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How to Realize the Integration of Urbanization and Rural Village Renewal Strategies in Rural Areas: The Case Study of Laizhou, China

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Abstract: To promote the coordinated development of urban and rural areas, China has adopted a hybrid strategy of urbanization and rural village renewal. Due to the large development differences between villages, choosing appropriate strategies is significant for rural development. By introducing a new idea to promote urban–rural integration development through a "rural cluster", this paper explores the comparative advantages of villages in urbanization and renewal, identifies the spatial interaction between villages, and proposes a rural cluster strategy based on the same characteristics and close relationships. Taking Laizhou city, a coastal county in eastern China, as the study area, it provides a new way to deal with village problems at a small scale but of a large number due to difficult development in China. The results indicated that some villages have both high or low rural urbanization suitability (*RUS*) and village renewal potential (*VRP*), which makes it difficult to choose development strategies. Compared with the *VRP*, the spatial interaction of villages in the *RUS* is closer, but fewer villages participated. The results of village clustering show that the scale of different village clusters and the degree of interaction between villages in Laizhou differ greatly, and village clusters across townships are very common. Since the driving forces of the different scale of rural groups vary, this paper suggests that the development direction and investment focus should be determined according to the scale and characteristics of individual rural groups.

Keywords: urbanization; village renewal; urban–rural integration; spatial interaction; village cluster

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1. Introduction

Due to the continuous flow of rural laborers to cities in the process of industrialization and urbanization, the rural recession has become a universal phenomenon [1]. To promote rural development, government departments of different countries have introduced various instruments, which could be described as rural urbanization and village renewal [2]. Through the implementation of these strategies, some rural areas have been well developed and full of vitality [3,4], but many other areas are still lifeless [5,6]. Scholars have been debating for a long time about how to realize the integration of these two strategies [7].

Rural urbanization promotes the industrialization and urbanization of rural areas through external investment [8,9], which is a typical exogenously driven model. Industrial sectors and large-scale enterprises are encouraged to locate in rural areas [10,11]. In contrast, village renewal is an endogenous driving force development model that emphasizes improving the local economic and social environment through the use of local resources [12,13]. The commonly adopted strategies include the development of agricultural product brands, the extension of the agricultural industry chain, and the cultivation of agricultural talent.

Before the 1970s, urbanization was the main method for rural development in most of the world, such as the United States and the European Union (EU). However, drawbacks of this model emerged over time. It led to an over-reliance on the government and large-scale enterprises, with outside investors not always respecting the local cultural values [14,15]. It is a development plan designed by outside experts and planners, considered a disruptive development model that removes cultural and environmental differences in rural areas [16]. After the 1980s, rural development changed from an exogenous model to an endogenous model. However, rural development has become difficult without external support [17,18]. In the 1990s, the hybrid model (endogenous and exogenous) emerged and became widespread. It advocated for the combination of regional internal and external resources to jointly promote rural regional development [19,20].

As the largest developing country in the world, China's rural development has also gone through a long process of exploration. Since reforms and the opening of the economy in 1978, the rural development policy formulated by the Chinese government can be divided into three stages. The first stage was from 1978 to 2000. Affected by the highly centralized planned economic system and the dual structure of rural and urban areas, China's rural development lagged behind, and farmers generally faced the problem of food shortages. The policy at this stage focused on improving agricultural production efficiency, including new rural construction and modern agricultural development, with the aim of increasing the supply of grain and major agricultural and sideline products. The endogenous development mode is the main characteristic of this stage [21,22]. The second stage was from 2001 to 2017. The problem of food shortages had been basically solved, and China's urbanization was developing at a high speed. Against this background, the government actively promoted a new people-oriented urbanization development strategy, which is an exogenous development model that promotes agriculture through industry and leads rural areas through urbanization [23,24]. The third stage was from 2017 to the present day. To further promote the development of rural areas and reduce the gap between urban and rural areas, the Chinese government put forward the village renewal strategy. Specific measures include deepening agricultural supply-side reform, inheriting and developing agricultural civilization, and innovating rural governance systems. The integration of a new type of urbanization and village renewal was the main feature of this stage [25,26].

