

# Research on the Distribution Characteristics and Influencing Factors of Secondary Education Resources in Guangxi

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**Abstract:** Taking the Guangxi Zhuang Autonomous Region as a case study, this paper explores the spatial distribution pattern and influencing factors of secondary education resources. It comprehensively employs methods such as kernel density analysis, average nearest neighbor, spatial autocorrelation, and the location quotient model to characterize the spatial differentiation features of secondary education resources, and utilizes a ridge regression model to identify key factors influencing their distribution. The study finds that: (1) The distribution of secondary education resources exhibits an agglomeration pattern characterized by “dense in the southeast and sparse in the northwest”; (2) At the prefectural city scale, secondary education resources are clustered in their distribution, but the degree of clustering varies among cities; (3) At the county scale, the distribution of secondary education resources shows significant spatial heterogeneity, with notable disparities in allocation equity; (4) The spatial pattern of secondary education resources among counties is primarily shaped by six factors: year-end total population, registered (hukou) population, number of students enrolled in regular secondary schools, number of students enrolled in regular primary schools, balance of urban and rural household savings deposits, and number of industrial enterprises above a designated size. This reflects a multi-dimensional driving response of “basic demand—deferred planning—economic support.” The research provides empirical evidence for understanding the issue of spatial equity of educational resources in border ethnic regions and holds reference significance for promoting the optimal allocation of educational resources and balanced regional development.

**Keywords:** Educational Resources; Spatial Pattern; Regional Disparities; Influencing Factors; Guangxi

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## 1.Introduction

The spatial allocation of educational resources is a key dimension for measuring social equity and development quality. As a pivotal stage for individual development and regional human capital formation, the equitable distribution of secondary education resources directly determines the substantive fairness of educational opportunities and profoundly reflects the distributive justice of social resources and sustainable development capacity. Against the backdrop of global concerns about inclusive development, spatial inequality in educational resources is regarded as an important mechanism exacerbating social stratification and regional imbalances. During China’s rapid urbanization process, although policies promoting educational equity have been vigorously advanced, the phenomena of “spatial agglomeration” and “resource depressions” of educational

resources, especially high-quality secondary education resources, between urban and rural areas and across regions remain significant, posing a potential challenge to social equity. The Guangxi Zhuang Autonomous Region, as a multi-ethnic border area in southwestern China, exhibits significant internal variations in natural conditions, economic development, and ethnic cultures, facing complex geographical constraints and socio-economic challenges in the distribution of educational resources. The allocation of educational resources in Guangxi is not only crucial for local livelihood development but also holds strategic significance for border stability and regional coordination. Therefore, this research systematically reveals the spatial pattern of secondary education resources in Guangxi and the regional disparities in their equity by comprehensively applying spatial analysis and econometric methods, possessing significant theoretical and practical value.

## 2. Literature Review

### 2.1 The Connotation of Social Equity in the Spatial Distribution of Educational Resources

The social equity connotation of the spatial distribution of educational resources is rooted in the core human geography concept that “space is a social product”<sup>[1]</sup>. Its essence lies in the fact that the locational configuration of resources such as schools, teachers, and funding is by no means a neutral technical process but rather a geographical projection and reproduction mechanism of social structure and power relations<sup>[2]</sup>. The agglomeration of high-quality educational resources in specific spaces, such as urban cores and economically developed areas, is highly isomorphic with the distribution of wealth and capital, making geographical location itself a key variable in accessing social opportunities<sup>[3]</sup>. Through education, a core means of socialization, this pattern systematically transforms geographical inequality into inequality of social opportunities, thereby consolidating or even intensifying existing class stratification, constituting the core of the spatial justice issue<sup>[4]</sup>. This issue is particularly acute in urban-rural and regional dimensions. The long-term tilt of educational resources towards advantageous locations implies a “spatial deprivation” of rural, peripheral, and underdeveloped areas<sup>[5]</sup>. This not only directly leads to disparities in educational quality but also, at a deeper level, restricts the accumulation of human capital and long-term development capacity in these areas, easily forming a vicious cycle of “peripheral location—resource scarcity—development lag”<sup>[6]</sup>. Therefore, examining the spatial pattern of educational resources is a profound test of the degree of social equity realization. It questions whether a society can conduct effective “spatial fixes”<sup>[7]</sup> through public policy to correct the imbalances shaped by historical and market forces, ensuring that people in different geographical units, especially groups in disadvantaged regions, can access the public good of education above a baseline level necessary for their comprehensive development<sup>[8]</sup>. The analysis of the spatial differentiation of secondary education resources in Guangxi is a concretization and deepening of this issue.

### 2.2 Research Methods and Progress on the Spatial Distribution of Secondary Education Resources

Regarding the spatial distribution of educational resources and their inequities, traditional education research, relying on its deep disciplinary foundation and field experience<sup>[9]</sup>, often focuses on multi-dimensional comprehensive assessments of individual schools or multiple schools, including teacher quality, school district enrollment, facility equity, funding input, and curriculum quality<sup>[10]</sup>. Such in-depth descriptions of concrete problems have yielded a body of highly theoretically insightful case studies<sup>[11]</sup>. However, traditional pedagogical methods lack quantitative analysis and visualization of the macro-distribution of educational resources, and lack research tools for large-scale inter-regional equity issues in educational resources. Fortunately, geography provides a relatively mature set of research methods for this issue. For instance, methods based on GIS for detecting cold and hot spots in the distribution of basic education resources<sup>[12]</sup>, kernel density analysis<sup>[13]</sup>, and spatial autocorrelation<sup>[14]</sup> are widely used. These methods have inherent advantages in visualizing the uneven distribution of educational resources but struggle to decompose the comparison of equity within and between regions<sup>[15]</sup>. This raises another question: what are the influencing factors causing this uneven distribution of educational resources? Therefore, research on educational resources should not only focus on the issue of spatial heterogeneity but also pay significant attention to the factors that trigger this spatial heterogeneity.

