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Research on the Synergistic Development of Optimizing the Spatial Pattern of Rural Tourism and Rural Revitalization in the Lijiang River Basin

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Abstract: *Amid the global emphasis on sustainable development and rural revitalization, optimizing the spatial configuration of rural tourism and exploring its synergistic mechanisms with revitalization efforts are vital for achieving balanced regional growth. This study investigates 56 characteristic villages within the Lijiang River Basin using multidimensional spatial statistical methods, including kernel density analysis and the geographic detector model, to examine spatial distribution patterns, agglomeration characteristics, and driving mechanisms. The results reveal a clustered spatial structure with significant imbalance ($G = 53.273 > G_0 = 26.726$; $S = 0.844 < 1$), characterized by a "dual-core—multi-level diffusion—belt-like extension" pattern. Hotspots are concentrated in Yanshan District, while cold spots are distributed along the basin's periphery. Permanent population is identified as the dominant driving factor ($q = 0.8067$), and the interaction between topography and transportation exhibits the strongest explanatory power ($q = 0.9990$). Based on these findings, three development models are proposed: culture IP cultivation–driven, ecological literacy–driven, and thematic scenario integration–driven. The study suggests strengthening the "core–corridor" linkage and adopting differentiated development pathways to enhance the synergy between spatial pattern optimization and rural revitalization.*

Keywords: *Characteristic Villages, Spatial Pattern, Rural Revitalization, Characteristic Development Model, Lijiang River Basin*

1. Introduction

Rural revitalization has become a crucial global strategy for promoting sustainable rural development and remains a central focus of interdisciplinary research. Particularly in developing countries, it plays a pivotal role in balancing regional development and mitigating the urban–rural divide [1]. As a core driver of rural revitalization, rural tourism is entrusted with advancing coordinated urban–rural integration and fostering sustainable rural transformation [2]. By mobilizing local cultural, ecological, and economic resources, it stimulates industrial integration, social restructuring, and diversified rural development[3][4]. The Lijiang River Basin in Guangxi, China, exemplifies the harmonious integration of karst landscapes and traditional culture. With its world-class natural heritage, nationally recognized historical and cultural assets, and numerous distinctive villages, the region provides an ideal foundation for synergistically promoting rural tourism and rural revitalization. However, the spatial distribution of rural tourism resources in this area is constrained by factors such as natural geography, transportation accessibility, and socioeconomic development levels. These constraints contribute to pronounced spatial heterogeneity and imbalance, leading to inefficient resource utilization, limited regional coordination, and uneven development momentum[5][6].

Existing research primarily concentrates on micro-level village development models or individual tourism resource evaluations, with relatively few studies exploring spatial distribution patterns and systemic coupling mechanisms between rural tourism and rural revitalization from a macro-spatial perspective[5][7]. Although some scholars have examined the spatial agglomeration, influencing factors, and development pathways of rural tourism in regions such as Beijing–Tianjin–Hebei and Yunnan–Guizhou[3][8], few have systematically integrated analyses of spatial clustering, interactive mechanisms among influencing factors, and optimization pathways across diverse rural types—including traditional villages, historical and cultural villages, and beautiful leisure villages[9][10]. Furthermore, while recent studies on smart rural tourism and urban–rural resilience emphasize technological empowerment and institutional innovation [11][12], they have not effectively bridged the gap between spatial planning mechanisms and the practical realization of rural revitalization. This gap is especially salient in ecologically sensitive, culturally rich, yet developmentally imbalanced regions such as the Lijiang River Basin, where targeted discussions on spatial structure optimization and innovative development models remain insufficient.

In response to these research gaps, this study adopts an interdisciplinary framework that integrates spatial geography with rural revitalization theory. Focusing on 56 distinctive villages within the Lijiang River Basin, it applies multiple spatial analysis methods—including the nearest neighbor index, Voronoi polygon coefficient of variation, kernel density analysis, local spatial autocorrelation, and geographic detector models—to systematically examine spatial distribution patterns, agglomeration characteristics, and driving mechanisms. The study identifies a "dual-core–multi-level diffusion–belt-like extension" spatial structure, elucidates the dominant influence of the synergistic effects between topographic elevation and transportation networks on village distribution, and extracts three revitalization models based on resource attributes: cultural IP cultivation, eco-health promotion, and thematic scenario integration. Through the spatial adaptation and pathway optimization of these models[13], this research aims to provide a scientific basis for achieving efficient rural tourism and sustainable revitalization in the Lijiang River Basin, while offering replicable frameworks for rural development practices in comparable regions[14][15].

2. Study Area, Data Sources, and Methods

2.1 Study Area

The Lijiang River, forming the upper reaches of the Guijiang River—a tributary of the Xijiang River within the Pearl River Basin—belongs to the Xijiang River system of southern China. It is situated within the administrative boundaries of Guilin City, Guangxi Zhuang Autonomous Region, spanning geographical coordinates 110°07′–110°47′E and 24°38′–25°53′N. The river originates on the southern slope of Laoshanjie Peak (elevation 1,732 m), located northeast of Mao'er Mountain in Huajiang Township, Xing'an County. Topographically, the eastern and northern parts of the basin are dominated by high mountainous terrain, while the central region features low mountains with well-developed karst landforms. The basin generally slopes from north to south, with the river flowing in a northwest–southeast direction[16]. At Sanjiangkou in Pingle County, the Lijiang River converges with the Chajiang and Lipu Rivers to form the Guijiang River, which subsequently flows southward to join the Xijiang River (Figure 1). The Lijiang River Basin is primarily composed of mountainous and alluvial plain landscapes, with striking karst formations along both banks. The region lies within the subtropical monsoon climate zone, characterized by hot, humid summers; mild winters; distinct seasonal variation; and abundant precipitation. The mean annual temperature ranges from 16°C to 20°C, while the average annual rainfall reaches approximately 1,900 mm[17]. Spatially, precipitation exhibits an uneven distribution, showing a decreasing trend from the northwest to the southeast across the basin [18][19].

