

Research Article

Analysis on Spatial Characteristics and the Adaptation Mechanism of Miao Traditional Settlement in Qiandongnan, China

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In the farming era, the ancestors of Miao moved to a mountainous area in Qiandongnan to avoid wars. When they started their settlement construction, people gave priority to how to deal appropriately with the great survival pressure they were facing. This paper uses the methods GIS spatial analysis, morphological index, and spatial syntax to explain the spatial characteristics of Miao traditional settlements from the perspective of both regional scale and individual settlement and explores the adaptation mechanism. The results show that (1) spatial distribution of settlements shows a tendency of agglomeration and significant spatial heterogeneity; the maximum kernel density is in the Leikaitai area, which is featured by an inclined “T” shape; (2) settlements are concentrated in areas mainly around Qingshui River and Duliu River, with an elevation of 500–1000 m, terrain relief of 10–20 m, and the slope of 5–15°; (3) the external boundary of settlement is mainly finger-shaped and buildings showed a large concentration of small distribution; and (4) settlements have generally formed an overall landscape pattern of “mountain-water-field-forest-building,” with the space center appearing inside the settlements and the road connecting the outside of the settlement. This paper summarizes the intrinsic relationship among settlements’ spatial characteristics, the natural environment, and the social and economic environment and concludes the internal morphological evolution of the settlement which has shifted from survival adaptability to active search for development. The results of this research can provide a valuable reference for traditional settlement protection, utilization, and sustainable development.

1. Introduction

In the 1950s, French geographer Mark Sone proposed the theory that geographical conditions determine the survival mode [1], in which settlement construction occupies a vital part and serves as the main space carrier [2]. Also, traditional settlements are regarded as witnesses of historical processes and carriers of cultural inheritance. They have important social, cultural, aesthetic, and tourism values [3, 4]. Particularly, as an essential part of traditional settlements, ethnic minority settlements are able to reflect the survival logic and historical culture of ethnic minorities [5]. They are the main resources for inheriting the excellent Chinese traditional culture and developing tourism in mountainous

areas. However, with the acceleration of urbanization and the development of tourism in rural areas, the spaces of traditional settlements are suffering various degrees of destruction and decay, such as ecological degradation, functional decline, and construction destruction [6, 7]. In 2018, the Chinese government proposed implementing rural revitalization and protecting traditional regional culture, which made it clear that the protection and inheritance of traditional settlements are of great significance [8]. Therefore, the sustainable development of traditional settlements has become a hot topic in the Chinese academic world.

Western academia, especially Poland architects, had studied the spatial characteristics of traditional settlements in rural areas and concluded that the traditional settlement

was a distribution of types and density depending on both natural and socioeconomic conditions [9–11]. The natural factors are regarded as the elementary role where the outset of traditional settlement is concerned [12]. Socioeconomic factors shape the spatial structure of the settlement system, especially for individual settlements [13, 14]. However, from the regional scale perspective to individual settlement, the quantitative analysis of the spatial characteristics of traditional settlements and their adaptation factors is not enough. Most researches are limited to the spatial organization, construction techniques, building decoration, and cultural connotation of settlements. There is a lack of systematic research on the spatial distribution, morphological characteristics, and adaptation mechanisms of settlements.

Based on the specific geographical environment of Qiandongnan, this research uses analysis methods of GIS, morphological index, and spatial syntax to investigate the relationship among the regional environment, the spatial distribution, the morphological characteristics, and internal spatial organization of the traditional settlement. It is found that the construction of Miao traditional settlements is formally rooted in the local area, adapted to, and cleverly used natural processes, and the final formation of the overall “mountain-water-field-forest-building” spatial pattern was the core requirement of Miao people’s survival and reproduction.

Today, the survival pressure of Miao people is greatly reduced, and they can go out to work and engage in tourism service industries and handicrafts to obtain survival security. The most important “field” factor in the past was no longer important to Miao people. Therefore, the adaptation mechanisms of cherishing fields, protecting mountains and forests, and respecting traditional rituals and beliefs formed in the entire settlement over hundreds of years are being eroded.

In response, the research focuses on the evolution processes and adaptation mechanism of spatial settlement structure to discuss possible solutions and seek out ways to strengthen the reuse of resources and cultural preservation in the process of rural revitalization and tourism to provide valuable enlightenment for traditional settlements restructuring, utilization, and sustainable development.

2. Study Area and Method

2.1. Study Area. Qiandongnan is located in the transitional zone from the Yunnan-Guizhou Plateau to Xianggui hills and basins in China, with continuous peaks and ridges. Karst is widespread in the territory and forms a particular karst ecosystem. The study area has jurisdiction over 15 county-level units, including Cenggong, Zhengyuan, Shibing, Huangping, Sansui, Majiang, Taijiang, Jianhe, Pingjing, Danzai, Leishan, Rongjiang, Liping, Congjiang, and Kaili. Qiandongnan is a specific area for studying Miao traditional settlements. The total population of Miao in China is 8,940,100, of which 3,799,500 live here. Its geographical location is 107°17′–109°35′ E, 25°19′–27°31′ N, and its land area is 30337 km².

2.2. Data Sources. Four main categories of data sources are included in this study: (1) the list of minority characteristic villages from the official website of the People’s Government of Guizhou province; as of August 2021, 314 settlements in the study area have been selected into the list of ethnic minority villages in Guizhou province; and the geographic coordinates were calibrated using Google Earth; (2) the vector map, elevation, and river system of the administrative boundary of Qiandongnan are provided by the Chinese Resources and Environment Science and Data Center; (3) the space syntax graph of traditional settlements was obtained from calculations of AutoCAD and Depthmap; (4) the drawing of overall landscape composition pattern map from field investigation and villager’s interview; and (5) social and economic data were acquired from statistical yearbooks.

