

Research on the Spatial Structure Optimization of Tourism Resources in Jiangxi Province from the Perspective of the Gan-Guangdong Canal

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Abstract: Taking the tourism resource points in Jiangxi Province as research samples, this study utilizes ArcGIS software and employs research methods such as accessibility model analysis and kernel density analysis. From the perspective of the Gan-Guangdong Canal waterway transportation line running north-south, it examines the current status of the spatial layout of tourism resources in Jiangxi Province, the spatial distribution of tourist attractions, and the spatial network of tourism transportation. This research aims to re-evaluate the spatial structure characteristics of tourism resources in Jiangxi Province and identify existing issues.

Based on the above analysis, the results indicate that Jiangxi Province has a rich variety of tourism resources with a high degree of resource combination, where natural scenery, cultural relics, and leisure vacation spots are the most widely distributed tourism resources. Along the Gan-Guangdong Canal waterway, the area surrounding Poyang Lake, at the starting point of the Jiangxi section of the canal, exhibits the highest density of tourism resources. The distribution of these tourism resources is significantly influenced by the underlying resources, the tourist source market, and transportation locations, showing a clear pattern along transportation corridors. To address these findings, the study proposes optimization strategies in areas such as canal port construction, tourism transportation network optimization, tourism route design optimization, and tourist attraction optimization, providing decision-making references for the development of the tourism industry in Jiangxi Province.

Keywords: Gan-Guangdong Canal Waterway;

Tourism Resources; Jiangxi Province; Optimization Strategies for Tourism Development

1. Introduction

In recent years, with the continuous development of China's economy, the tourism industry has become an important pillar of China's economic development and an indispensable part of people's lives. The normalization of travel and policy incentives have driven the rapid recovery of medium and long-distance tourism, with a significant increase in tourist travel distances and destination leisure radii. In early 2021, the "Plan for Cultural and Tourism Development" released by the Ministry of Culture and Tourism proposed to implement regional major strategies, and regional coordinated development strategies, integrating cross-regional resources to construct a new tourism space pattern, optimize the layout of tourism cities and destinations, and optimize the urban and rural tourism leisure space from three aspects to further build a high-quality development tourism space layout and support system [1].

In January 2021, the Jiangxi Provincial Government's "Opinions on Promoting the Construction of a Transportation Strong Province" mentioned the "Century Water Transport Project" - the Gan-Guang Canal, which has attracted much attention. As the only province connected to the Yangtze River Delta, the Pearl River Delta, and the Haixi Economic Zone, the opening of the Gan-Guang Canal can become a breakthrough for Jiangxi Province to demonstrate its unique geographical position, clarifying the spatial structure of tourism resources to lay the foundation for the rational development and effective utilization of tourism resources. Therefore, research on the

optimization of tourism resource spatial structure from the perspective of the Gan-Guang Canal has significant value for the future tourism development of Jiangxi Province, with good economic and social benefits. This study, from the perspective of the planned Gan-Guang Canal waterway transportation mainline, re-examines the current spatial structure characteristics and problems of tourism resources in Jiangxi Province, aiming to provide decision-making references for the optimization of Jiangxi's tourism space.

2. Data Sources and Research Methods

2.1 Data Sources

The data for this study primarily consists of two categories: (i) Spatial data related to lineaments (water systems, transportation lines) and punctual elements (cities, tourist attractions) based on the administrative division map of Jiangxi Province, processed for visualization using ArcGIS 10.7 (see Figure 1); (ii) Tourism resource data derived from the China Tourism Academy's "China Domestic Tourism Resource Development Report (2023-2024)," the Jiangxi Provincial Tourism Bureau, the Jiangxi Provincial Department of Culture, and other relevant authorities' websites, as well as various resource data published in public documents.