2.2 Data Sources

As of 2023, data on distinctive villages within the Lijiang River Basin were compiled from multiple sources, including the lists of National Beautiful and Leisurely Villages, National Key Villages for Rural Tourism, Guangxi Traditional Villages, and National Historical and Cultural Villages. A total of 56 villages were identified: 6 National Beautiful Leisure Villages, 4 National Key Rural Tourism Villages, 43 Traditional Villages, and 3 National Historical and Cultural Villages. Spatial geographic coordinates for these villages were obtained using the coordinate extraction tool of the AutoNavi Open Platform and subsequently imported into ArcGIS Pro 3.0 to establish a geospatial database of distinctive villages in the Lijiang River Basin. Digital Elevation Model (DEM) data were sourced from the Geospatial Data Cloud (www.gscloud.cn), while the administrative map of Guilin City was obtained from the National Basic Geographic Information Center (https://www.ngcc.cn/). Transportation network data for Guilin were derived from the open-source platform OpenStreetMap (https://openstreetmap.org). Socioeconomic attribute data—including GDP by city, county, and district, as well as permanent resident population statistics—were acquired from the Guilin Municipal Bureau of Statistics, Guangxi.

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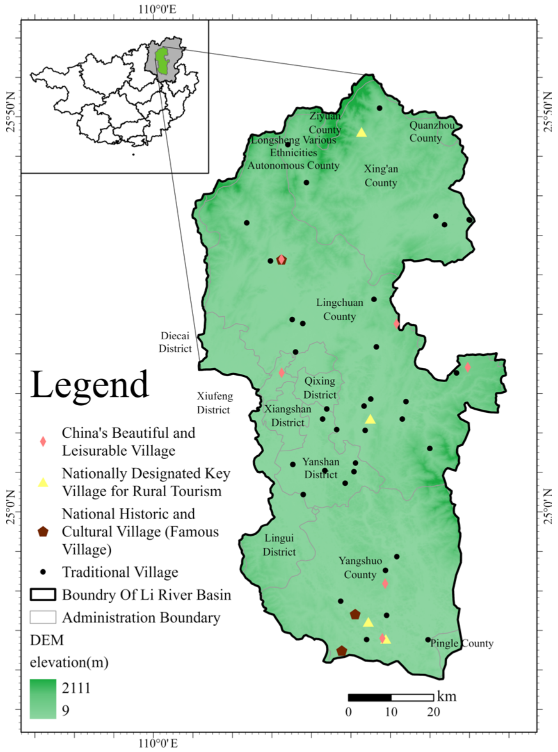

Figure 1 Location of the Study Area

2.3 Research Methods

This study employs six research methods—kernel density analysis, nearest neighbor index analysis, local association analysis, geographic concentration index, imbalance index analysis, and geographic detector—to explore the spatial pattern characteristics and influencing factors of distinctive villages in the Lijiang River Basin. In the overall framework, the nearest neighbor index determines whether the spatial distribution pattern of distinctive villages in the basin tends toward clustering or dispersion; kernel density analysis identifies the core aggregation zones of these villages. Building upon the spatial distribution structure, local association analysis identified significant hotspots and cold spots within the study area, revealing the spatial differentiation of these villages. Finally, the factor detector and interaction detector within the geographic detector quantitatively analyzed the primary drivers of their spatial distribution patterns and the interactions among these factors.

2.3.1 Kernel Density Analysis

Kernel density analysis simulates actual probability distribution curves through smooth peak functions, effectively capturing the point-focused intensity and spatial continuity characteristics of differentiated distributions within geographic areas. This paper employs kernel density analysis to measure the dispersed or clustered spatial distribution patterns of distinctive villages in the Lijiang River Basin[20]. The calculation formula is as follows:

$$f(x,y) = \frac{1}{nh^2}\sum_{i=1}^{n} k\left(\frac{d_i}{h}\right) \tag{1}$$

Where f(x,y) represents the estimated density of characteristic villages at position (x,y); n denotes the number of observations; h is the bandwidth or smoothing parameter; k is the kernel function; d_i is the distance from position (x,y) to the i-th observation point.

2.3.2 Nearest Neighbor Index Analysis

The Proximity Index is a method for measuring the spatial distribution patterns of "point elements," determining their structural configuration in geographic space by analyzing the degree of mutual proximity among objects[20]. Its calculation formula is as follows:

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$$R = \frac{R_i}{R_e} = \frac{1}{n}\sum_{i=1}^{n} d_i(s_i) \times \frac{1}{2\sqrt{\frac{n}{A}}} \tag{2}$$

Where R denotes the nearest neighbor index; R_i represents the actual average nearest neighbor distance among characteristic villages in the Lijiang River basin; R_e denotes the theoretical nearest neighbor distance; $d_i(s_i)$ represents the distance from a village to its nearest neighboring village; A denotes the geographical area of the Lijiang River basin; n denotes the number of key villages for rural tourism.

2.3.3 Local Association Analysis

Investigate the spatial clustering patterns of service attribute values to identify locations where high and low values are spatially aggregated[21]. The calculation formula is as follows:

$$G_i^* = \frac{\sum_j^n W_{ij} x_j}{\sum_j^n x_j} \tag{3}$$

$$Z(G_i^*) = \frac{G_i^* - E(G_i^*)}{\sqrt{Var(G_i^*)}} \tag{4}$$

Where W_{ij} denotes the spatial weight matrix between patches i and j; n represents the total number of patches; x_j indicates the attribute value of patch j; $E(G_i^*)$ signifies the mathematical expectation of G_i^*; Var (G_i^*) denotes the variance of G_i^*.

2.3.4 Geographic Concentration Index and Imbalance Index

The geographic concentration index (G) can indicate the degree of concentration of the research subjects and is used to investigate the concentration of characteristic villages in the Lijiang River Basin[22]. Its calculation formula is as follows:

$$G = 100\sqrt{\sum_{i=1}^{n}\left(\frac{x_i}{T}\right)^2} \tag{5}$$

Where x_i denotes the number of characteristic villages in the i-th district or county within the Lijiang River basin; T denotes the total number of distinctive villages in the Lijiang River basin; n represents the total number of districts and counties within the basin. A higher G value indicates greater concentration. Assuming an even distribution of distinctive villages in the Lijiang River basin, $G = G_0 = 26.726$. If $G > G_0$, it signifies a concentrated distribution of distinctive villages in the basin; conversely, a lower G value indicates a more dispersed distribution.