2.3. Methods

2.3.1. The Nearest Average Neighbor Ration. Thinking of the traditional settlements as abstract points in space, these settlements will present three spatial distribution patterns: discrete, random, and agglomeration. The nearest average neighbor index (R) method is used to identify the spatial distribution of traditional settlements, and the result shows the degree of mutual proximity of traditional settlements in the geographic space [15]. The R index can be calculated as follows:

$$R = \frac{\overline{r1}}{rE} \quad (1)$$

2.3.2. The Kernel Density Estimation. The kernel density estimation (KDE) method is the most widely used non-parametric estimation method in spatial point pattern analysis. It is used to calculate the aggregation of elements in its entire area. The greater the KED value, the higher the degree of aggregation of settlements. The KDE can be calculated as follows:

$$f(x) = \frac{1}{nh} \sum_{i=1}^n k\left(\frac{x-x_i}{h}\right), \quad (2)$$

where $f(x)$ denotes the estimated density at the location, h is the bandwidth or kernel size, n is the number of traditional settlements, K is the kernel function, and $(x-x_i)$ is the distance from the location to the measuring point x_i [16].

2.3.3. Boundary Morphology Index. The settlement boundary morphology can be classified into three types: cluster, band, and finger shape. Boundary morphology is illustrated in the subject using the length-width ratio, void-solid ratio, radian, and concave-convex degree [17].

- (1) The length-width ratio of the shape index (λ) reveals the narrowness of the settlement boundary morphology. Set $\lambda = 2$ as the critical point; when $\lambda > 2$, the settlement is the central control feature of the group,

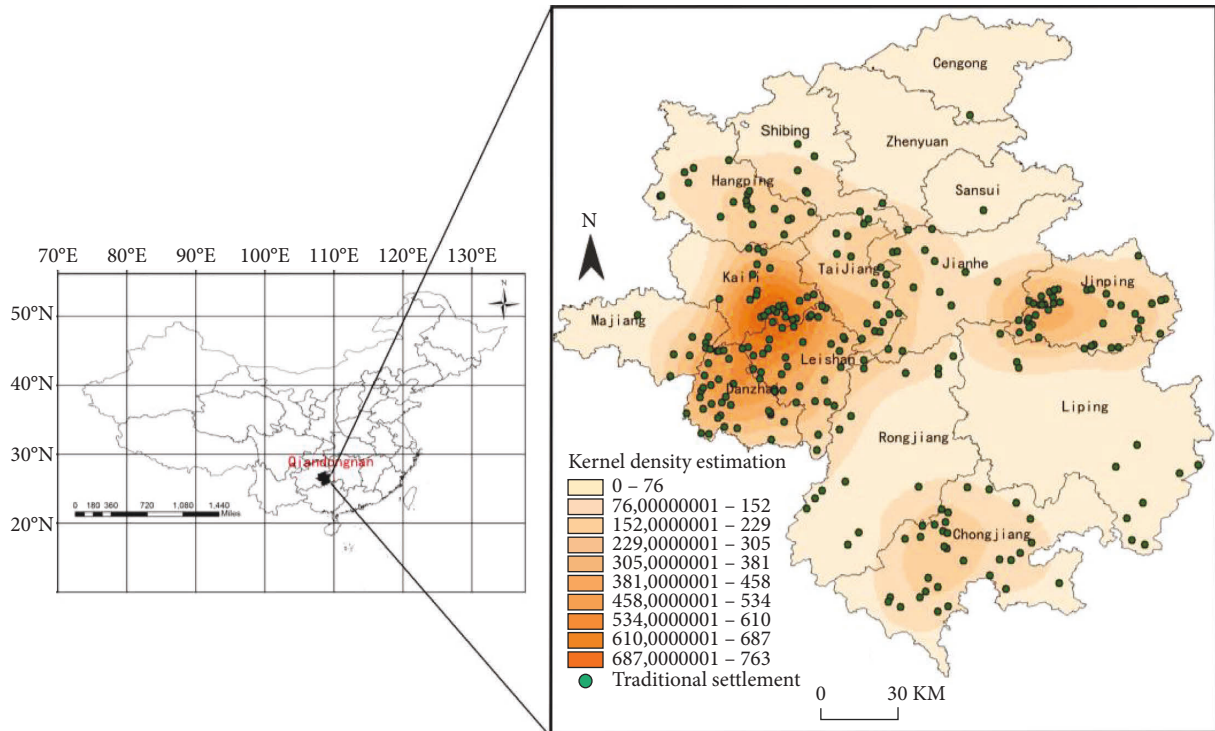


FIGURE 1: The kernel density distribution of Miao traditional villages in the study area.

and between 1.5 and 2, the settlements are either atypical clusters or atypical belts, becoming clusters with a tendency towards belts.

- (2) The minimum value of the shape index (S) is 1. The closer the value is to 1, the closer the graph is to the circle. The larger the value, the greater the difference between the shape and the circle, and the more complex and irregular. Thus, the boundary characteristics of traditional settlements can be calculated as follows:

$$S = \frac{P}{(1.5\lambda - \sqrt{\lambda + 1.5})} \sqrt{\frac{\lambda}{A\pi}} \quad (3)$$

where P means the circumference, and A is the area of the settlement.

2.3.4. The Space Syntax Technique. Use the remote sensing images of six typical traditional settlements in 2021 to make the base map, then draw the road axis map in AutoCAD, and import it into “Depthmap” software to analyze the topological relationship, obtain the spatial integration and control degree, and then do the traditional settlement quantitative analysis of internal organization characteristics [18].

The global integrated axis map can reproduce the spatial structure of traditional settlements. Then, the chromatographic analysis of the axis reflects the level of spatial visibility and accessibility. The red area has the highest spatial visibility and accessibility, the yellow area is the second, and the blue area is the third.

3. Results

3.1. Spatial Distribution Characteristics

3.1.1. Density Analysis of the Spatial Distribution. Using the average nearest neighbor tool under the spatial statistics module of ArcGIS 10.21, it was calculated that the actual distance of traditional settlements was 13.79 km, the expected average distance was 43.90 km, the nearest neighbor ratio was 0.31, and the significance $P < 0.01$, Z value was -23.34 , the result shows that traditional settlements presented an agglomeration spatial morphology (Figure 1).

