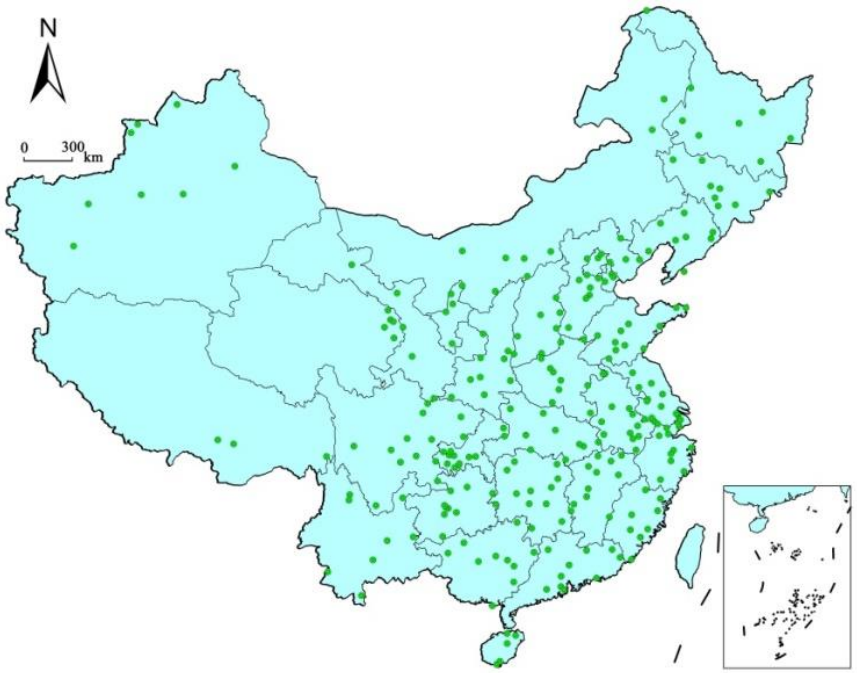

Figure 1. Distribution of the number of tourism and leisure villages in China in 2023.

Table 1. Distribution of tourism and leisure villages in various provinces of China in 2023.

Province (District, City)	Distribution (Number)	Proportion (%)
Beijing	4	1.56
Tianjin	4	1.56
Hebei	8	3.13
Shanxi	8	3.13
Inner Mongolia	8	3.13
Liaoning	8	3.13
Jilin	8	3.13
Heilongjiang	8	3.13
Shanghai	4	1.56
Jiangsu	12	4.69
Zhejiang	10	3.91
Anhui	12	4.69
Fujian	8	3.13
Jiangxi	10	3.91
Shandong	10	3.91
Henan	10	3.91
Hubei	10	3.91
Hunan	12	4.69
Guangdong	10	3.91
Guangxi	10	3.91
Hainan	5	1.95
Chongqing	12	4.69

Sichuan	12	4.69
Guizhou	10	3.91
Yunnan	8	3.13
Xizang	3	1.17
Shaanxi	8	3.13
Gansu	6	2.34
Qinghai	5	1.95
Ningxia	5	1.95
Xinjiang	8	3.13
Total (pieces)	256	100.00

- Calculation law of the nearest neighbor index

By substituting the horizontal and vertical coordinates of 256 tourism and leisure villages, the actual average nearest distance of China's tourism and leisure villages is calculated as $\overline{u_1} \approx 119.04$ km, the theoretical nearest distance is $\overline{u_v} \approx 85.6$ km, and the nearest neighbor index $T \approx 0.719 < 1$. Therefore, China's tourism and leisure villages show significant clustering distribution patterns (Lin & Chen, 2021).

- Calculation rules of the geographic concentration index

The geographical concentration index of China's tourism and leisure rural areas is calculated, and the geographical concentration index is $K \approx 18.85$. If 256 tourism and leisure rural areas are evenly distributed in 31 provinces, the scenic spots in each region are approximately 8.26, and the geographical concentration index is $K_0 \approx 17.96 < 18.85$. This result fundamentally verifies that China's tourism and leisure rural areas are in an uneven distribution state at the provincial level (Liu et al., 2023).