However, the following problems have arisen with regard to adopting the hybrid model. What kind of villages can be urbanized? What kind of village can realize renewal? How can rural urbanization and village renewal be realized? The hybrid model is based on the idea that each rural area should make use of existing resources or potential comparative advantages, but it is difficult to identify whether the region has advantages in urbanization or village renewal [27]. At present, it mainly relies on the subjective judgment of the local government and the experience of planners and lacks the technical level of development decision-making support. In addition, the development potential of a single village may be insufficient due to the limitations of nature, location, and culture. Scholars' case studies are often limited to counties or villages themselves, finding that not all rural areas have growth potential that can be effectively translated into competitive advantage [28]. In contrast, the cluster approach solves a wide range of economic, social, and ecological problems through its collaborative and cooperative activities [29,30], which is one of the driving forces for promoting economic growth and introducing competition to less-developed regions.

Therefore, the aim of this paper is to identify the comparative advantages of villages in rural urbanization and village renewal from the perspective of rural clusters and networks. The concept of clusters has been extensively described in the literature [31,32], but it is often used in the study of urban agglomerations and rarely in the field of rural development. The contributions of this paper are to (1) explore a new idea to promote urban–rural integration development through a "rural cluster" and (2) quantitatively identify the relative advantages of villages in urbanization and village renewal from the perspective of the existing capabilities and linkages of the villages, and then propose a cluster development model for villages based on the comparative advantages.

The structure of the remainder of this paper is as follows. It begins with a description of the analytical framework and research methods. The following section introduces the study area, Laizhou County on the east coast of China, and the data source. Next, the proposed methods are used to analyze the comparative advantages of Laizhou villages in rural urbanization and village renewal, and the cluster development in rural areas is revealed. The last section summarizes the conclusions and provides suggestions for rural development based on the research results.

2. Theoretical Framework and Methodology

2.1. Theoretical Framework

Affected by the development status, geographical location, resource endowment, and other factors, the adaptive capacity of villages in rural urbanization and village renewal varies greatly [33,34]. Thus, this paper first reveals the characteristics of the individual village by constructing evaluation systems of rural urbanization suitability (*RUS*) and village renewal potential (*VRP*) and then measuring the two indices using POI data and multiple sources of data. Second, the spatial interaction between villages is explored with the gravity model and social network analysis. Finally, village clusters are identified by Markov clustering, the features of the main clusters are analyzed, and suggestions on village development are put forward (see Figure 1).