The traditional settlements presented typical unbalanced characteristics in space, mainly concentrated in the central and western regions, accounting for 66.20% of all settlements. In contrast, the least were distributed in Zhenyuan, Cengong, and Sansui, accounting for only 1.37% of the total.

From the perspective of the spatial distribution of KDE, the KDE of traditional settlements formed a spatial distribution pattern of primary centers and secondary centers, which were similar to the “ T ” character. The first-level center was the junction of Leishan, northern Danzhai, and southern Kaili. The secondary centers spread around the first-level center to east Jinping and showed decreasing grades whereas the lowest values of traditional settlements KDE were located in Zhenyuan, Cengong, Sansui.

3.1.2. Elevation Analysis of Spatial Distribution. Miao is a typical alpine ethnic group, and mountains constitute the natural environment and basic skeleton of their settlements. The traditional settlements were concentrated at an altitude

TABLE 1: Elevation statistics of Miao traditional settlements in the study area.

Elevation (M)	Number	Percentage	Land area (km ²)	Percentage
91–500	41	13.05	41.76	20.38
500–1000	217	69.10	148.18	71.84
1000–1500	38	12.10	13.02	6.31
1500–2178	18	5.73	4.20	1.94

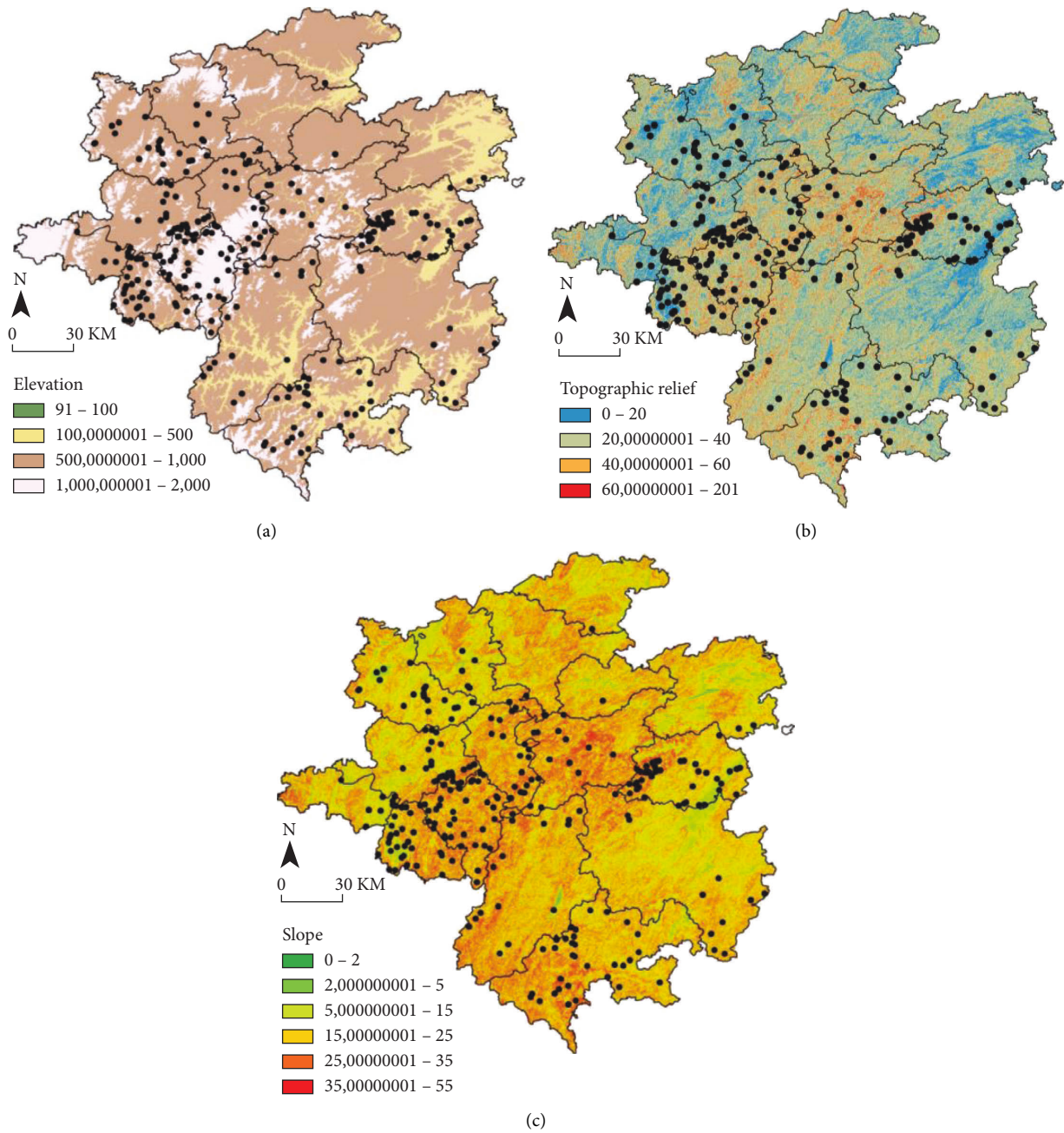


FIGURE 2: Topographic map: (a) elevation map; (b) topographic map; and (c) slope map.

of 500–1000 M, with 217, accounting for 84.07% of the total. Instead, only 18 settlements with an altitude of more than 1500 M accounted for 4.14% of the total, and 41 settlements

with an altitude of <500 M accounted for 12.10% of the total (Table 1, Figure 2(a)). As the altitude increases, the number of settlements decreases, and the settlement patch areas

TABLE 2: Slope statistics of Miao traditional settlements in the study area.

Slope classification	Slope (°)	Number	Percentage
Flat to almost undulating	0–5	29	9.24
Gently inclined	5–15	153	48.72
Moderately inclined	15–25	78	24.84
Steep	25–45	54	17.19
Very steep	>45	0	0

reach a peak between 500 and 1000 M above the sea level. Furthermore, the total area of settlements in this altitude range was 148.18 km², accounting for 71.84%.