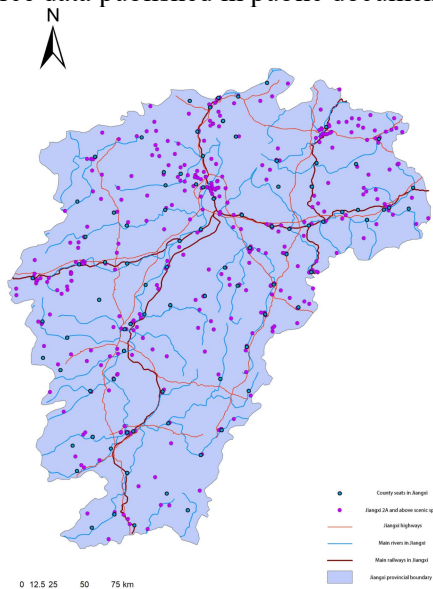


Figure 1. Jiangxi Province Tourism Resource Distribution Map

2.2 Research Methods

2.2.1 Kernel Density Estimation (KDE)

To better analyze the spatial aggregation of

tourism resources along the Gan-Guang Canal in Jiangxi Province, kernel density analysis is employed to calculate the density of tourism resources. The formula is as follows [2]:

$$f(x) = \frac{1}{nh} \sum_{i=1}^n k((x - X_i)/h) \quad (1)$$

where $f(x)$ is the kernel density estimate, $k((x - X_i)/h)$ is the kernel function, $h > 0$ is the bandwidth, and $(x - X_i)$ represents the distance from the valuation point x to the event X_i . Specifically, GIS is used for kernel density analysis of tourism resources in Jiangxi Province to further analyze the data.

2.2.2 Accessibility model

The accessibility coefficient is used to measure the level of accessibility within a certain area, with a smaller coefficient indicating better accessibility. In this study, accessibility is understood as the average travel time from Nanchang Port, Jiujiang Port, Ganzhou Port, and Ji'an Port along the Gan-Guang Canal to all 4A-level and above tourist attractions in Jiangxi Province, thereby establishing a network of 4A-level and above tourist attractions along the Gan-Guang Canal, known as the "D-D cost matrix". The specific calculation formula is as follows [3]:

$$R'_i = R_i / \left(\sum_i^n R_i / n \right) \quad (2)$$

where i is any point within the area, n is the number of tourist attractions in the area, and R is the average travel time for tourist attraction ii , with a smaller value indicating better accessibility. To make the accessibility data of tourist attractions comparable, a certain processing method is needed to standardize the data to the interval $[0, 1]$.

3. Analysis of the Current Spatial Structure of Tourism Resources in Jiangxi Province

3.1 Spatial Layout of Tourism Resources

Jiangxi Province boasts a comprehensive range of tourism resources, with a high quantity and quality, encompassing 153 out of the 155 types classified under the national tourism resource standards. Based on their tourism characteristics, these resources can be categorized into four distinct tourism resource types: landscape tourism, red tourism, ceramic tourism, and religious tourism.

From the perspective of the Gan-Guang Canal, the overall distribution of tourism resources in

the sections of Nanchang Port and Jiujiang Port is relatively abundant and dense. In terms of landscape tourism, Jiangxi is surrounded by mountains on three sides, making it a rich area for landscape tourism resources, with the ancient saying "six parts mountains, one part water, and two parts fields." Mount Lu, Jinggangshan, Sanqingshan, and Longhu Mountain are classic representatives of Jiangxi's landscape tourism; for red tourism, the spatial distribution of red tourism resources in Jiangxi is locally concentrated but not uniformly distributed, mainly clustered in the central part of Nanchang, the northern part of Jiujiang, the eastern part of Ganzhou, the central part of Pingxiang, the southwestern part of Ji'an, and the central part of Shangrao, with a total of 171 red tourism resources in these areas; for ceramic tourism, it is primarily concentrated in the millennia-old porcelain capital, Jingdezhen, located in the northeastern part of Jiangxi; for religious tourism, the cumulative proportion of religious tourism sites in Nanchang, Jiujiang, and 14 other counties and cities reaches over 50% [4]. The mouth of Poyang Lake, the entrance to the Gan-Guang Canal, and the Gan River, which are rich in surface water, are relatively dense in religious resources.

3.2 Spatial Layout of Tourist Attractions

Using ArcGIS 10.7 software for kernel density analysis and applying the accessibility model tool to measure 4A and above tourist attractions in Jiangxi Province (Figure 2), the specific results indicate that the average travel time to Nanchang Port and Ji'an Port is shorter than that to Ganzhou Port and Jiujiang Port. The tourist attractions in Jiangxi Province are generally distributed in a clustered pattern, with a higher concentration in the central and southern regions compared to the northern part. By employing the Kernel Density module in ArcGIS 10.7, kernel density calculations were performed for 2A and above tourist attractions in Jiangxi Province. Considering the four main nodes of Nanchang Port, Jiujiang Port, Ji'an Port, and Ganzhou Port from the perspective of the Gan-Guang Canal and in conjunction with actual conditions, higher-grade tourist attractions typically have a greater influence range than general tourist attractions. A kernel density map of the spatial distribution of tourist attractions in Jiangxi Province was created. The northern region of Jiangxi, with Jiujiang Port and Nanchang Port,

has more high-value concentration areas in the spatial distribution of tourist attractions than the regions of Ji'an Port and Ganzhou Port [5].