### 2.3 The Research Framework of This Study

Based on the above review, this study will take secondary education resources in Guangxi as the object, integrating educational geography and social equity theory. It will use GIS spatial analysis to characterize the spatial distribution features

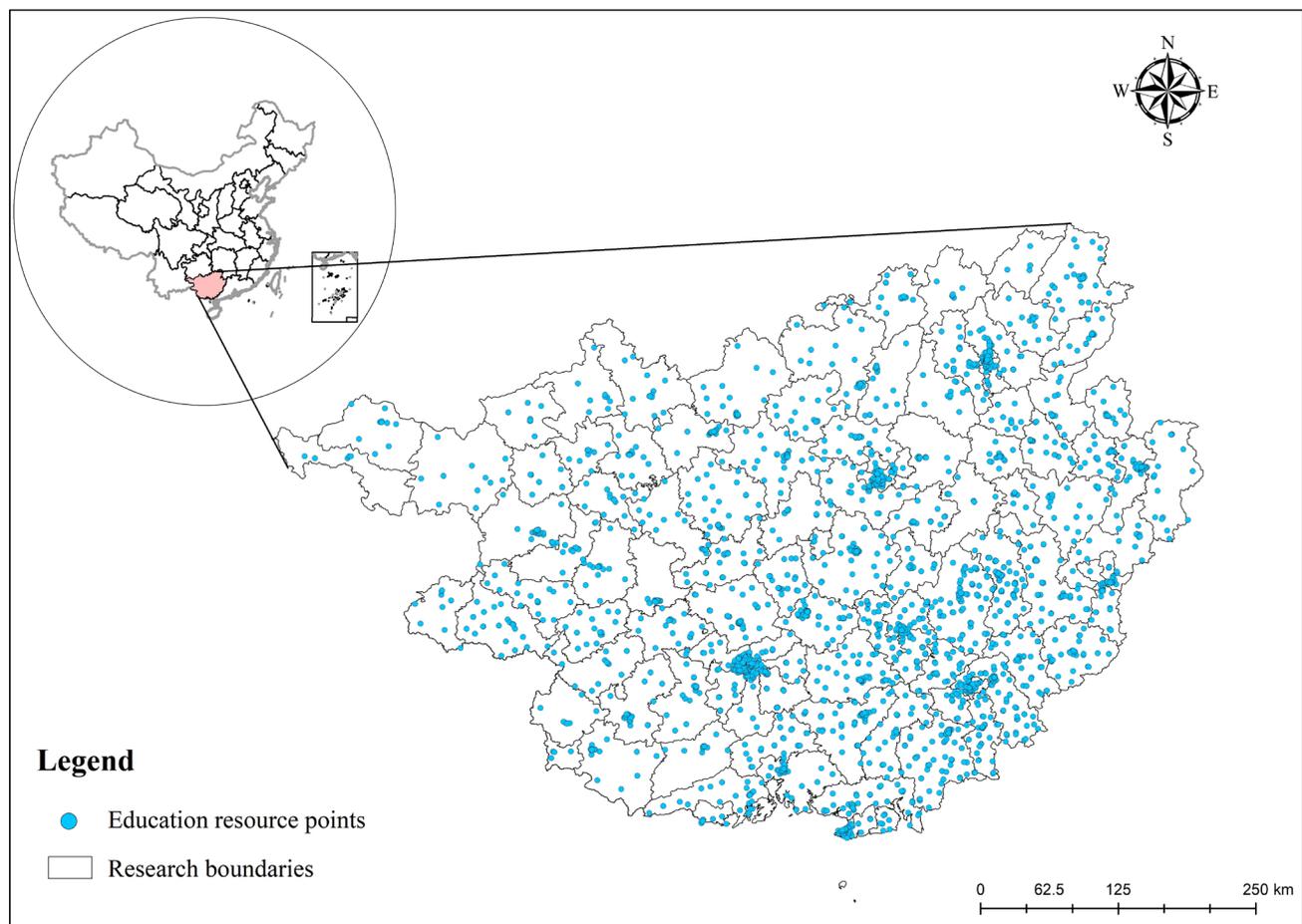
of resources, decompose the spatial heterogeneity of secondary education resource distribution in Guangxi, and introduce a ridge regression analysis model based on spatial heterogeneity to capture the multi-dimensional influencing factors causing this heterogeneity. The research aims to answer: What spatial differentiation patterns exist in secondary education resources in Guangxi? What are the factors influencing their spatial distribution? The conclusions will provide empirical evidence and policy references for optimizing educational resources in border multi-ethnic regions.