The imbalance index (S) reflects the distribution equilibrium of characteristic villages in the Lijiang River basin[22], calculated as follows:

$$S = \left[\sum_{i=1}^{n} Y_i - 50(n+1)\right] \Big/ [100n - 50(n+1)] \tag{6}$$

Where n represents the total number of districts and counties within the Lijiang River basin; Y_i denotes the cumulative percentage of the i-th position after sorting the proportion of characteristic villages in each district/county relative to the total number of characteristic villages in the entire basin from largest to smallest. S ranges from 0 to 1: When S=0, characteristic villages are evenly distributed across all districts and counties; When S=1, all characteristic villages are concentrated in a single district or county; When $0 < S < 1$, characteristic villages exhibit uneven distribution throughout the basin.

2.3.5 Geodet

Geodetector is a set of statistical methods for detecting spatial heterogeneity and revealing its underlying drivers[23], with the following calculation formula:

$$P_{D,H} = 1 - \left(\frac{1}{n\sigma_H^2}\right)\sum_{i=1}^{L} n_{D,i}\sigma_{D,i}^2 \tag{7}$$

Where $P_{D,H}$ represents the explanatory power of factor D for the spatial density H of characteristic

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villages; n denotes the sample size; σ_H^2 denotes the variance; L denotes the number of categories for factor D of type i; $n_{D,i}$ and $\sigma_{D,i}^2$ denote the sample size and variance of factor D of type i, respectively.

3. Spatial Distribution Patterns of Characteristic Villages in the Lijiang River Basin

3.1 Overall, it exhibits a clustered distribution pattern

From the perspective of the county-level administrative divisions within the Lijiang River Basin, there are currently 56 distinctive villages across four categories: National Historical and Cultural Villages, National Key Rural Tourism Villages, China's Beautiful Leisure Villages, and China's Traditional Villages. Distributed across the eight districts and counties of Guilin City, their overall distribution is uneven (Figure 2). Lingchuan County and Yangshuo County, located in the central and southern parts of the Lijiang River Basin, possess a relatively large number of such villages. Together, they account for 66.07% of the total number of characteristic villages in the entire Lijiang River Basin. Among them, Lingchuan County has the most, representing 44.64% of the total characteristic villages in the Lijiang River Basin; followed by Yangshuo County at 21.43%. The remaining six districts/counties collectively account for approximately 33.93% of the total.

Regarding village types, National Historical and Cultural Villages, National Key Rural Tourism Villages, and China's Beautiful Leisure Villages are scarce and scattered. National Historical and Cultural Villages and Towns, along with National Key Rural Tourism Villages, are primarily distributed along the main stem of the Lijiang River and its tributaries (Figure 3). China's Beautiful Leisure Villages are concentrated in the central part of the Lijiang River Basin. Influenced by the Lijiang River, traditional villages are mostly distributed along the main stem or tributaries of the Lijiang River, with relatively high concentrations in Lingchuan County and Yanshan District in the central part of the Lijiang River Basin[24].

Analysis of the spatial distribution patterns of characteristic villages in the Lijiang River Basin using the nearest neighbor index revealed a nearest neighbor index of 0.635164 (Figure 4)(Table 1), indicating an overall clustered distribution pattern for key rural tourism villages. Further testing for potential errors in the nearest neighbor index was conducted using the Voronoi polygon coefficient of variation (CV)[25]. A set of Voronoi polygons was created, with each characteristic rural tourism center as the generating point, forming a Voronoi polygon bounded by the Lijiang River Basin (Figure 5). The coefficient of variation (CV) value (the ratio of the standard deviation to the mean of the Voronoi polygon area) was then calculated based on the area of the Voronoi polygons to test the spatial structure types of characteristic rural tourism. Duyckaert's research indicates: When points are “randomly distributed,” CV = 57% (range 33%–64%); when points are “clustered,” CV = 92% (range >64%); when points are “uniformly distributed,” CV = 29% (range <33%). The calculated Voronoi polygon area CV value was 77.25%, exceeding 64% and thus yielding a CV value of 92%. This validates the finding that distinctive villages in the Lijiang River Basin exhibit a clustered distribution pattern, as determined by the nearest neighbor index[25].

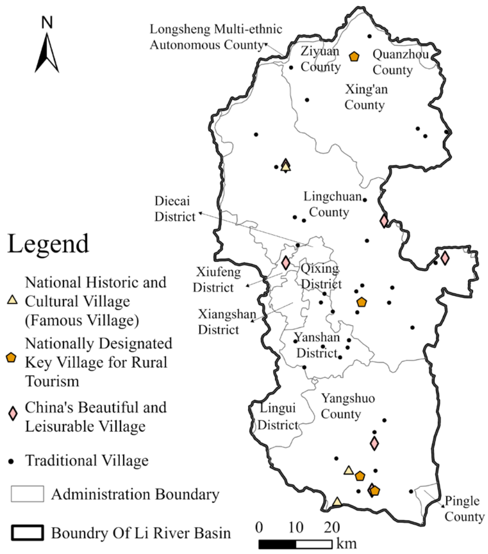

Figure 2 Spatial Distribution of Characteristic Villages in the Lijiang River Basin

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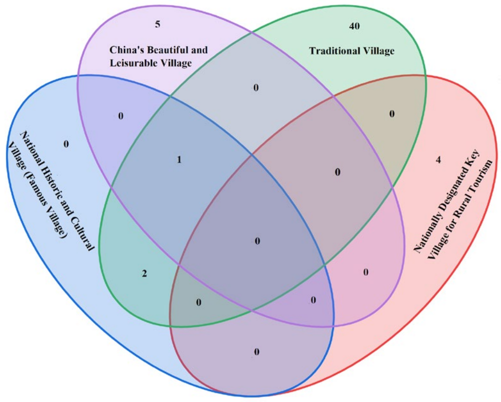

Figure 3 Cross-Statistics of Characteristic Villages in the Lijiang River Basin (by Village Count)