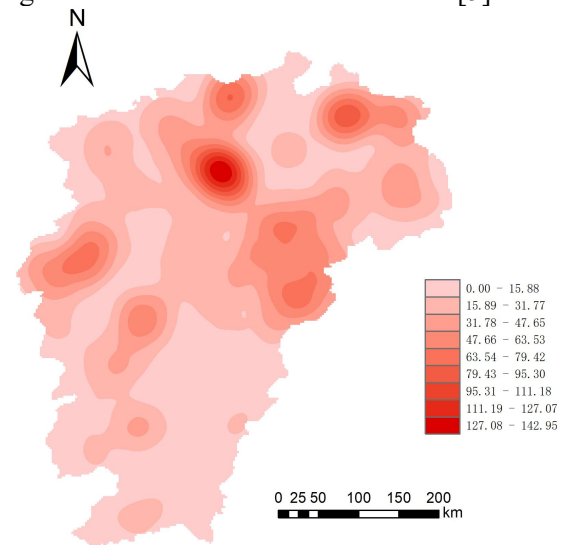


Figure 2. Jiangxi Province Tourist Attractions Spatial Distribution Kernel Density Map

3.3 Tourism Spatial Transportation Network

Transportation routes, serving as the channels connecting tourism resource points with the source markets, are crucial for the development of tourism resources and the layout of the industry. Currently, Jiangxi Province has been increasing its investment in transportation infrastructure, significantly improving the transportation conditions. A four-hour interconnectivity transportation network has been established within the province.

The Gan-Guang Canal passes through several key nodes, including Ganzhou, Nanchang, Jiujiang, and Ji'an, which are also the main transportation hubs in Jiangxi. All four major ports along the canal have direct highway access to 4A-level and above tourist attractions in Jiangxi, and the main tourist attractions are also interconnected by highways. A study focusing on 4A-level and above tourist attractions in Jiangxi reveals that the distribution of tourism resources in the province is not very balanced, with a concentration in the central and northern parts of Jiangxi (mainly Nanchang and Jiujiang). The central and southwestern parts of the province have relatively fewer tourism resources, and the density of tourist attractions in the central and northern parts is significantly higher than in the southwestern and southeastern parts. Calculating the basic travel time and accessibility coefficients from the four ports of

Nanchang, Jiujiang, Ganzhou, and Ji'an, and using ArcGIS 10.7 to create kriging interpolation maps, it is evident that there are slight differences in accessibility to tourist attractions in Jiangxi from the Gan-Guang Canal. In terms of travel time, Nanchang Port has the shortest average travel time to 4A-level and above tourist attractions in Jiangxi, requiring only 157.21 minutes, while Ganzhou Port has the longest, requiring 268.80 minutes. Some areas around Poyang Lake near Nanchang and places like Yichun have short straight-line distances but longer travel times. Economically developed areas such as Dexing City, Wuyuan County, and Xinjian District have better transportation, while most counties in Ganzhou and some areas in Ji'an have longer travel times and lower levels of transportation coordination. From the perspective of accessibility, with Nanchang Port and Ji'an Port as the centers, travel time increases "from the center to the periphery," and accessibility "sharply decreases from the center to the periphery," showing relatively better accessibility compared to the other two ports, but there are still some areas with poor accessibility and unreasonable transportation networks within a small range. With Jiujiang Port and Ganzhou Port as the centers, travel time increases "on average from the port outward," and accessibility "sharply decreases on average from the port outward," with significant regional differences. Overall, the development of tourist attractions and transportation networks along the Gan-Guang Canal in Jiangxi Province still has shortcomings, with slightly inferior conditions compared to adjacent provinces, and the transportation network structure still has some irrational aspects. There is still a "bottleneck" phenomenon in transportation to some popular tourist attractions near the Gan-Guang Canal.