### 3. Study Area and Methods

#### 3.1 Study Area

This study takes the Guangxi Zhuang Autonomous Region (hereinafter referred to as “Guangxi”) as the research area (Figure 1). Guangxi is located in China’s southern border region, characterized by both border and coastal locations. Karst landforms are widely distributed within its territory, and the complex topography has, to some extent, constrained the development of transportation infrastructure. Meanwhile, Guangxi is a multi-ethnic inhabited region, with distinct regional characteristics in the distribution of various ethnic groups, and significant disparities in economic development levels within the region. This dual heterogeneity of physical geography and socio-economic conditions profoundly influences the spatial allocation pattern of educational resources, presenting unique regional issues<sup>[16]</sup>. Therefore, selecting Guangxi as a case provides a typical and practically significant research sample for exploring the spatial equity issue of secondary education resources in ethnic regions.

Figure 1: Overview Map of the Study Area



#### 2.2 Data Sources and Processing

The geographic data in this paper are sourced from the Geospatial Data Cloud (<http://www.gscloud.cn>). Spatial location data for secondary education resources were obtained by web scraping Gaode Maps (<https://www.amap.com/>) using Python. Considering the update timelines of county-level Statistical Yearbooks, the scraping cutoff point was the end of 2022. Relevant socio-economic influencing factors (such as population size, GDP, etc.) were obtained from the 2022 China City

Statistical Yearbook. Spatial analysis was completed using ArcGIS 10.8 software, and data computation was performed using the SPSS PRO platform.

## 2.3 Research Methods

### 2.3.1 Kernel Density Analysis

Kernel density analysis<sup>[13]</sup> reflects the density and spatial pattern of secondary education resource distribution in Guangxi. The calculation formula is as follows:

$$F_n(x) = \frac{1}{nh} \sum_{i=1}^n k\left(\frac{x-x_i}{h}\right)$$

Where  $x$  represents the distance from a secondary education resource point to  $x$ ;  $h>0$  is the bandwidth;  $k$  is the kernel function; and  $n$  is the total number of secondary education resource points in Guangxi. This reflects the density of spatial distribution of secondary education resource points in Guangxi. A larger value indicates a denser distribution and a higher probability of occurrence.

### 2.3.2 Nearest Neighbor Index

The Nearest Neighbor Index<sup>[17]</sup> uses quantitative statistical methods to judge the spatial distribution type of point features (secondary education resource points) in different cities of Guangxi, in order to verify the varying agglomeration densities identified in cold/hot spot analysis. The calculation formula is as follows:

$$R = \frac{r}{r_E}$$

Where  $R$  is the nearest neighbor index for secondary education resource points in different cities of Guangxi;  $r_1$  is the average actual nearest distance;  $r_E$  is the theoretical nearest distance. This judges the spatial distribution type of secondary education resource points in different cities of Guangxi. When  $R = 1$ , the distribution tends to be random; when  $R > 1$ , it tends to be uniform; when  $R < 1$ , it tends to be clustered.

### 2.3.3 Local Moran's I Analysis

Local Moran's I analysis<sup>[18]</sup> reflects the clustering of secondary education resource point distribution in Guangxi. The specific calculation formula is as follows:

$$Z(Gi^*) = \frac{Gi - E(Gi^*)}{\sqrt{Var(Gi^*)}}$$

$$Gi^* = \frac{1}{n} \sum_{j=1}^n W_{ij}(d) X_j$$

Where  $G_i^*$  are attribute values at locations  $E(G_i^*)$  and  $Var(G_i^*)$  is the mean attribute value,  $W_{ij}(d)$  is the spatial weight between locations  $X_j$  and  $j$ , and  $n$  is the total number of locations. A positive  $Z$  value indicates spatial clustering of similar values (high-high or low-low), while a negative value indicates spatial clustering of dissimilar values (high-low or low-high).

### 2.3.4 Location Quotient Model

The Location Quotient model<sup>[19]</sup> is used to measure the spatial distribution of a particular element in a region, reflecting its relative concentration, degree of specialization, and relative advantages/disadvantages within the region. This study primarily adopts a proportional model to measure the level of educational facility construction, by calculating the ratio of the number of educational facilities to the total number of such facilities in the region and comparing it to the ratio of the research unit's population to the total regional population. The formula is:

$$LQ = \frac{\left(\frac{F_k}{P_k}\right)}{\left(\frac{F}{P}\right)}$$

Where:  $LQ$  is the location quotient of educational facilities in the research unit;  $F_k$  is the number of educational facilities in county  $k$ ;  $P_k$  is the population size of county  $k$ ;  $F$  is the total number of educational facilities in Guangxi;  $P$  is the total population of Guangxi. When  $LQ = 1$ , it indicates that the scale of educational facilities in that county is comparable to the average level of all counties in Guangxi; when  $LQ < 1$ , it indicates that the county's educational facility scale is at a disadvantage in Guangxi; when  $LQ > 1$ , it indicates that the county's educational facility scale is at an advantage in Guangxi.