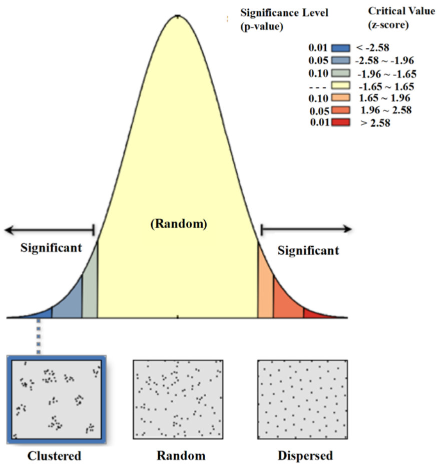

Figure 4 Nearest Neighbor Index (NNI)

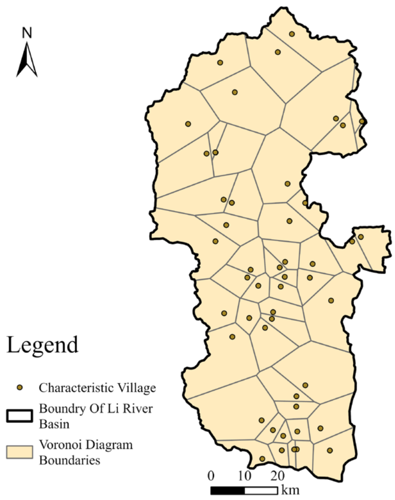

Figure 5 Voronoi polygon verification

Table 1 Summary of Average Nearest Neighbor Analysis

Targets	Results
Average observation distance	3406.1204 Meters
Expected average distance	5362.5820 Meters
Nearest Neighbor Ratio	0.635164
z Score	-5.223027
p-value	0.000000

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3.2 Characteristic villages across districts and counties exhibit a concentrated yet uneven distribution pattern

By calculating the spatial distribution of characteristic villages in the Lijiang River Basin using the geographic concentration index, Equation (5) yields $G = 53.273$ and $G_0 = 26.726$. Since $G > G_0$, this indicates a high degree of spatial concentration for characteristic villages at the district and county scales. Calculating the imbalance index S using Equation (6) yields $S = 0.844$, indicating uneven distribution of characteristic villages in the Lijiang River Basin. The Lorenz curve for characteristic villages in the basin (Figure 6), generated from statistical data, shows significant deviation from the uniform distribution line with pronounced convex curvature. This confirms uneven distribution across districts and counties, revealing pronounced non-equilibrium characteristics[26].

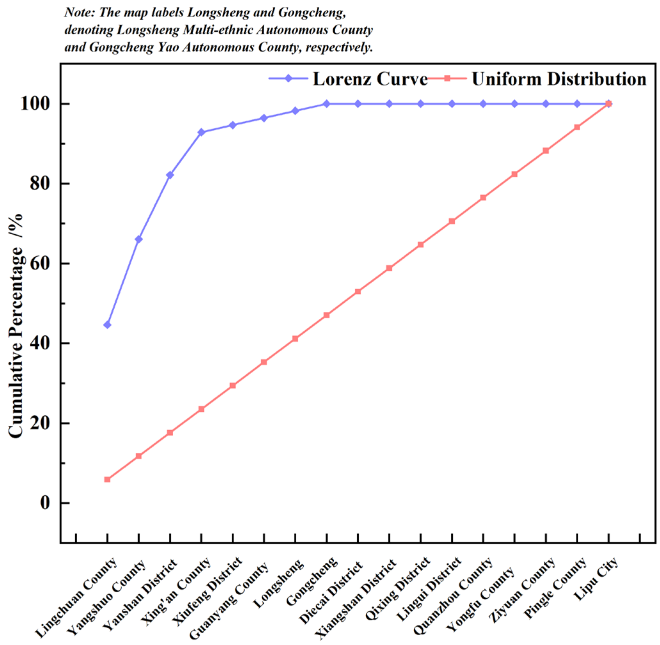

Figure 6 Spatial Lorenz Curve for Distribution of Characteristic Villages by County in the Lijiang River Basin

3.3 Concentrated contiguous distribution based on a "dual-core—multi-level diffusion—ribbon-like extension" pattern

Using ArcGIS Pro 3.0, kernel density analysis was conducted to assess the spatial distribution of distinctive villages within the Lijiang River Basin. These villages exhibit a concentrated spatial pattern characterized by a "dual-core—multi-level diffusion—strip-like extension" structure[24][27]. The two major density cores are centered around Guilin City and Yangshuo County, respectively (Figure 7). Guilin City exhibits a pronounced diffusion effect, radiating northward to drive development in Lingchuan County and extending southward to Yanshan District, forming a ring-core diffusion belt. Yangshuo County radiates along river valleys toward surrounding areas like Fuli Town, forming a ring-nucleus extension cluster. The strip-like extension exhibits two major axes: a continuous high-density belt concentrated along the main Lijiang River channel, and branching low-density belts emerging in tributary basins like the Taohua River and Yulong River. This "dual-core—multi-level diffusion—strip-like extension" spatial distribution pattern embodies the agglomeration characteristics of distinctive rural settlements. Single-core clusters form micro-centers around Xing'an and Pingle counties, with diffusion diminishing outward in a hierarchical distribution. This structural feature aligns with transportation-driven development patterns within river basins, indicating that the distribution of distinctive villages is closely tied to shipping nodes and scenic hubs.

3.4 The region exhibits a spatial differentiation pattern characterized by scattered cold spots and concentrated hot spots

Using the Getis-Ord Gi* local association index to identify statistically significant clusters within

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each county, and applying Jenks' natural breaks method, the spatial distribution of characteristic villages in the Lijiang River basin was categorized into hot zones, sub-hot zones, transition zones, sub-cold zones, and cold zones[28]. Using ArcGIS Pro 3.0's hotspot analysis tool, we generated a distribution map of hotspot and coldspot areas for distinctive villages in the Lijiang River Basin (Figure 8). Hotspot areas predominantly occur in Yanshan District; sub-hotspot areas comprise Lingchuan County, Yangshuo County, and Lingui District; Transition zones are distributed in the central and northern parts of the basin, primarily encompassing Diecai District and Qixing District within the urban area, along with Xing'an County in the north. Semi-cold zones are mainly concentrated in the southeastern region and scattered in isolated areas, with semi-cold zones present in small portions of Xiufeng District and Pingle County. Cold zones are clustered in parts of Ziyuan County, Quanzhou County, and Xiangshan District. The spatial differentiation pattern is markedly uneven, with hot and cold spots interspersed. This is characterized by scattered cold spots and concentrated hot spots. At the watershed level, distinct "block-like" distribution and clustered development patterns emerge. This spatial correlation directly relates to the formation and distribution of distinctive villages in the Lijiang River Basin, influenced by spatial process factors such as regional connectivity, geographic location, and socioeconomic development[24].