- Application rules of nuclear density formula

The spatial distribution of core density in rural Chinese tourism and leisure areas is shown in Figure 2. First, the core density values were divided into nine blocks, with the first yellow block ranging from 0.0000 to 0.2075 and the ninth dark blue block ranging from 1.6606 to 1.8681. Across the country, two major blocks, I and II, are the most prominent. The most typical area of Block I is mainly in Jiangsu and Zhejiang provinces (the ninth block contains three in Jiangsu and three in Zhejiang, totaling six Chinese tourism and leisure villages), including Qianyuan Village in Taihua Town, Yixing City, Wuxi City, Guilin Village in Tianmuhu Town, Liyang City, Changzhou City, Maoshan Village in Qiqiao Street, Gaochun District, Nanjing City, Jiangsu Province, and Fangyi Village in Xiaopu Town, Changxing County, Huzhou City, Zhejiang Province Xiangyang Village, Shuanglin Town, Nanxun District, Huzhou City and Xiaogucheng Village, Jingshan Town, Yuhang District, Hangzhou City, Zhejiang Province. The second typical block is mainly a municipality, directly under the central government of Chongqing (the eighth block contains two Chongqing villages, totaling two national-level tourism and leisure villages), which comprises Baoping Villages in Xianfeng Town, Jiangjin District, Chongqing, and the New Rural Area in Shijiao Town, Qijiang District. Therefore, a significant spatial distribution pattern is observed at the junction of the Yangtze River Delta region along the coast and in the Chongqing, Sichuan, and Guizhou provinces (Kong et al., 2023).

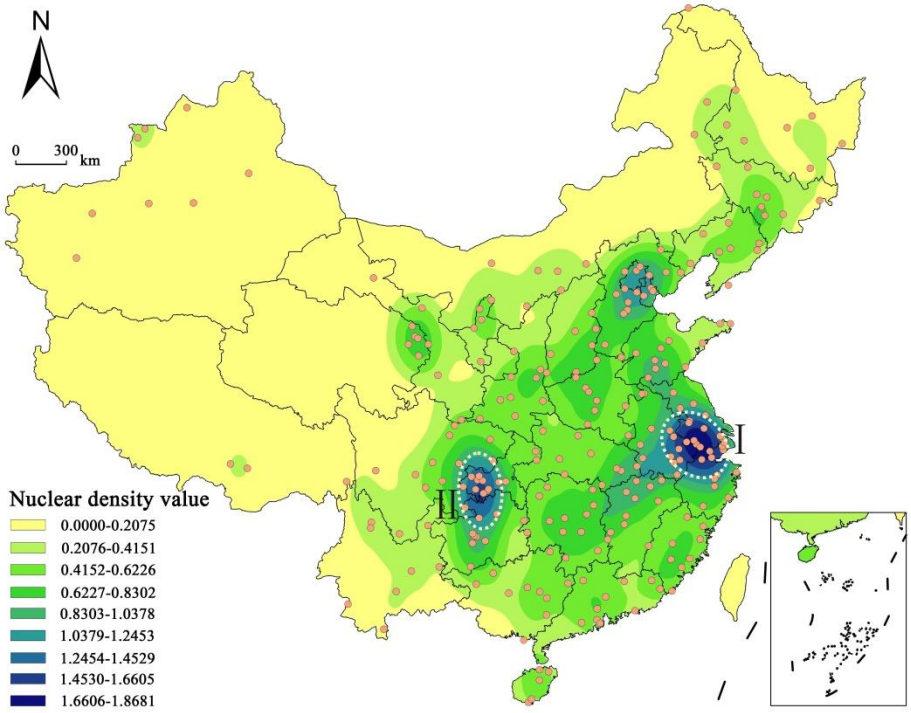

Figure 2. Spatial distribution of core density in Chinese tourism and leisure villages.

Figure 3 shows a 3D topographic map of the kernel density space formed in ArcScene. The top layer was obtained from the resolution digital elevation database GDEMV3 30m.