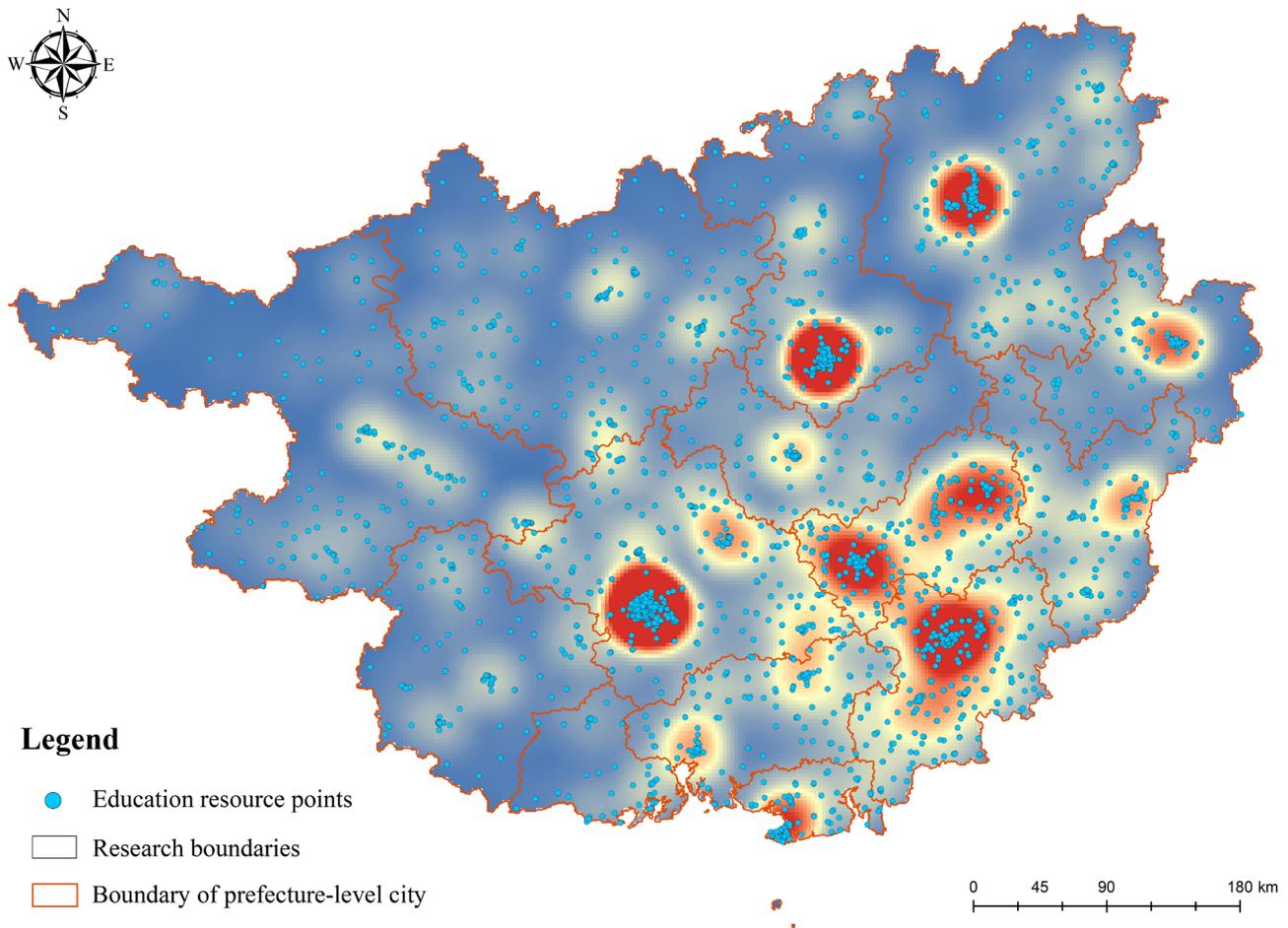
A higher  $LQ$  value indicates more significant agglomeration of educational facilities and a more pronounced relative advantage.

## 4. Spatial Distribution Characteristics of Secondary Education Resources in Guangxi

### 4.1 Overall Spatial Pattern of Secondary Education Resources

Kernel density analysis shows that secondary education resources in Guangxi generally exhibit a “multi-core, multi-center” distribution pattern. Agglomeration cores are mainly distributed southeast of a line extending from Guilin City in the north to Chongzuo City in the south. Secondary education resources form three agglomeration cores in Guilin City, Liuzhou City, and Nanning City, and four agglomeration centers in Yulin City, Guigang City, and Beihai City (with two agglomeration centers within Guigang City). Six secondary agglomeration centers are formed in cities such as Wuzhou City, Hezhou City, Laibin City, Qinzhou City, and Nanning City. Cities like Hechi City, Baise City, Chongzuo City, and Fangchenggang City form only small agglomeration clusters.

Figure 2: Kernel Density Analysis of Secondary Education Resource Distribution in Guangxi



### 4.2 Spatial Distribution Characteristics of Secondary Education Resources at the Prefectural City Scale

To further verify the kernel density analysis results and delve into the prefectural city scale, this study introduces nearest neighbor analysis to further analyze the differences in spatial distribution density of secondary education resource points across cities with varying administrative area sizes. Observing the Nearest Neighbor Index (NNI) values (Table 1), distinct inflection points are evident at  $NNI = 0.549803$  and  $NNI = 0.831116$ . Using the natural breaks method (Jenks)<sup>[20]</sup>, the NNI values for secondary education resource distribution across different cities were reclassified into three categories. The results indicate that five cities—Yulin City, Guigang City, Nanning City, Laibin City, and Wuzhou City—exhibit a highly clustered distribution pattern, with schools highly concentrated and very strong spatial proximity. Six cities—Liuzhou City, Guilin City, Qinzhou City, Hezhou City, Beihai City, and Baise City—show a moderately clustered pattern, where secondary education

schools are relatively concentrated but exhibit some dispersion trends. Three cities—Chongzuo City, Fangchenggang City, and Hechi City—show a low clustering pattern, with school distribution relatively dispersed and the weakest agglomeration trend.