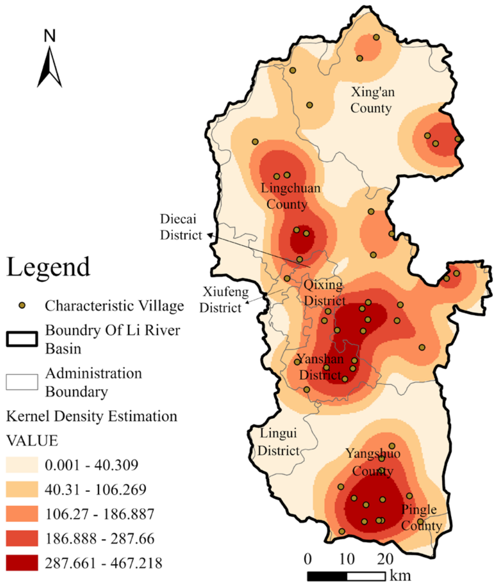

Figure 7 Kernel Density Distribution of Characteristic Villages in the Lijiang River Basin

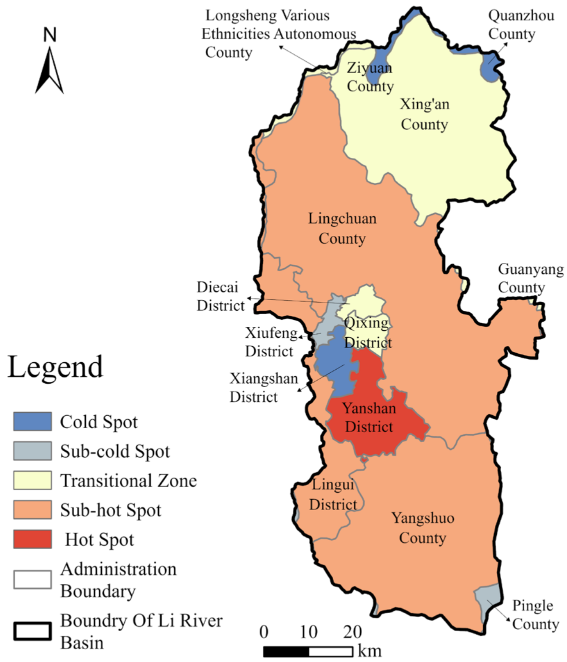

Figure 8 Spatial Clustering of Cold/Hot Spots for Characteristic Villages in the Lijiang River Basin

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4. Heterogeneous Factors Influencing the Spatial Distribution of Various Characteristic Villages in the Lijiang River Basin

4.1 Analysis of Factors Influencing the Spatial Distribution of Characteristic Rural Areas

The distribution of distinctive villages within the Lijiang River Basin results from the coupled effects of multiple factors. To investigate the spatial heterogeneity factors influencing the distribution of these villages, the GeoDetector method was employed to determine the relationship between various influencing factors and the village distribution pattern, as well as the impact of factor interactions on village distribution. GeoDetector was employed to conduct an influence factor analysis on the statistical count of distinctive villages (Y) across counties and districts within the study basin, examining correlations with permanent resident population (X_1), regional GDP (X_2), average elevation (X_3), river network density (X_4), and road density (X_5). Environmental data such as elevation and river network density often form spatially distinct low-high value zones. Socioeconomic data like population and GDP are also influenced by environmental factors, naturally creating underdeveloped and developed regions. These data exhibit non-uniform distribution patterns with pronounced clustering characteristics. The natural breakpoint method in ArcGIS Pro effectively identifies breaks and clusters in the study data. Skewed data undergoes discretization and classification. Using risk factor detection in the Geographic Detector tool, the explanatory power q-values for each influencing factor were calculated[27](Table 2).

The detection results indicate that the explanatory power of factors influencing the distribution of characteristic villages in the Lijiang River Basin decreases in the following order of strength: permanent resident population (X_1) > average elevation (X_3) > road density (X_5) > river network density (X_4) > regional GDP (X_2). This indicates that the permanent resident population significantly influences the distribution variation of characteristic villages, with an explanatory power q value of 0.8067. This demonstrates that socio-demographic factors play a crucial role in the spatial distribution of characteristic villages within the study basin. In contrast, average elevation, road density, river network density, and regional GDP exert relatively weaker influences on the spatial distribution patterns of characteristic villages.

Table 2 Explanatory Power of Impact Factors

	X_1	X_2	X_3	X_4	X_5
q statistic	0.8067	0.1915	0.5472	0.2658	0.3686
p value	0.0425	0.7027	0.2148	0.4836	0.4580

4.2 Interaction Analysis of Factors Influencing the Spatial Distribution of Characteristic Rural Areas

Interaction detection identifies the presence of interactions among risk factors—specifically, whether the combined effect of two assessment factors enhances or weakens the explanatory power for the dependent variable, or whether each factor's influence on the dependent variable is independent of the others.

Results indicate that, except for the single-factor nonlinear weakening observed when Regional GDP (X_2) interacts with Average Elevation (X_3), all other factor pairs exhibit either a two-factor strengthening or nonlinear strengthening pattern (Figure 9). Compared to the effects of individual risk factors, these distinct factor interactions often exert a stronger influence on the spatial distribution of distinctive villages. In single-factor analysis, the explanatory power q of average elevation (X_3) was 0.5472, while road density (X_5) yielded an explanatory power of q = 0.3686. The interaction between these two factors achieved an explanatory power of 0.9990, representing the highest explanatory power among all interaction analyses. This indicates that the synergistic effect of topography and transportation accessibility possesses extremely high explanatory power for the spatial distribution of distinctive villages, exerting a more significant influence on the spatial distribution patterns of such villages in the Lijiang River Basin. Although regional GDP (X_2) exhibits weaker explanatory power in single-factor detection, it demonstrates a significant enhancement effect when combined with multiple variables in dual-factor interaction detection. This indicates that while it is not a dominant factor, it possesses critical latent synergistic influence. It suggests that economic development potential indirectly influences the distribution pattern of villages through the dissemination of transportation networks and resource flows.