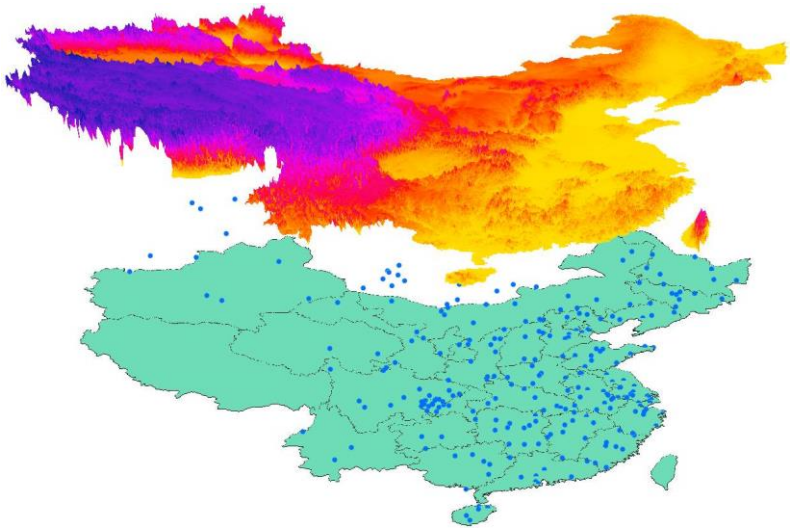

Figure 3. Kernel density spatial 3D topographic map.

- Kriging interpolation function

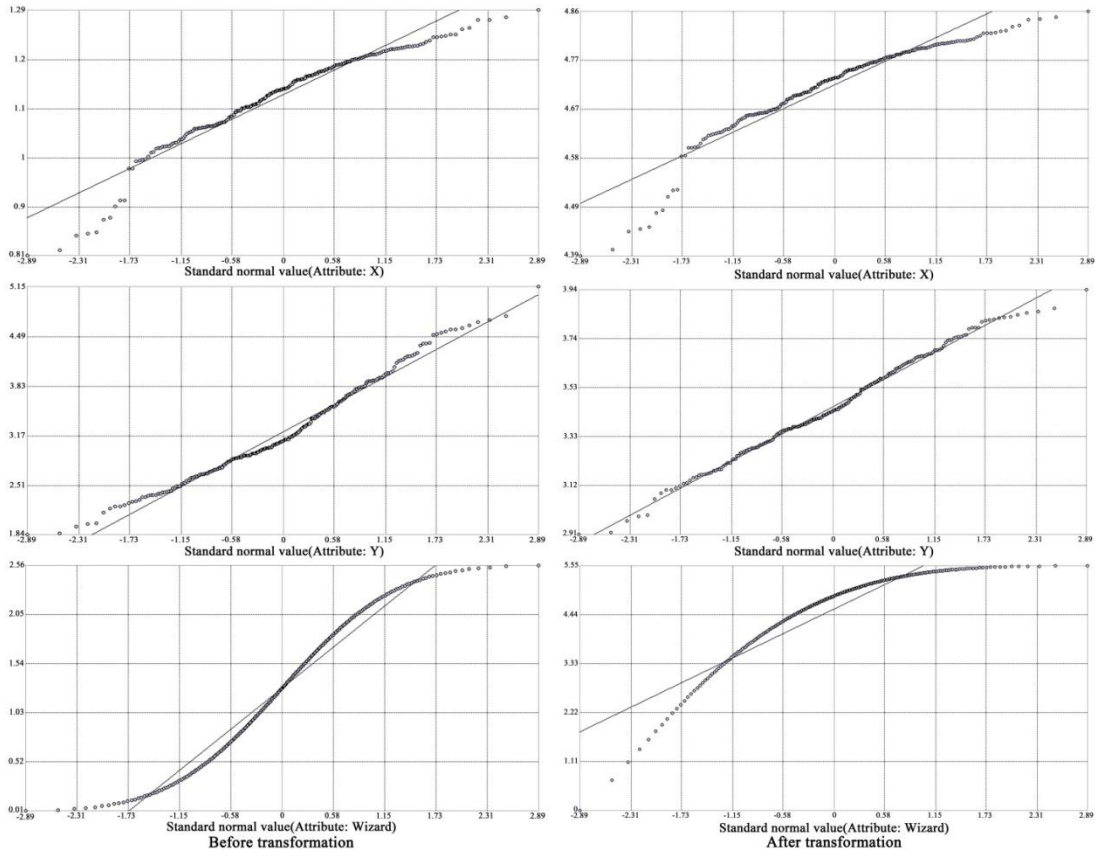

Figure 4. Normal QQ before and after a Log transformation selection.