Table 1: Average Nearest Neighbor Analysis Results

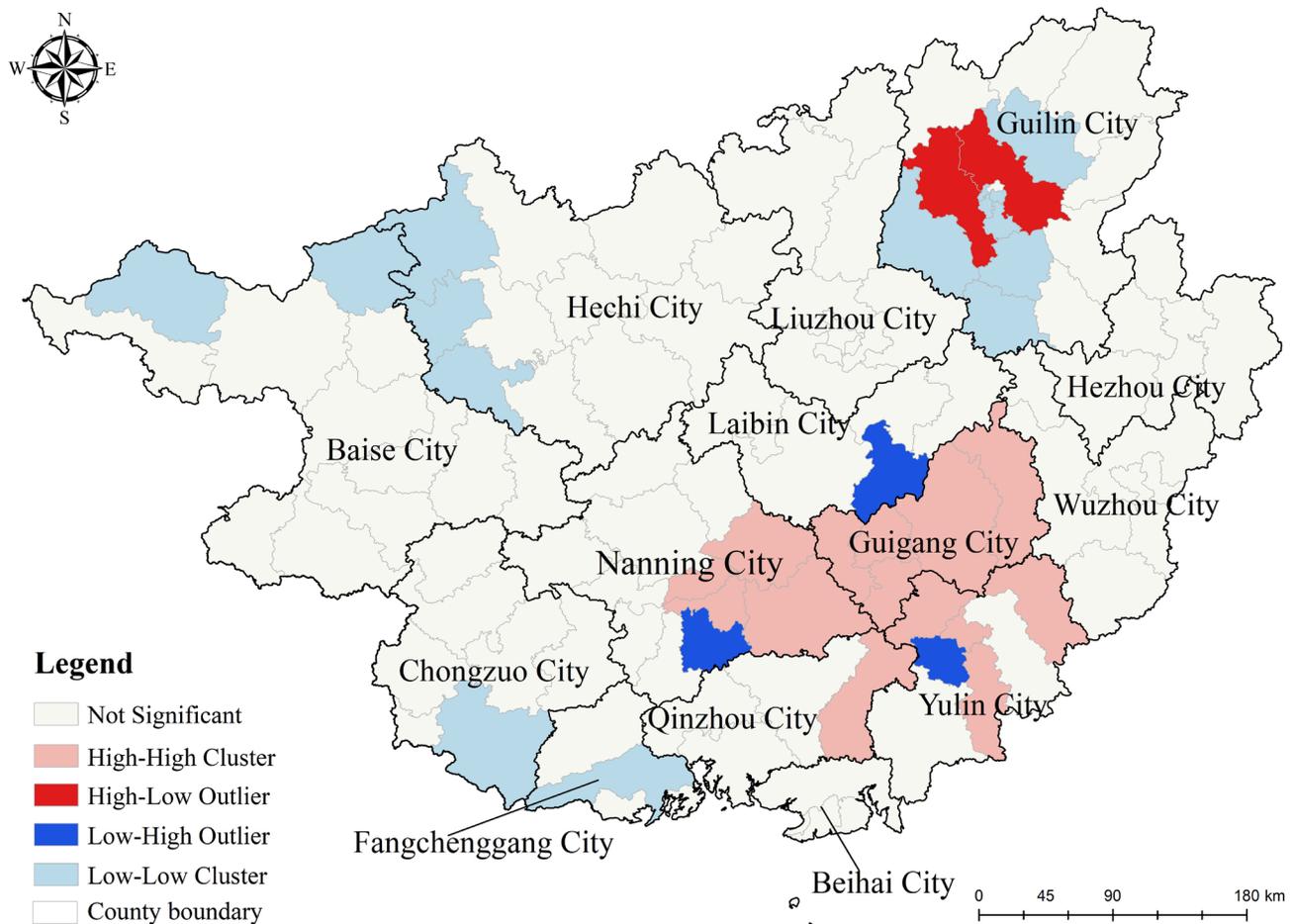
City	Nearest Neighbor Ratio	Z-score	P-value	Distribution Pattern
Baise City	0.673646	-7.995427	0.000000	Moderate Clustering
Beihai City	0.669157	-5.903531	0.000000	Moderate Clustering
Chongzuo City	0.831116	-3.149064	0.001638	Low Clustering
Fangchenggang City	0.836210	-2.101958	0.035557	Low Clustering
Guigang City	0.496083	-15.544493	0.000000	High Clustering
Guilin City	0.602212	-12.152125	0.000000	Moderate Clustering
Hechi City	0.843444	-4.073681	0.000046	Low Clustering
Hezhou City	0.644360	-7.359262	0.000000	Moderate Clustering
Laibin City	0.515320	-9.455902	0.000000	High Clustering
Liuzhou City	0.569135	-11.916398	0.000000	Moderate Clustering
Nanning City	0.513858	-18.507245	0.000000	High Clustering
Qinzhou City	0.621690	-8.440109	0.000000	Moderate Clustering
Wuzhou City	0.549803	-10.335097	0.000000	High Clustering
Yulin City	0.450945	-18.162773	0.000000	High Clustering