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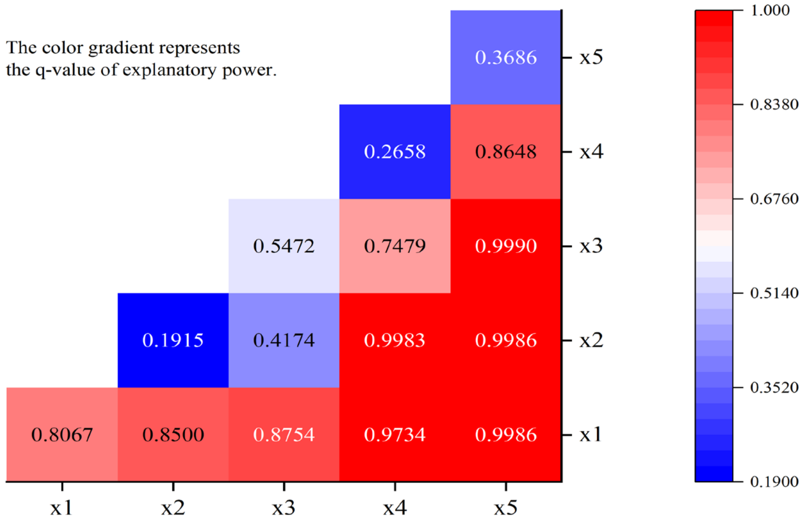

Figure 9 Interaction Detection of Driving Factors for Characteristic Villages in the Lijiang River Basin

5. Typical Development Models of Characteristic Villages in the Lijiang River Basin

The tourism resources of characteristic villages in the Lijiang River Basin are categorized into five types: ancient architectural tourism resources, red cultural resources, distinctive folk cultural resources, historical and cultural resources, and natural scenic resources. The following table (Table 3) shows the proportion of each resource cate gory.

Table 3 Tourism Resources in Characteristic Villages of the Lijiang River Basin

Resource Type	proportion
Ancient Architectural Tourism Resources	26.92%
Red Cultural Resources	7.69%
Distinctive Folk Culture	20.77%
History and Culture	17.69%
Natural scenery	26.92%

Based on the classification of tourism resources, three development models can be summarized using typical villages as representative examples.

5.1 Cultural IP Deep Cultivation Model: The Case of Jiangtou Village, Jiuwu Town, Lingchuan County

With cultural resources at its core, value multiplication is achieved by integrating historical culture, ancient architectural heritage, and distinctive folk traditions. The essence lies in leveraging profound historical foundations to synthesize diverse resources, forging a sustainable development path that equally prioritizes preservation and development. Centered on historical themes like "lotus culture" and "imperial examination culture," the revitalization of ancient architectural complexes and immersive folk experiences—such as the autonomous region-level intangible cultural heritage event "Girls' Festival" as an annual spectacle—draw visitors to participate in traditional celebrations. Jiangtou Village concurrently earned designations as a "China Beautiful Leisure Village," "National Historical and Cultural Village," and "China Traditional Village." Guided by the principle of "ancient architecture as the body, culture as the soul, and folk customs as the color," it achieved the dynamic transformation of static heritage through systematic resource integration and deep cultivation of cultural IP. Its model offers a blueprint for similar ancient villages—emphasizing "light development and heavy revitalization" (Figure 10). By extracting unique cultural symbols through preservation and activating the village's endogenous momentum with experiential tourism, it ultimately achieves a win-win outcome of cultural inheritance and economic development.

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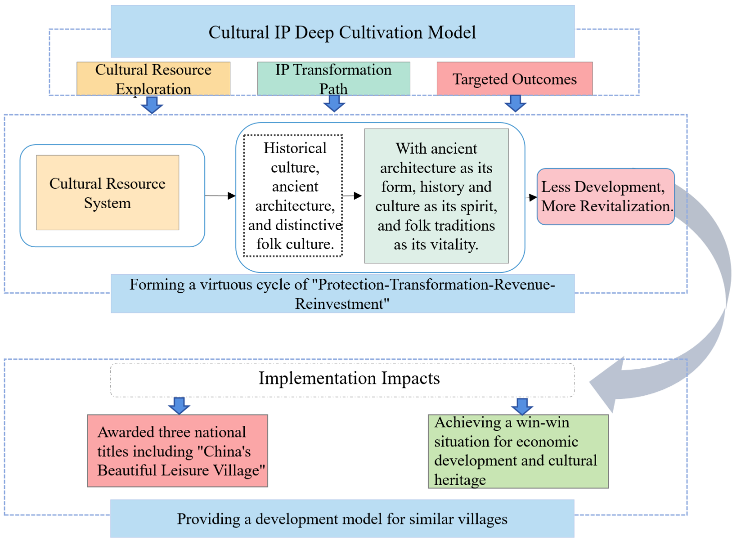

Figure 10 Intensive Cultivation Model of Cultural IP-based Development

5.2 Ecological Wellness-Driven Model: The Case of Longtangjiang Village, Huajiang Yao Ethnic Township, Xing'an County

Longtangjiang Village leverages the world-class ecological resources of Maoshan Mountain and the rich heritage of Yao culture to build a composite industrial chain integrating “natural healing and ethnic charm.” Guided by the principles of “top-tier ecology as foundation, Yao culture as lifeline, and industrial innovation as axis,” the village transforms premium natural resources through deep processing and refined operations. This approach converts pristine landscapes into high-value experiential products while building a dynamic Yao cultural industry chain. The strategy achieves a spiraling ascent in ecological conservation, cultural preservation, and economic returns, setting a new benchmark for rural development in ethnic regions. This initiative forges a sustainable development pathway characterized by “ecological foundation, cultural soul, and industrial synergy,” pioneering a rural revitalization model that integrates “natural healing resources, cultural production factors, and industrial chain value enhancement” (Figure 11). It provides a practical blueprint for ecologically sensitive areas, emphasizing “light development, rich experiences, and deep integration.”