4. Optimization Strategies for the Tourism Spatial Structure of Jiangxi Province from the Perspective of the Gan-Guang Canal

4.1 Optimization Principles

4.1.1 Diversification principle

In the planning and layout of attractions, a variety of types of attractions should be considered, including natural landscapes, cultural heritage, and rural scenery, to meet the needs of different tourist groups and form a diverse range of tourism products.

4.1.2 Accessibility principle

The optimization of attraction layout should take into account the convenience of transportation, connecting various attractions to form a convenient transportation network that facilitates tourist travel and sightseeing.

4.1.3 Intelligent management principle

With the rapid development of the economy, modern technological means, such as intelligent guide systems and intelligent traffic management systems, should be introduced to improve the efficiency of scenic area management and service levels.

4.1.4 Regional coordinated development principle

The spatial structure of tourism resources must protect local natural and cultural resources and enable coordinated development among various regions along the canal. The layout of tourist attractions should be coordinated with the development plans of surrounding areas to promote coordinated regional economic development, avoiding resource waste and environmental damage caused by the development of the tourism industry.

4.2 Optimization Strategies

4.2.1 Optimization of tourist attractions (points)

4.2.1.1 Enriching cultural connotations of attractions

Develop specialized tourism routes that reflect regional tourism characteristics. Strengthen the protection and utilization of the history, culture, and natural resources of current attractions. Organize a variety of cultural activities, exhibitions, and performances. Develop themed and in-depth cultural experience projects.

4.2.1.2 Eco-Environmental protection and sustainable development

Focus on protecting the ecological environment of scenic areas, enhance ecological restoration, and environmental remediation. Promote green development in scenic areas by introducing green energy and energy-saving emission reduction measures. Advocate for civilized tourism among visitors and encourage low-carbon, environmentally friendly tourism practices.

4.2.1.3 Strengthening industrial integration

Combine tourism with local characteristic industries to create integrated projects such as tourism + agriculture, tourism + cultural creativity, etc. Encourage private investment in tourism projects and promote the coordinated

development of the tourism industry with related industries.

4.2.2 Canal port construction optimization

4.2.2.1 Port Infrastructure Construction

The four canal ports of Nanchang, Jiujiang, Ji'an, and Ganzhou in Jiangxi Province should focus on improving the level of infrastructure construction, including wharves, yards, storage facilities, etc. Advanced loading and unloading equipment and information management systems should be introduced to increase cargo throughput, achieve rapid and efficient loading and unloading of goods, and improve the efficiency and automation level of port operations, thereby reducing operational costs. The development of ports should promote the economic development of surrounding areas, drive industrial upgrading, attract investment, increase employment opportunities, and promote regional economic prosperity. In particular, Nanchang Port should be developed into a "one-port, ten-areas, two-core" port layout to enhance the market competitiveness of Jiangxi's foreign trade enterprises; as one of the ports open to cross-strait "three direct links", Jiujiang Port should increase the port line along the river sections to further enhance the port's competitive advantage and radiation capability, promoting the development of port-adjacent industries and product processing, logistics, and trade, which actively promotes local economic and social development.

4.2.2.2 Logistics services

Strengthen the connection with the inland transportation network, provide a variety of intermodal services, optimize logistics channels, and improve the efficiency of cargo transportation, developing Nanchang Port into an important hub for the transshipment of goods by rail, road, and water within the province. At the same time, expand international cooperation channels, actively participate in international cargo transportation cooperation projects, and expand the international influence and competitiveness of various ports to meet market demands and promote the smooth flow of logistics channels.

4.2.2.3 Port service level

Enhance port service functions to provide comprehensive, high-quality, efficient, and convenient services for ships and cargo, meeting customer needs and enhancing port competitiveness. At the same time, strengthen the construction of port talent teams, cultivate

port management and operation talents with an international perspective and professional skills, and further improve the level of port management.

4.2.3 Tourism transportation network optimization

The optimization of the tourism transportation network aims to enhance the traffic efficiency of tourist destinations, ensuring that visitors can safely and conveniently arrive and depart, while also reducing environmental impact. This is an essential booster for the development of the local tourism industry. The optimization of the tourism transportation structure facilitates the optimization of the tourism spatial structure. Based on the analysis above, the following optimizations can be carried out:

Firstly, along the route of Nanchang—Jiujiang—Jingdezhen—Shangrao—Yingtang—Nanchang, the existing transportation conditions should be further improved by strengthening the construction of inter-city high-speed rail and highways. This will shorten the time distance from the Gan-Guang Canal line to the 4A-level and above tourist attractions in Jiangxi Province, improve the connectivity between scenic spots, and enhance the connectivity construction with famous tourist attractions in neighboring provinces. This will fully leverage the role of the Gan-Guang Canal and promote the healthy and rapid development of the tourism economy.