### 4.3 Spatial Distribution Characteristics of Secondary Education Resources at the County Scale

Previous research has demonstrated that secondary education resources in Guangxi exhibit a clustered distribution pattern at both the regional and city scales. However, studying only these scales may introduce scale bias. To further investigate the distribution pattern and spatial agglomeration correlation of secondary education resources, cluster and outlier analysis was introduced to determine whether secondary education resources exhibit spatial correlation and heterogeneity at the county scale. The results of the Local Moran's I calculation (Figure 3) show that secondary education resources exhibit local positive spatial correlation. Specifically, high-value clusters ("High-High" clusters) are formed in counties such as Qingxiu District, Xingning District, Binyang County, and Hengzhou City under Nanning City; Pubei County, Luchuan County, Yuzhou District, Xingye County, and Rong County under Yulin City; and Tantang District, Gangbei District, Gangnan District, Guiping City, and Pingnan County under Guigang City. Low-value clusters ("Low-Low" clusters) are formed in areas including Ningming County under Chongzuo City; Fangcheng District under Fangchenggang City; Longlin County and Leye County under Baise City; Tian'e County, Fengshan County, and Bama County under Hechi City; and Qixing District, Xiangshan District, Yanshan District, Lipu City, Yongfu County, Yangshuo County, Gongcheng County, and Xing'an County under Guilin City. High-value outliers ("High-Low" clusters) appear in Lingui District and Lingchuan County under Guilin City. Low-value outliers ("Low-High" clusters) appear in areas such as Yongning District under Nanning City, Fumian

District under Yulin City, and Wuxuan County under Laibin City. Overall, the range of “High-High” clusters is relatively concentrated and small, while the distribution range of “Low-Low” clusters is larger, mainly located northwest of the “Guilin-Chongzuo” line.

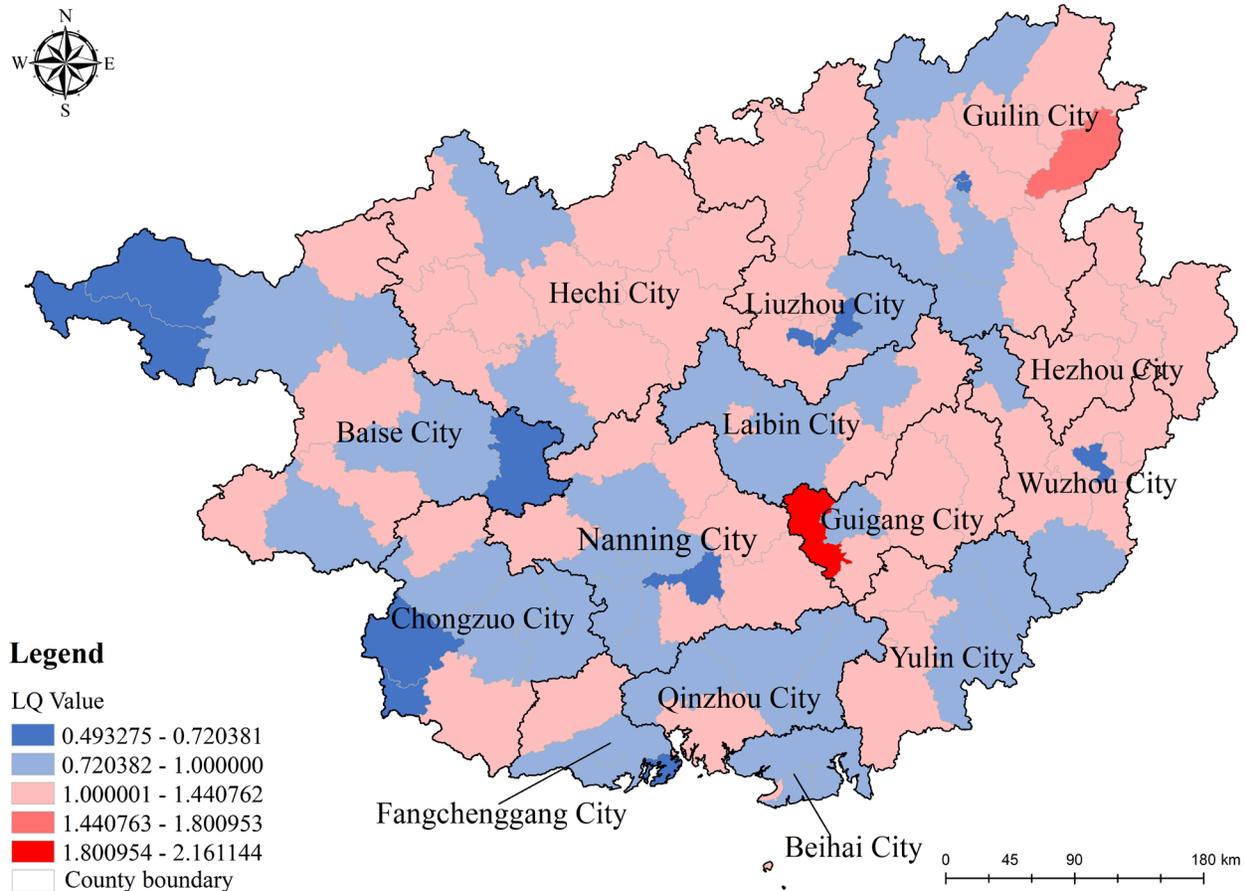
Figure 3: LISA Map of County-level Secondary Education Resources in Guangxi