3.1.3. Topographic Relief Analysis of the Spatial Distribution. The Miao traditional settlements were concentrated in flat dams and hilly areas with a topographic relief of 10–20 M, accounting for 69.42% (Figure 2(b)). In contrast, in areas where topographic relief >60 M had a significant drop, geological disasters such as mudslides, avalanches, and landslides were more frequent, and soil erosion was more serious.

3.1.4. Slope Analysis of the Spatial Distribution. To analyse the effect of slope on the location of Miao traditional settlements, we divided the slope of the study area into five grades according to the division plan of the Geomorphological Survey and Cartography Committee of the International Society [19]. The study found that the spatial distribution of traditional settlements grew firstly and then decreased with the increase in slope. Traditional settlements mainly concentrated in the gently inclined area and were more minor in the flat to the almost undulating area (Table 2 and Figure 2(c)) because the area with a slope of 0–5° in the study was relatively small. Moreover, the area with a slope of 5°–15° has apparent undulations. But it has specific soil resources. Moreover, the agricultural area accounts for 39.54% of the total, so there are 153 traditional settlements. At the same time, the area with a slope >25° had intense soil erosion, barren soil, and highly fragile ecology, which was not suitable for farming activities and settlement construction.

3.1.5. River System Analysis of the Spatial Distribution. The abundant rainfall and river systems in the study area have a certain influence on traditional settlements' site selection and agricultural production. To analyse the effect of the river on the spatial distribution of traditional settlements, we measured the river to traditional settlements distance by the Hydrology model of GIS (Table 3 and Figure 3(a)). As a result, from along the river to distances >1500 M and <500 M, the number of traditional settlements showed a gradual decrease. The most significant number of traditional settlements was 500–1500 M away from the river, accounting for 47.45% of the total, followed by 1–500 M and 1500–2000 M, which accounted for 26.75%, 13.38%, respectively. Besides, buildings along the river system of Qingshui and Dulu were a common feature shared by traditional settlements (Figure 3(b)).

3.2. External Spatial Morphology Characteristics

3.2.1. The External Boundary. In order to plot the traditional settlements boundary, we assumed the distance of 30 M as the farthest distance wherein faces, clothing, and behavior of people could be recognized. The morphological characteristics and relevant indexes of the six typical settlements were computed scientifically and summarized in Table 4.

The calculation results for λ and S reflected the narrow extension and concave-convex degree. First, $S \geq 2$, the external boundary morphology exhibited a zonal plane characteristic, while a finger-shaped tendency occurred given the effect of the landform environment. Second, when $\lambda < 1.5$, the morphology was finger-shaped and tended to clump, such as Yemeng, Nanmeng, and Wudong. Third, $\lambda \geq 2$, they were finger-shaped and tended to band, such as Zhangao, Basha, $1.5 \leq \lambda < 2$, and it was finger-shaped with no clear tendency, like Getou. The settlements with finger-shaped external boundaries were commonly found in Qiandongnan.

3.2.2. The Structural Characteristics of the Buildings. Miao peoples followed the principles of natural factors to arrange and integrate the internal space of settlement in an orderly manner according to their own survival needs and a particular logical relationship (Figure 4).

Firstly, the structure of buildings presented a clustered pattern that was a distributed morphology of large concentration and small dispersion. The buildings' structures in the area were gathered together in the form of a group, which could be defined as a "reunion type." Then, according to the number of building groups, it could be divided into "single reunion" and "multiple reunions." "Single-group" refers to a settlement with only one large concentrated area of building structure, such as Getou, Wudong, and Yemeng, while "multigroups" refers to the structure of a settlement group with two or more concentrated areas, such as Nanmeng, Basha, Zhangao, which were formed by the combination of several small settlements. The structural characteristics of the buildings were still large concentration and small dispersion, but there are multiple large concentration areas instead of one.

Secondly, the distance between the individual building was small, and they were close to each other in a staggered or parallel manner, forming a compact space feature. When the settlement expands, new buildings always fill in the gaps inside or outside the settlement to improve the compactness of the space. It can be seen that the spatial characteristics of the compact buildings not only stay in the present but also will continue over time.

TABLE 3: The statistics between Miao traditional settlements and the river buffer zone.

Nearest water distance (M)	0–100	100–500	500–1500	1500–2000	>2000
Number	30	84	149	42	9
Percentage	10.46	26.75	47.45	13.38	2.86

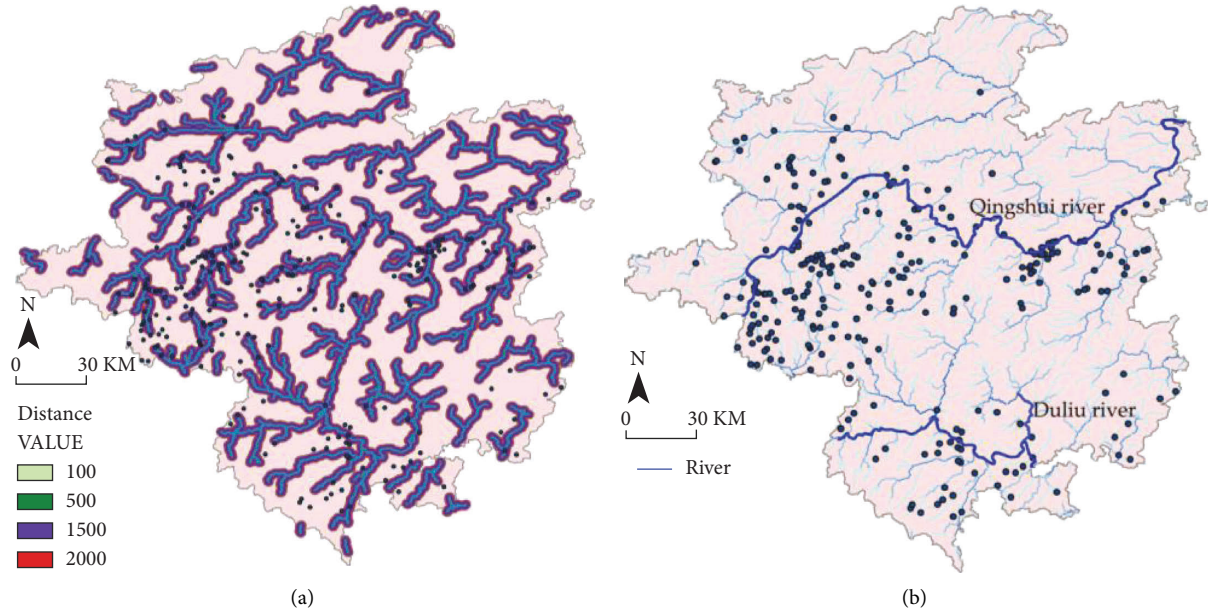


FIGURE 3: Water system distribution map: (a) water buffer map and (b) river distribution map.