(1) Normal distribution QQ plot tests. Next, we tested the normal distribution QQ chart. Figure 4 shows that before selecting the Log transformation, the standard normal values *X, Y,* and the guide values of the three coordinate attributes differ from the standard normal distribution, indicating that the data do not follow a standard normal distribution. However, after selecting the Log transformation in the transformation column, the standard normal values *X, Y,* and guide values of the three coordinate attributes in the normal QQ graph on the right follow a normal distribution.

(2) Trend analysis. Next, using the trend analysis function in the ArcGIS Kriging interpolation, the following analysis was conducted on China's rural tourism and leisure areas (Figure 5). The XY plane is similar to the distribution map of the number of rural tourism and leisure areas in China, with the X-axis direction from west to east and the Y-axis direction from south to north. The Z-axis serves as a guide, supporting the two vertical planes (Hu et al., 2020).

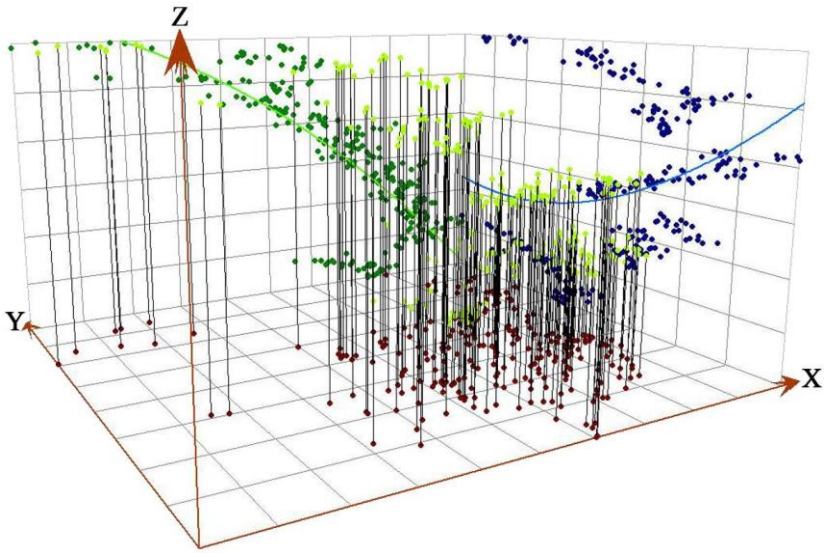

Figure 5. Trend analysis chart.

Classification of tourism and leisure rural functions in China

Rural tourism and leisure areas in China can be classified according to their functions as follows:

- Rural agricultural sightseeing

Rural agricultural tourism refers to agricultural skills that can meet residents' spiritual and material needs in rural areas, attracting tourists to participate in activities such as sightseeing, tasting, entertainment, and labor (Hjalager, 1996). Heiguanyin Village, Tiechang Town, Rong County, Zigong City, Sichuan Province exploits its unique natural landscape in the Stalagmite Valley to introduce tea tourism to tourists. They form a rural complex that combines leisure sightseeing, tea-picking experiences, and agricultural product processing. Niuzaping Village, Dianjun Street, Dianjun District, Yichang City, and Hubei Province are surrounded by mountains and rivers with beautiful rocks and forests. The Yangtze River flows around the village, driving the improvement of the rural ecological value and tourism.

- Rural agricultural experience

Relaxed and enjoyable agricultural labor activities are proposed based on rural agricultural production. The plan is to provide tourists with family picking and planting agricultural activities, such as vegetable picking, rice field transplanting, beekeeping, honeymaking, sweet potato digging, and medicinal garden picking experience functions, making their activities more interesting and satisfying the curiosity of tourists (Kastenholz and Lima, 2011). Xibailianyu Village in Fengjiayu Town, Miyun District, Beijing, has created an agricultural industrial park containing various characteristic crops and plans to build a zebra camp for tourists to experience farming, adopting, picking, leisure, and entertainment. Yangshan Village, Guling Town, Mashan County, Nanning City, Guangxi Zhuang Autonomous Region, has developed a rural tourism industry with peculiar characteristics and built an organic planting and breeding base for perfume lemons, a sunshine rose grape plantation, and a citrus planting base.

- Rural leisure vacation

Rural recreational vacations mainly refer to the provision of catering, accommodation, and other living and service facilities for tourists in leisure villages so that they can eat and live in the countryside as soon as they arrive (Everett and Aitchison, 2008). For example, Houheilongmiao Village in Zhangshanying Town, Yanqing District, Beijing, is a homestay-gathering village where each homestay courtyard is spacious and tidy, with unique decorative styles.