#### 4.4 Equalization Configuration Characteristics of Secondary Education Resources at the County Scale

Local Moran's I analysis has confirmed that secondary education resources exhibit significant spatial correlation and heterogeneity at the county scale. The macro-level equalization distribution characteristics of secondary education facilities can provide a scientific reference basis for regional optimization of educational facility allocation. Furthermore, the configuration status of educational facilities in each county also serves as a reference for equitable regional educational facility allocation<sup>[21]</sup>. Therefore, the Location Quotient (LQ) model is introduced to measure the configuration level of educational facilities in each county relative to the whole of Guangxi. The location quotient for secondary education resources was calculated for each county and visualized (Figure 4). The results indicate that among the 111 counties in Guangxi, 59 counties (53.15%) have an LQ value greater than 1, meaning that secondary education resources in over half of the counties are at an advantageous position relative to the Guangxi average, while the remaining counties are at a disadvantage. The highest LQ value is 1.80 in Tantang District, Guigang City, and the lowest is 0.49 in Port District, Fangchenggang City. This indicates that counties such as Tantang District, Guanyang County, and Yongning District have relatively advantageous secondary education resource construction compared to Guangxi as a whole, while counties such as Port District, Hepu County, and Leye County are at a relative disadvantage.

Figure 4: Location Quotient Values of Secondary Education Resources in Counties/Districts of Guangxi



## 5. Influencing Factors of the Spatial Distribution of Secondary Education Resources in Guangxi

### 5.1 Indicator System Construction and Calculation

Previous research indicates that secondary education resources exhibit significant spatial heterogeneity. Existing studies show that the distribution of educational facilities is influenced by multiple dimensions including current and projected urban population, economic development, fiscal revenue, and urban construction scale. Many domestic and international scholars have found that factors such as urban resident population, built-up area, and industrial distribution are primary influencing factors for the uneven distribution of educational facilities<sup>[22-23]</sup>. Based on the principles of scientificity, availability, and comprehensiveness, and considering educational resource beneficiaries, practitioners, and projected construction inputs, this study selects relevant indicators such as student population size, fiscal expenditure, and economic structure to explore the influencing factors of the spatial distribution of educational resources at the county level in Guangxi.

Using the SPSS PRO platform, an explanatory model for the uneven distribution of secondary education resources was constructed. Considering data completeness issues, 7 counties with incomplete data were excluded from the calculation, leaving a total of 94 counties for analysis. First, Pearson correlation analysis was used to screen indicators significantly correlated with county-level secondary education resources. Subsequently, based on ridge regression analysis, significantly correlated indicators were included in the regression model, while factors with insignificant correlation and strong multicollinearity, such as administrative land area, regional GDP, and local fiscal revenue, were eliminated. Finally, relevant variables with high goodness-of-fit were obtained (Table 2).

Table 2: Stepwise Regression Equation Analysis Results for Factors Influencing Secondary Education Resource Distribution

K=0.201	Standardized Coefficients	t	P	R <sup>2</sup>	Adjusted R <sup>2</sup>	F
Constant	0	0	1.000	0.922	0.91	F=73.043 P=0.000***
Year-end Total Population	0.207	12.292	0.000***			
Balance of Savings Deposits of Urban and Rural Residents	0.124	4.878	0.000***			
Number of Registered Population	0.238	12.384	0.000***			
Number of Students in Regular Primary Schools	0.104	4.49	0.000***			
Number of Students in Regular Secondary Schools	0.15	6.034	0.000***			
Number of Industrial Enterprises above Designated Size	0.118	3.952	0.000***			

The ridge regression analysis results indicate that six factors jointly influence the distribution of secondary education resources at the county level in Guangxi: year-end total population, registered (hukou) population, number of students enrolled in regular secondary schools, number of students enrolled in regular primary schools, balance of urban and rural household savings deposits, and number of industrial enterprises above a designated size. The significance P-values for the ridge regression calculation results were all less than 0.05, indicating that each factor has a significant impact on the model. Furthermore, through variance testing, the P-values of the regression models were all 0.000, indicating that the regression model has significant statistical meaning. The goodness-of-fit ( $R^2$  value) was 0.922, and the adjusted  $R^2$  value was 0.91, proving that the regression model has high goodness of fit [24] and can be used to analyze the spatial heterogeneity of county-level secondary education resources with strong explanatory power.

## 5.2 Interpretation of Regression Equation Results

A specific interpretation of the ridge regression analysis results is as follows:

- (1) The Beta values for the two factors, year-end population and registered (hukou) population, are 0.207 and 0.238 respectively, the highest among all influencing factors. This reflects that the distribution of educational resources still highly adheres to the fundamental principle of population size. Both the registered population, serving as an institutional planning basis, and the resident population, reflecting actual service demand, jointly shape the distribution pattern, indicating strong consistency between planning and actual demand.
- (2) The Beta values for the two factors, number of primary school students and number of secondary school students, are 0.104 and 0.15, respectively. The number of primary school students is a forward-looking and deferred demand signal. Current primary school students will enter secondary schools in a few years; therefore, the primary school student count is a core indicator for predicting future secondary school seat demand. Its significant positive influence indicates that the spatial planning of educational resources is not static but follows a deferred planning logic of “predicting and planning future secondary school resources based on current primary school scale,” which also explains why its influence intensity is slightly lower than that of the secondary school student count. The number of secondary school students represents the most direct and immediate demand. The current number of secondary school students in an area directly determines its required number of classes, teacher allocations, school building area, etc., ultimately manifesting as a demand for the quantity of secondary education resources, embodying the basic logic of “meeting current service demand” in educational resource allocation.
- (3) The Beta value for the factor ‘balance of urban and rural household savings deposits’ is 0.124, reflecting that wealth stock shapes educational resource supply. Savings deposits represent a concentration of local financial resources. High savings balances can enhance the ability of local governments to finance through urban investment platforms and attract social capital cooperation, thereby providing “extra-budgetary” capital for constructing, expanding, or upgrading secondary school hardware facilities, such as building new campuses or private schools.
- (4) The Beta value for the factor ‘number of industrial enterprises above a designated size’ is 0.118. As a core indicator

measuring regional industrialization level, industrial agglomeration, and local economic structure, its significant influence reveals the underlying economic geography and fiscal capacity logic behind educational resource distribution. Industrial enterprises are direct contributors to main local tax sources such as value-added tax and corporate income tax. A larger number of enterprises implies stronger local fiscal capacity, enabling governments to independently increase educational investment, improve school facilities, teacher compensation, and teaching quality without relying entirely on upper-level transfer payments. Industrial enterprise agglomeration attracts industrial workers and related families, forming a stable and sustainable inflow of school-age population. Unlike transient populations, family migration driven by industrial employment tends to be more long-term, directly creating rigid and predictable demand for secondary education resource places (seats). In summary, factors such as year-end total population, registered (hukou) population, primary and secondary school enrollment size, household savings deposit balances, and the number of industrial enterprises above a designated size jointly shape the spatial distribution pattern of county-level secondary education resources in Guangxi. Based on the empirical model of county-level educational resource allocation, while adhering to the basic planning principles of registered and resident population size to ensure immediate seat supply, it is essential to prospectively plan secondary school resources differentially based on primary school enrollment size. Furthermore, special attention should be paid to counties with relatively high household savings deposits or strong industrial foundations. These areas, due to their stronger potential for private capital and greater local fiscal autonomy, often can generate resource supplies exceeding the general level. In allocation strategies, they should be guided to play a leading and complementary role. This is of great significance for promoting the balanced optimization and overall enhancement of secondary education resources among counties in Guangxi.

## 6. Conclusion and Discussion

### 6.1 Conclusion

This study comprehensively utilizes methods such as kernel density analysis, nearest neighbor index, local spatial autocorrelation, and location quotient, combined with a ridge regression model, to systematically reveal the spatial distribution pattern and influencing factors of county-level secondary education resources in Guangxi. The main conclusions are as follows:

First, the spatial distribution exhibits a significant heterogeneous pattern of “dense in the southeast, sparse in the northwest.” At the regional scale, secondary education resources show a “multi-core, multi-center” agglomeration pattern, with core areas mainly distributed southeast of the “Guilin-Chongzuo” line, centered on cities like Nanning, Liuzhou, Guilin, Yulin, and Guigang. At the prefectural city scale, resource agglomeration density decreases from southeast to northwest, with high agglomeration in places like Yulin, Guigang, and Nanning, and low agglomeration in western and border areas like Hechi, Baise, and Chongzuo. At the county scale, spatial differentiation becomes more apparent, forming “High-High” agglomeration hotspots mainly in southeastern Guangxi counties and “Low-Low” agglomeration cold spots mainly in northwestern and border counties, indicating a clear center-periphery structure in resource allocation.

Second, there are considerable disparities in the equity of resource allocation among counties. Location quotient analysis shows that although educational resources in over half (53.15%) of Guangxi’s counties are in a relatively advantageous position, the gap between advantageous and disadvantaged areas is substantial. Resource allocation does not fully match the population geography distribution; some populous or remote counties remain in resource depression states, reflecting the uneven supply of educational public services across regions.

Third, resource allocation is the result of the combined effect of multiple factors. The ridge regression model ( $R^2 = 0.922$ ) indicates that its spatial differentiation is mainly influenced by three categories of factors: basic demand, deferred planning, and economic supply. Population size constitutes the basic constraint on resource allocation; the structure of the school-age population determines immediate demand and planning foresight; while resident savings levels and local industrial foundation, by shaping fiscal capacity and financing potential, provide differentiated economic support for educational resource supply, ultimately forming a joint driving force of “basic demand – deferred planning – economic support.”

### 6.2 Discussion

The results of this study corroborate the foundational role of population and economy, and further reveal their internal complex structure: population needs to be differentiated into “current students” and “future students,” and the economy needs to be disaggregated into two differentiated supply sources: “private savings” and “industrial foundation.” This indicates that the spatial layout of educational resources is actually shaped by the combined forces of planning logic, market forces, and local economic structure.

This study also has certain limitations: First, it primarily analyzes the “quantity” distribution of educational resources, with insufficient exploration of “quality” dimensions such as teacher quality and teaching effectiveness. Second, due to data constraints, it could not fully incorporate factors like terrain, transportation, and culture. Third, it is a static cross-sectional analysis, unable to reveal the dynamic evolution process. Future research that integrates multi-source data, constructs long-term panel data, and incorporates quality indicators will be able to more systematically reveal the formation and transformation mechanisms of the spatial pattern of educational resources.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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