TABLE 4: Statistics on the external boundary of typical settlements.

Settlements	P (m)	A (m ²)	λ	s	Boundary characteristics
Zhangao	2545	30805	8.73	6.91	Finger-shaped with a tendency to banded
Nanmeng	9136	41454	1.21	12.57	Finger-shaped with a tendency to clump
Getou	2561	30360	1.66	3.95	Finger-shaped with no clear tendency
Yemeng	1303	23034	1.34	2.37	Finger-shaped with a tendency to lump
Wudong	1894	40452	1.47	2.58	Finger-shaped with a tendency to lump

3.2.3. Overall Landscape Composition Pattern. After the initial exploration and a long process of evolution, Miao traditional settlements in Qiandongnan had generally formed an overall landscape pattern of “mountain-water-field-forest-building.” The results show (Figure 5) those as follows: (1) Mountains and rivers together shape the natural background of the settlement landscape, forming a “trough” flat land along the river; (2) open up fields in flat land and draw water from rivers for irrigation; (3) planting forests on the mountains; (4) the dwelling house is built at the foot of the mountain to ensure that it “occupies the mountain but not the cultivated land.”

3.3. Syntactic Analysis of Internal Spatial Morphology Characteristics. To analyse the visibility and accessibility of the internal spatial organization of traditional settlements, we selected global angular distance (Ang N), and two morphological variables, including the global average

integration degree and the global control degree, to analyze the spatial organization of settlements.

3.3.1. Integration. The global average integration degree of Wudong and Getou were $R_n0.47$ and $R_n0.44$, respectively, (Figure 6(a)), and the red and yellow axes with high integration were mostly enclosed in important nodes, such as Lushenping, Huzhai tree, shelter bridge, and pond. These critical nodes had morphological control and dominance and were the core of the settlement’s humanistic spirit. Moreover, significant celebrations, ceremonies, meetings, and other public activities were usually held here, which gives it the characteristic of being powerful and the nature of “public domain.” In addition, the global average integration degrees of Nameng, Basha, Zhangao, and Yemeng were $R_n0.28$, $R_n0.26$, $R_n0.21$, and $R_n0.20$, respectively, which were lower and higher spatial dispersion values. As a result, the most integrated axis was the roads that connect the

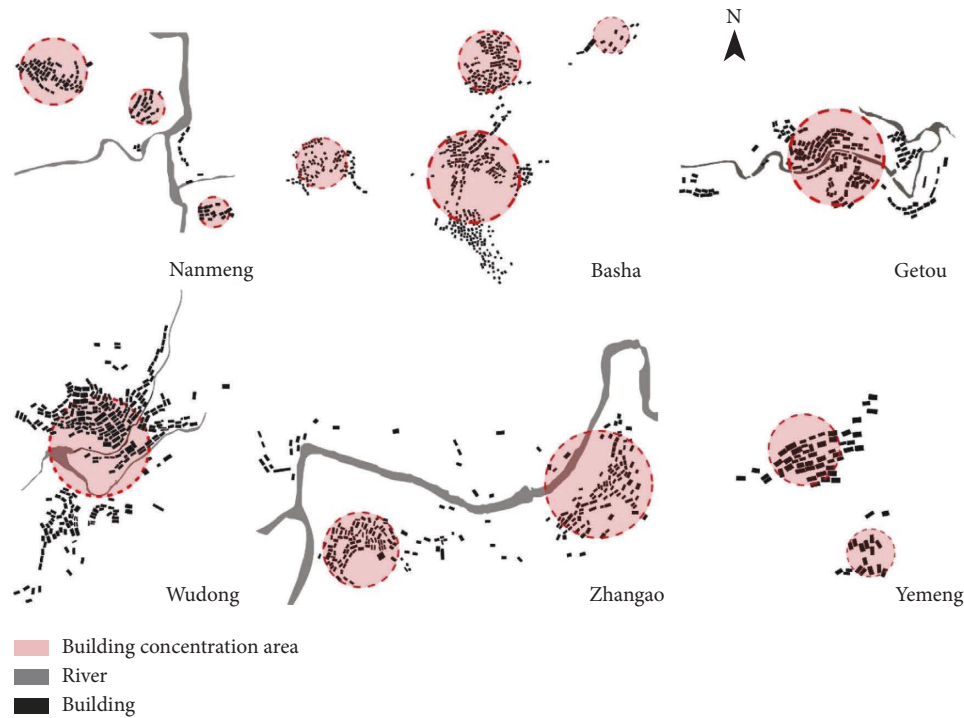


FIGURE 4: The aggregation analysis map of typical sample buildings.