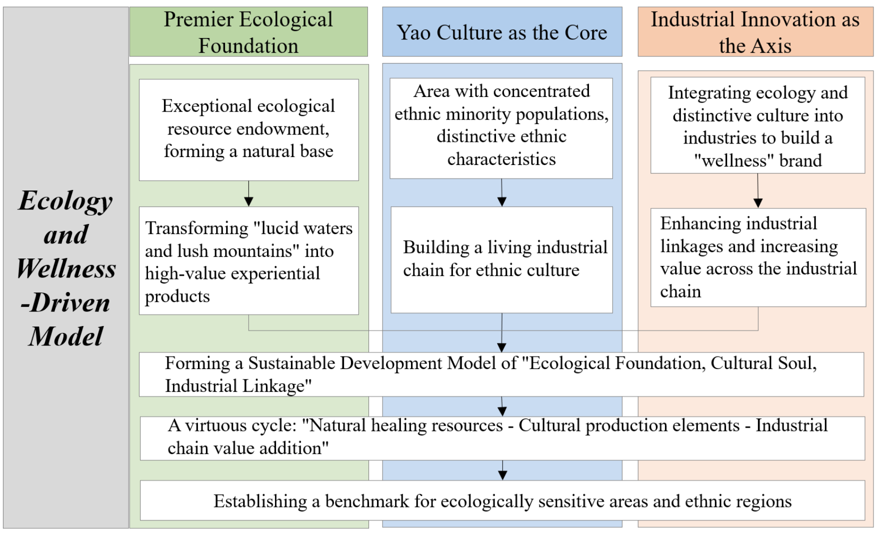

Figure 11 Eco-wellness-driven Development Model

5.3 Theme-Based Scenario Integration: The Case of Lu Xi Village, Dingjiang Town

The revitalization of revolutionary sites leverages the former logistics transfer station of the Eighth

Route Army's Guilin Office in Luxi Village to establish a memorial hall showcasing historical artifacts and photographs. This initiative integrates other sites of historical legacy, including the former site where key historical resolutions were communicated (Longwang Temple), the former residence of Li Kenong, and military supply warehouses, to create a comprehensive historical education experience.Selected as a national red tourism premium route and classic scenic area, it connects various revolutionary sites through red tourism itineraries, enhancing the "immersive revolutionary history immersion" experience.

The thematic scenario-embedded development model represents a sustainable path for the systematic preservation and revitalization of red cultural resources. It aims to synergistically integrate historical heritage conservation, educational function transmission, and cultural tourism development. Its key mechanism lies in using thematic route design to systematically connect dispersed site resources. For instance, integrating the Sixth Plenary Session of the Sixth Central Committee venue with related revolutionary sites creates premium tour routes featuring logical coherence and narrative depth, enhancing visitors' sense of historical presence and emotional resonance. This framework not only emphasizes the preservation of sites themselves and the maintenance of historical authenticity but also prioritizes the contemporary dissemination and communication effectiveness of revolutionary spirit values (Figure 12).

By establishing a virtuous cycle between heritage conservation and cultural tourism development, this model promotes the innovative inheritance of revolutionary culture in contemporary society and the sustainable development of local cultural ecosystems. It achieves the organic integration of multiple objectives: the continuity of cultural memory, social education, and regional development.

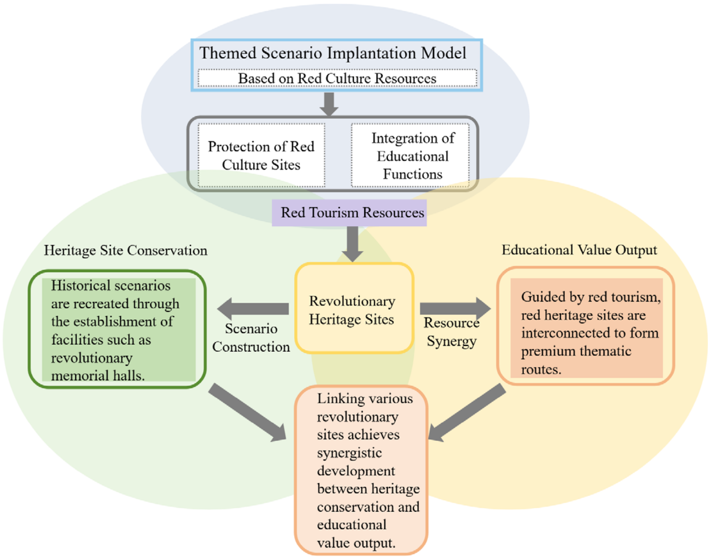

Figure 12 Context-Sensitive Themed Scenario Implantation Model

6. Recommendation

6.1 Strengthen the mechanism of "dual core—multi-level diffusion—belt-shaped extension"

Upgrade the dual-core rural tourism attraction pattern formed by Guilin city center, leveraging its cultural and tourism services, and Yangshuo County, serving as an international tourism gateway. Local governments in Guilin should improve the transportation network and digital infrastructure to enhance convenience, promote coordinated regional development, expand its influence, and strengthen the core areas' radiating effect on secondary nodes such as Lingchuan County and Yanshan District[29][30]. Transport accessibility is a primary factor influencing the spatial distribution and interconnected development of distinctive villages. Priority should be given to developing villages with advantageous geographical locations that are easily accessible to tourists. Simultaneously, based on the topographical characteristics of different villages, optimizing rural roads, improving transportation facilities, and providing specialized passenger services can effectively enhance the development of rural tourism and leisure sightseeing industries. Considering that travel times within 5 kilometers between villages typically range from 5 to 10 minutes, indicating strong accessibility value, a 5-kilometer buffer zone was analyzed for distinctive villages in the Lijiang River basin. The results demonstrate that this approach

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can effectively connect villages within a given area (Figure 13). Using villages as nodes and transportation as lines, a regional transportation network can be constructed to link distinctive villages with surrounding settlements. This provides a macro-level reference for fostering cluster development among neighboring villages. The rural tourism special plan of the Lijiang River Basin should optimize rural road construction by rationally linking village roads and integrating villages with strip-like distribution patterns within a specific area into a single tour route. This enhances the visibility and accessibility of distinctive villages within the transportation network.