Secondly, for areas with backward economies but rich in tourism resources, infrastructure construction and improvement should be regularly expanded and maintained to ensure that roads in tourist areas are spacious and unobstructed, reducing traffic congestion. Additionally, public transportation can be added to develop an efficient public transportation system, facilitating tourist travel.

Thirdly, in the future, the deep integration of "high-speed + tourism" should be accelerated by creating self-driving tourism belts. The construction of service systems along the highway, including service areas, characteristic towns, car camping sites, viewing platforms, and tourist toilets, should be strengthened to build a comprehensive tourism transportation network that allows for "fast access and slow tourism." This will integrate tourism resources along the highway and create distinctive red cultural tourism, historical and cultural tourism, and natural landscape lines, promoting Jiangxi's self-driving tourism premium routes [6].

4.2.4 "Point-Axis" tourism axis expansion

In combination with the "point-axis" development theory, within a specific geographical space, the Gan-Guang Canal, which has advantages and development potential and is traversed by linear infrastructure such as transportation and rivers, should be developed as an axis. This will promote the flow and aggregation of elements along the Gan-Guang Canal line. Based on the distribution pattern of tourism resources in Jiangxi Province, the direction of transportation/rivers, and the distribution of towns around ports, the Gan-Guang Canal tourism development axis should be constructed as a priority. This will explore the typical natural ecology, historical relics, ancient villages, and other tourism resources along the line, expand the space for tourism development, refine tourism services, upgrade tourism formats, and actively integrate into the development of the Yangtze River Economic Belt and the "Belt and Road" initiative

5. Conclusions and Prospects

5.1 Main Conclusions

Through a comprehensive study of the tourism spatial structure of Jiangxi Province from the perspective of the Gan-Guang Canal, the following conclusions have been drawn in terms of theoretical research and empirical analysis: By examining the waterway transportation mainline that runs through the north and south, the current status and problems of the spatial structure of tourism resources in Jiangxi Province have been analyzed. Corresponding optimization strategies for the tourism spatial structure under the Gan-Guang Canal perspective have been proposed. By utilizing GPS positioning and GIS software, and applying the accessibility model and kernel density method based on the "point-axis" system theory, an in-depth analysis of the tourism spatial structure in Jiangxi Province has been conducted. This has enabled the visualization of tourism resources in space, the reconstruction of the tourism space in Jiangxi Province, and the proposal of specific directions for the spatial structure of tourism resources. These efforts aim to promote high-quality development of the tourism industry, fully unleash the vitality of tourism development, and accelerate the construction of a strong tourism province.

5.2 Research Limitations and Prospects

There are several limitations in this study on the optimization of the tourism spatial structure of Jiangxi Province from the perspective of the Gan-Guang Canal. First, there is a lack of official data sources; the basic data involved in this study were obtained through online queries and web scraping, which may result in some deviation from the actual situation. Second, there are many factors that influence the layout of tourism space. This study uses quantitative analysis methods to analyze the weight of indicators affecting the tourism spatial structure under the Gan-Guang Canal perspective, thus lacking factors such as tourism policy, historical culture, transportation location, and canal port location, which are difficult to quantify, leading to an incomplete study of the influencing factors on the tourism spatial structure along the Gan-Guang Canal. Third, the study of tourism space layout involves knowledge from multiple disciplines such as geography, management, and ecology. This study only provides a simple analysis from the perspective of tourism geography and proposes optimization strategies for the tourism spatial structure of Jiangxi Province under the Gan-Guang Canal perspective, lacking research from other perspectives. In the future construction of the Gan-Guang Canal, studies can be introduced to more deeply discuss the tourism spatial structure in Jiangxi Province, such as research on the ecological base and tourism environmental carrying capacity of the Gan-Guang Canal, research on the behavioral preferences of tourists along the Gan-Guang Canal, and research on the scale of construction of various tourism nodes, based on the actual construction and development situation.

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