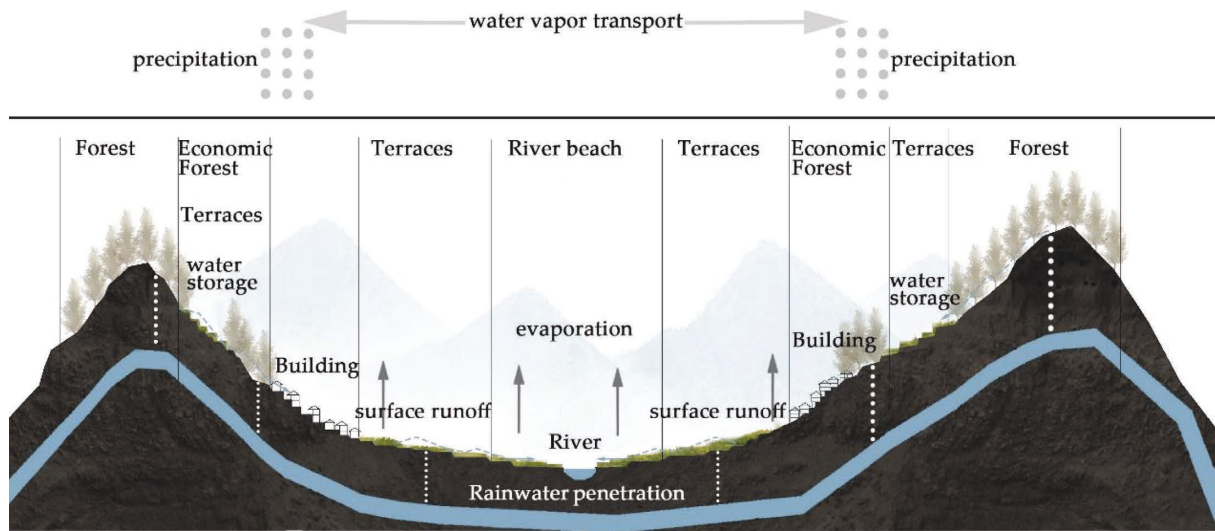


FIGURE 5: The overall landscape pattern analysis map of typical sample settlements.

outside of the settlements, and its functions are closely related to life laid out along the roads. Moreover, these settlements have no core spaces surrounded by several highly integrated axes.

3.3.2. *Control.* The global control degree analysis shows that most traditional settlements presented light green or blue short lines on the control axis (Figure 6(b)), which means that the global control degree of the main streets was low because there are many turns of streets and lanes dividing the axis of the main street into multiple short lines. In contrast, the connection between these streets or lanes was

single, making the settlement's internal space structure more private and defensive. Moreover, the space has a certain degree of change and interest. Consistent with the global average integration degree of settlements, the most controlled axis in the six typical settlements was still the core area of important nodes or the roads connected to the outside.

4. Discussion

In this study, we demonstrated that the spatial distribution and morphological characteristics of Miao traditional

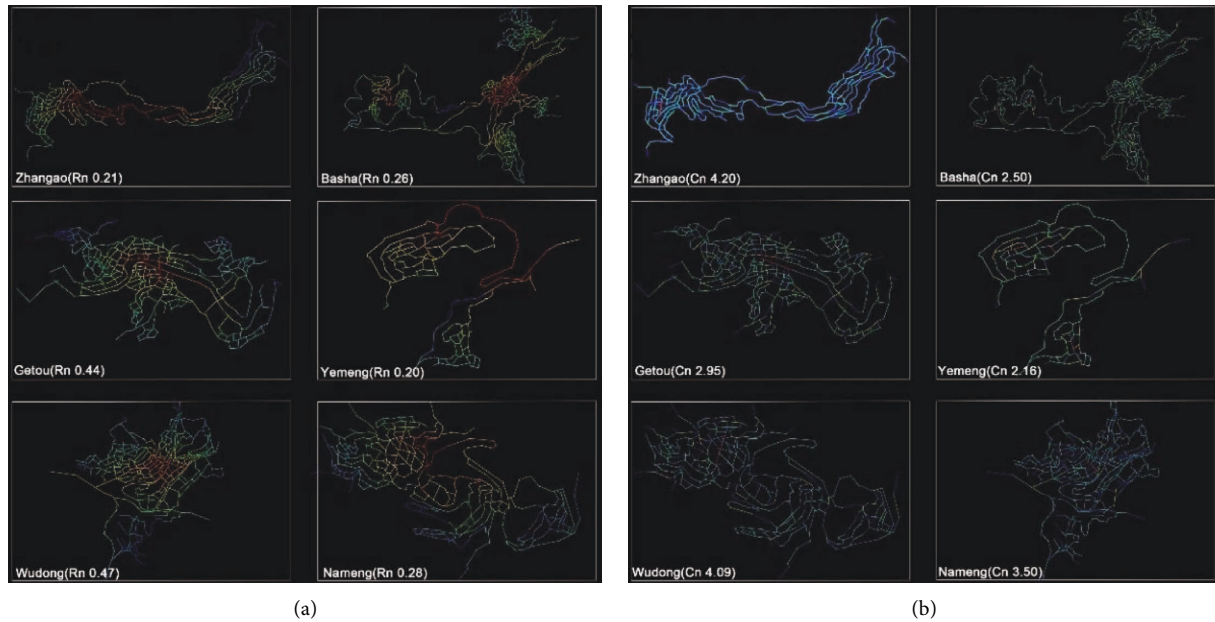


FIGURE 6: The spatial syntactic analysis map. (a) The global integration map of settlements. (b) The global control map of settlements.

settlements was a survival process of constantly adapting to the harsh natural environment and coping with changes in internal and external conditions in different periods, which was an external manifestation of the joint effect of the natural environment, social environment, and economic environment [20]. However, due to the development of tourism, the implementation of the rural revitalization policy, and the changes in the production and lifestyle, the internal and external conditions for the formation and development of traditional settlements are changing. The traditional settlements and their adaptation mechanisms face multiple challenges (Figure 7).

4.1. Natural Environment and Settlement Spatial Distribution.

The natural environment is the material basis for the survival and development of traditional settlements. Traditional settlements are located in the mountains area of Qian-dongnan, a fragile karst natural ecosystem with broken terrain, limited natural resources, changeable climate, and jointly impacted the spatial distribution of the seat of the settlement.

In the early stage of settlements formation, most settlements were located areas with an altitude of 50–1000 M, sloping gentle slopes of 5°–15°, and topographic relief of 10–20 M were easy to defend and difficult to attack and had a relatively good geographical environment, suitable for agricultural production activities with a low cost of living. In contrast, most of the northeast and southeast region had dangerous terrain, deep canyons, and poor soil. So the number of traditional settlements was relatively small.