Along the Lijiang River mainstem, develop a composite corridor model centered on "ecology-culture." The Lijiang River Basin Management Committee should integrate low-density areas along tributaries like the Taohua River and Yulong River by establishing and refining a water-based public transit system resembling a water bus.This enhances the carrying capacity and network density of the water transport corridor, thereby optimizing accessibility within the watershed. It significantly reduces travel time costs between tourist village nodes, expands the temporal and spatial scope for visitors to engage with tourism culture, ultimately enhancing spatial connectivity and service efficiency throughout the basin.

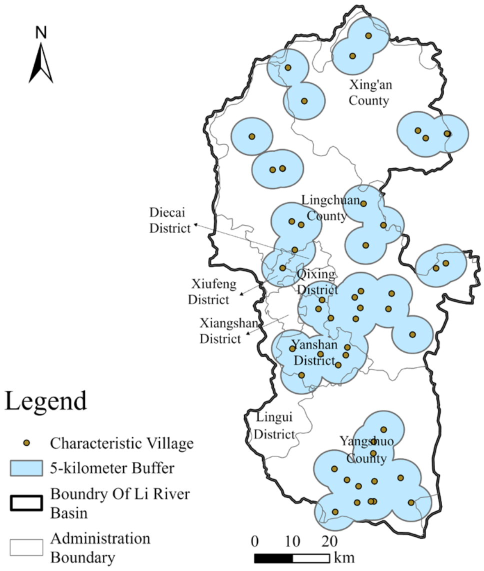

Figure 13 Five-kilometer buffer zone for characteristic villages in the Lijiang River Basin

6.2 Differentiated activation of hot and cold spot areas

In key regions such as Yanshan District and Lingchuan County, it is essential to moderate the intensity of ecologically oriented development driven by rapid economic growth and adopt a strategy of sustainable economic transformation. Efforts should focus on revitalizing ancient architecture and enriching folk cultural experiences through a "cultural IP cultivation" model, thereby avoiding homogenized competition and enhancing the overall attractiveness to tourists. In resource-abundant counties and underdeveloped areas—particularly parts of Quanzhou County—development should build upon existing natural resource endowments by introducing the ecological wellness model exemplified by Longtangjiang Village in Huajiang Yao Ethnic Township. Based on ecological conservation principles, emphasis should be placed on developing low-carbon industries, strengthening regional infrastructure, and optimizing the spatial layout of tourism, leisure, and entertainment facilities. At the same time, increasing regional road density is crucial for mitigating topographical constraints on distinctive villages ($q = 0.9990$) and enhancing the synergistic relationship between terrain conditions and transportation accessibility.

6.3 Enhance cross-regional collaboration among various models

Establish a three-pronged integrated approach combining "cultural IP, ecological wellness, and themed experiences" to promote cross-county/district design of distinctive thematic routes. This will facilitate shared visitor flows and complementary resource utilization while exploring "enclave economy" mechanisms. Policymakers and tourism authorities should encourage enterprises from high-demand areas to invest in projects within low-demand zones, thereby fostering coordinated regional development ($S=0.844$) and balancing growth momentum with the spatial distribution of distinctive rural areas.

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7. Conclusion

This study applied kernel density analysis, the nearest neighbor index model, and local association analysis to examine the quantitative characteristics and spatial distribution patterns of distinctive villages. The geographic concentration index was employed to assess the degree of clustering among these villages. Furthermore, geographic detector models were used to investigate the relationships between various influencing factors and village distribution patterns, as well as the interactive effects of these factors on rural spatial organization. The research focused on the spatial distribution characteristics of distinctive villages in the Lijiang River Basin and their coordinated development within the broader context of rural revitalization [23]. The main findings are as follows:

(1) The spatial pattern exhibits significant clustering and unevenness. The nearest neighbor index of 0.635 and CV value of 77.25% indicate distinct cluster distribution characteristics, forming a hierarchical structure centered on Guilin City and Yangshuo County as dual cores. This structure features "strip-like extensions" along the Lijiang River mainstem and "low-density branches" along tributaries. Furthermore, the geographic concentration index $G=53.273>G_0=26.726$ and the imbalance index $S=0.844$ indicate highly uneven distribution at the county level, with hotspots concentrated in Yanshan District and cold spots scattered along the periphery of the watershed.

(2) Permanent residents and terrain-transport synergies dominate spatial differentiation. Permanent residents ($q=0.8067$) serve as the core social driver, confirming human capital's foundational role in rural tourism. The synergistic effect between terrain elevation and transport networks exhibits exceptional explanatory power ($q=0.9990$), revealing that natural geographical conditions must be transformed into enhanced transport accessibility to unlock development potential and drive regional growth. Therefore, optimizing transportation networks is key to enhancing resource allocation efficiency.

(3) Three development models offer replicable revitalization pathways. Jiangtou Village exemplifies deep cultural IP cultivation, achieving ancient village revival through living heritage of historical culture and traditional architecture. Longtangjiang Village employs an eco-healthcare-driven model, leveraging premium ecological resources to monetize "green mountains and clear waters." Theme-scenario integration (e.g., Luxi Village) activates peripheral areas through "red-green integration." Together, these models validate that spatial restructuring must be grounded in resource endowment differences, achieving holistic coordination through "core empowerment—corridor linkage—model adaptation."

The formation of distinctive villages results from the deep coupling and synergistic interaction of multiple dimensions, including the geographical environment, historical culture, resource endowments, policy orientation, and market demand. This study focuses on data collection and analysis within a specific recent timeframe; while it provides valuable insights into the conditions of that period, the limitation of a single time span constrains its capacity to capture the long-term evolutionary trajectory of rural development, uncover deep-seated structural mechanisms, and forecast sustainable development pathways. Therefore, advancing the rural revitalization strategy requires grounding efforts in local realities, accurately identifying and effectively activating distinctive regional resource advantages, and adhering to the principle of "tailored approaches based on local conditions and village-specific strategies." On this basis, development should be scientifically planned and the pace and intensity of industrial upgrading, ecological protection, and cultural preservation carefully managed, so as to achieve comprehensive, high-quality, and sustainable rural development.

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