- Rural cultural inheritance

The development of tourism and leisure in rural areas can promote the countryside's unique industrial and folk culture; at the same time, it can also provide a rural culture with special charm and color (Stebbins, 1996). Shantang Village, Langxia Town, Jinshan District, Shanghai, exhibits the Congpu Cultural Park and Qingyan Printmaking Art Center, which share folk culture. Bailong Village, Yueqing Town, Tumen City, Yanbian Korean Autonomous Prefecture, Jilin Province explores new development opportunities with their unique Korean ethnic villages, becoming a window for tourists to learn about Korean folk culture. Shiyi Village, Qushan Town, Beichuan Qiang Autonomous County, Mianyang City, Sichuan Province leverages the advantages of Qiang culture and other local areas to teach tourists excellent Qiang family rules and teachings, such as Qiang songs and dances and Qiang embroidery skills. The giant panda culture in Wannian Village, Longcanggou Town, Yingjing County, Ya'an City makes it a showcase center for the achievements of the Giant Panda National Park. Zhuotongjing Town, Daying County, Suining City is a village that leverages the resource advantage of a well-salt culture to achieve industrial revitalization.

- Rural science popularization education

Tourism and leisure rural areas pass on local customs and agricultural knowledge to tourists, helping them recognize various animals, plants, crops, labor tools, and usage skills (Che and Wargenau, 2011). The "Mushroom Mobilization" scenic area in Lushui Village, Jungle Town, Qijiang District, Chongqing is a paradise with edible mushrooms as its theme. Facilities in the scenic area are constructed to simulate the appearance of mushrooms.

Conclusion and recommendations

This study examined 256 Chinese tourism and leisure villages. First, the nearest neighbor index, geographic concentration index, and kernel density formula were used. ArcScene was then used to create a 3D terrain map. ArcMap was employed to perform Kriging interpolation (normal distribution QQ map test and trend analysis) of Chinese tourism and leisure villages. The spatial differentiation characteristics of Chinese tourism and leisure villages were explored, and the functional classification of Chinese tourism and leisure villages was analyzed.

Research conclusions

The main research conclusions are as follows:

(1) According to the nearest neighbor index, China's rural tourism and leisure areas exhibit a significant clustering distribution pattern.
(2) From the perspective of the geographical concentration index, China's rural tourism and leisure areas are unevenly distributed at the provincial and regional levels.

(3) From the kernel density application law, China's rural tourism and leisure areas show a significant spatial distribution difference pattern at the junction of the Yangtze River Delta region in the coastal region and Chongqing, Sichuan, and Guizhou provinces.
(4) According to the Kriging interpolation function, the normal distribution QQ graph follows a normal distribution after a Log transformation. In addition, the *X*-axis, *Y*-axis, and *Z*-axis in the trend analysis function bear significant meanings.
(5) The functional classification of rural tourism and leisure areas in China includes five types: rural agricultural sightseeing, rural agricultural experience, rural leisure vacation, rural cultural inheritance, and rural science popularization education.

Related suggestions

(1) By combining various projects tourists enjoy, China encourages them to engage in activities such as vegetable and fruit picking, shrimp fishing, and growing melons and vegetables. This strategy creates a one-stop service chain for ecological tourism and leisure vacations that allows tourists to experience the novelty and freshness of rural tourism services in terms of food, clothing, accommodation, and transportation. In addition, this paradigm can be built into a tourism and leisure countryside that integrates agricultural labor, rural tourism, folk experience, ecological leisure, and popular science education (Saxena and Ilbery, 2008; Pröbstl-Haider *et al.* 2014).
(2) Tourism and rural leisure homestays should be comprehensively considered based on local tourism and cultural factors, tourism market requirements, and tourist reception capacity. Regarding architectural features, the fusion of traditional customs and modern features can be chosen to create rural characteristics, allowing tourists to experience local folk culture while feeling the comfort of a modern accommodation environment (Keith *et al.* 1996).
(3) China should promote the transformation of rural tourism and leisure consumption from agricultural sightseeing to leisure vacation and build rural tourism projects with self-driving camps, scientific research and learning, and elderly care and health preservation as the main lines, thus forming a consumption agglomeration area with guaranteed quality and quantity (Jansen-Verbeke, 1991).

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