After determining the selection and layout of the settlements, the ancestor of Miao began the overall management of the settlement environment, transforming the natural environment, opening up fields, and

planting economic trees, finally forming a landscape pattern of “mountain-water-forest-field-building.” It has been gradually formed after several generations of Miao people’s continuous exploration, construction, and adjustment. In this pattern, firstly, mountains surrounding the settlements provide shelter for living, and streams flowing in the fields provide for drinking and convenient field irrigation. Secondly, the fields make full use of the flat land in the mountains to provide people with the most basic food security, and the forests cover the mountains to maintain the ecology and protect the settlements from natural disasters, such as mudslides. Thirdly, the settlement houses are built in the mountains and will never invade the cultivated lands. As the population grows, the settlements continue to develop based on the unique natural conditions, presenting the following three modes:

- (1) *Natural growth within the original settlement pattern.* The population growth rate was still within the ecological capacity of the settlement, and the buildings were distributed along the contour lines, which formed a random and orderly group space. Its external boundary broke the balanced form of clusters or bands and extended in different directions and developed into finger shapes, and this is because the ravine of surrounding mountains made the environment and space resources uneven in all directions, and new buildings will always choose relatively flat and livable land followed natural environment as much as possible.
- (2) *Relying on the “multigroup” growth of the original settlement pattern.* There were some available lands for reclaiming in the settlement area, but the original settlement’s construction land was insufficient.

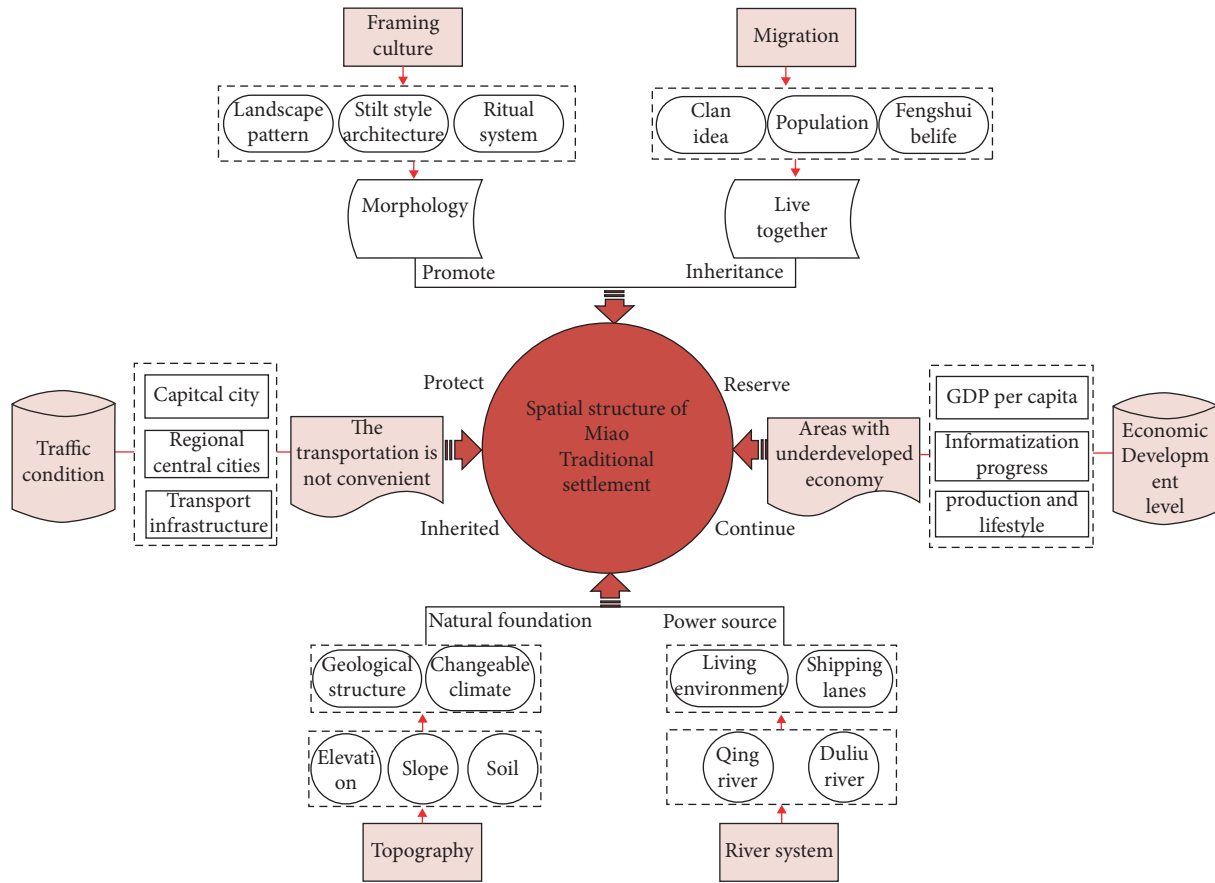


FIGURE 7: Adaptation mechanism for spatial evolution of Miao traditional settlement.

(3) Find a new location along the river to build a new settlement, then form a “branding” layout. When the lands of settlements were not enough to support the population growth, the residence would generally find a suitable location near the Qingshui and Duliu rivers to rebuild a new settlement. The rivers provided sufficient water for agricultural production and living in newly built settlements and served as important navigation between the Miao settlements and the Han areas, bringing agricultural production technology and living materials to Miao from Han areas.

4.2. Social Environment and Settlement Internal Space Organization. The social environment plays a guiding and controlling role in the evolution of traditional settlement spaces. Social environmental factors, such as clan ideas, “Fengshui” beliefs, and ritual systems, have affected the architectural layout, the spatial growth of streets, lanes, and bridges, the function of public space, and the formation of the morphology of traditional settlements.

Due to wars, ethnic oppression, and other reasons, the Miao people were forced to migrate from the plains and lakes to settle in the mountains. This migration was oppressive. However, the painful history of migration has not

diminished the national consciousness of the Miao people. The authority of the Miao clan, the sense of belonging to the migration, the common defense needs, and the consistent “Fengshui” beliefs and other group ideologies urged the Miao groups to live together in the same family or the same clan. Hence, the festival activities in the Miao culture are vibrant, and various activities had specific venues, such as Lushenping, Huzhai tree, Fengyu bridge, and pond, which were closely related to the process of ritual activities and created an orderly space. For example, the Miao ancestor chooses a flat open space in the internal space of settlements to build “Lushenping.” Its location was often in the center of the settlements space. The accessibility and the global average integration degree were also the highest based on the syntactic analysis of the six typical traditional settlements. As a matter of fact, “Lushenping” was usually used as a space for Miao people’s daily communication opportunities. But it has a very sacred meaning in festivals and has become an important cultural symbolic place to connect “ancestors and future generations.”

After the traditional settlements were formed, people started to reclaim fields, build houses, and expand the scale when the ecological capacity permitted. Once the original agglomeration point reached saturation, it became an important task for the Miao people to separate the surplus population and open up new strongholds. Then, settlements

were separated by clan ideas and “Fengshui” beliefs, and its branches were relocated to other surrounding spaces to multiply and develop. The spreads were like cell division, with new agglomeration points growing continuously and then a new round of fission. In brief, the internal spatial organization of settlements linked by social environment factors is the core of controlling the spatial order.

4.3. Economic Rise and Fall and Settlements Spatial Morphology Protection. Backward economic development has a positive impact on the protection of traditional settlements. Per capita GDP, per capita disposable income, and transportation convenience restrict the development scale and capacity of the settlement [21]. The settlements space formed during the agricultural cultivation period, and accordingly, its initial development depended on the scale of agricultural land. Although the settlement has formed the “mountain-water-forest-field-building” production space in the adjustment process, its production capacity can still only meet the basic survival needs, and Miao people mostly rely on self-sufficient small farmers to live. Before 1949, there were almost no current traffic conditions to contact the outside world, which also allowed many settlements to maintain traditional spatial characteristics and the wisdom of ancients [22].

In recent years, with the transformation of the rural economy, informatization, and tourism advancement, the settlements far away from the city and with inconvenient transportation were hit by unprecedented impact. The inherent production and lifestyles of settlements could no longer meet the needs of the younger generation, which caused the younger generation, especially the young and middle-aged laborers, to leave their homes. And eventually, the settlements disappeared. In addition, due to the continuous advancement of urbanization and the rural tourism industry, in the settlements that were relatively close to the urban space, a large number of new buildings arose, expanded to flat land and roads, and occupied farmland, which broke the overall pattern of “mountain-water-forest-field-building,” and made the original settlements become hollowed out. What’s more, this disorderly construction might bring about the demise of traditional settlements or the presence of totally new Miao settlements with no characteristics.

In contrast, the areas with poor social and economic development were subjected to many restrictions on contact with the outside world and were weaker from foreign cultural invasions. As a result, the settlements could continue their unique customs and habits, and spatial characteristics, such as buildings structures, boundary morphology, spatial distribution, and overall landscape pattern, got the possibility to be inherited and developed.

5. Conclusion

This paper uses spatial analysis methods to disclose the internal logic of the formation, organization scientifically, and the growth of Miao traditional settlements space from

the spatial distribution at the regional level to the micro-level settlement morphological characteristics, which are of specific reference value to policies and plans related to the conservation, utilization, and sustainable development of traditional settlements. The results show those as follows:

- (1) The spatial distribution of traditional settlements are affected by the comprehensive effects of the natural environment, social environment, and economic environment, mainly distributed areas with altitudes of 500–1000 M, terrain undulations of 10–20 M, slopes of 5°–25°, near the Qingshui river and Dulu river, and with backward economy and transportation.
- (2) Traditional settlements from a T-shaped structure in the overall regional spatial distribution pattern present a spatial distribution pattern of dense central and sparse northeast. The first-level center of the density pattern is the junction of Leishan, northern Danzhai, and southern Kaili. The “finger-shaped” form is the most common form of the external boundary of settlements.
- (3) The structure of traditional buildings shows a feature of large concentration and small dispersion and can be divided into “single-group” and “multigroup.” Moreover, these settlements generally formed an overall landscape pattern of “mountain-water-field-forest-building,” which is the basic space guarantee for survival and reproduction in the face of survival pressure.
- (4) External forces such as the natural environment, social economy, and technology are the basis for the formation and pattern evolution of the traditional settlement space and are also an important driving force that affects the transformation of the settlement space. The internal driving force, such as social culture, is vital for controlling the functional organization and continuing the spatial form.

At present, China has been in the process of rural revitalization, and excessive and disorderly constructions not only continue to invade and occupy rural land but also lead to some traditional settlements being demolished and becoming tourist towns. With the rise of social space research, traditional settlements should not be limited to traditional material spaces, and more attention should be paid to the accompanying social space research. Traditional settlements are caused by the spatial projection of people’s social activities and their organizational methods. The transformation of social structure will inevitably lead to the renewal of settlements space. Based on this cognition, follow-up research is needed to strengthen the interaction and coupling relationship between social structure and the evolution of settlements.

Data Availability

Four main categories of data sources are included in this study: (1) the list of minority characteristic villages from the

official website of the People's Government of Guizhou province; as of August 2021, 314 settlements in the study area have been selected into the list of ethnic minority villages in Guizhou province and; the geographic coordinates were calibrated using Google Earth; (2) the vector map, elevation, and river system of the administrative boundary of Qain-dongnan are provided by the Chinese Resources and Environment Science and Data Center; (3) the space syntax graph of traditional settlements was obtained from calculations of AutoCAD and Depthmap; (4) the drawing of overall landscape composition pattern map from field investigation and villager's interview; and (5) social and economic data were acquired from statistical yearbooks.

Conflicts of Interest

The authors declare that there are no conflicts of interest in the paper.

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