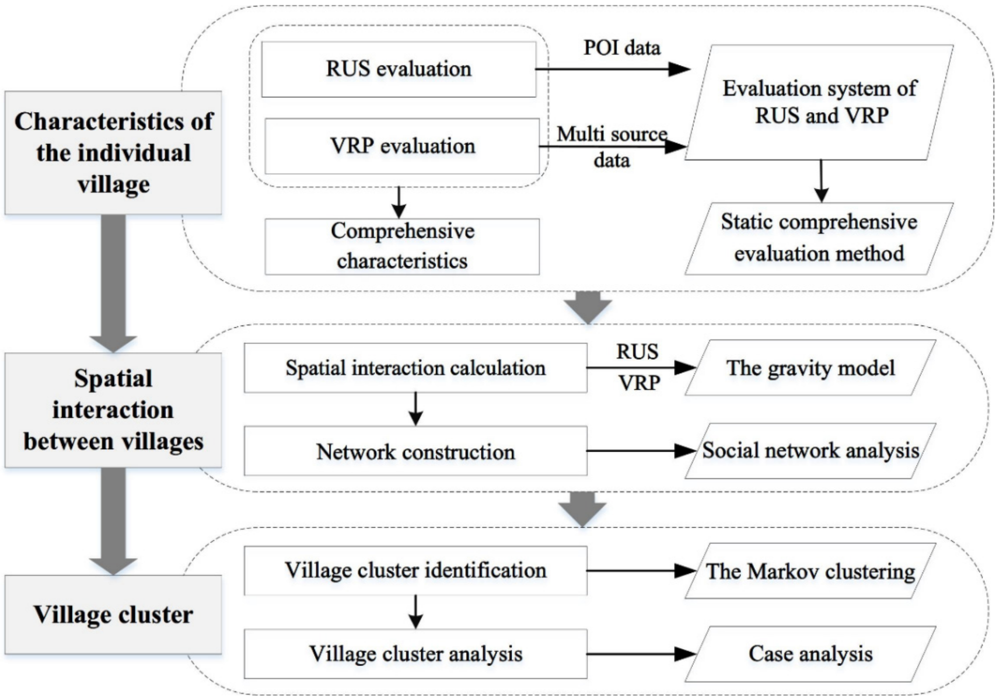

Figure 1. Analytical framework.

The hypotheses of the research are as follows: (1) There is a spatial interaction between villages due to the influence of labor, capital, and commodity flows. (2) The scope of spatial interaction between a village and its surrounding villages is mainly determined by the main means of local transportation. In general, the higher the efficiency of transportation means (i.e., fast speed and high convenience), the more frequent the element flow, so that the spatial interaction between villages is broader and closer.

2.2. Methodology

2.2.1. Rural Adaptive Capacity Assessment for Urbanization and Village Renewal

The *RUS* Evaluation System

Rural areas with good urban functions, such as a large number of schools, medical institutions, and service industries, more easily realize urbanization [35]. Since point-of-interest (POI) data are widely used to assess urban functions [36], the classification method and data of POI were used to identify the basic condition of the areas in this paper. POI data have the spatial features of geographical indications, including name, category, longitude and latitude, and other information, which is important for spatial big data analysis. According to the AutoNavi map, POI data are divided into 16 categories. Considering that the number and types of POI points in rural areas are relatively small compared to cities, this paper integrates POI types with similar functions and finally summarizes them into 8 categories, including public facilities, government agencies, educational offices, etc. (see Table 1). In addition, due to the differences in the impact of different types of POIs on new urbanization, the Delphi method was applied to discuss the weighting system, in which questionnaires and interviews were used to collect expert opinions.

Table 1. Classification of POI data in rural areas.

First-Level Classification	Second-Level Classification	Weights
Public facilities	Bus station, railway station, parking lot, port terminal, public toilet, etc.	0.1268
Institutional unit	Government agencies, social organizations, public security, industrial and commercial taxation, industry associations, etc.	0.1595
Educational institution	Science, education and cultural venues, museums, media institutions, schools, scientific research institutions, etc.	0.1489
Tourist attraction	Parks, squares, scenic spots, bays and straits, religious temples, etc.	0.1277
Enterprise	Production bases, factories, industrial parks, warehousing, banking, etc.	0.1383
Life service place	Auto repair shops, communication services, logistics, health care services, etc.	0.0885
Entertainment places	Dining venues, shopping venues, sports venues, entertainment venues, leisure venues, holiday convalescence venues, etc.	0.1108
Residential	Apartments, villas, community centers, etc.	0.0996

To explore whether rural areas are suitable for urbanization, the weighted quantity of POIs (*QPOI*), the nearest neighbor index (*NNI*), and the Shannon diversity index (*SHDI*) are adopted to measure the industrial and infrastructure conditions. To exclude the influence of differences in the area of administrative villages on the results, these three indicators were first calculated to a honeycomb grid unit with a scale of 500 m and then counted to the administrative village unit by means of a scale conversion method.

First, the *QPOI* could intuitively reflect the number of industries and infrastructure in the grid. The *QPOI* was obtained by multiplying the number of various POIs and their weights in each grid. The formula is as follows:

$$QPOI = \sum_{i=1}^{n} X_i p_i \tag{1}$$

where X_i is the number of POIs of a certain type and p_i is the weight corresponding to this type.

Second, the *NNI* detects the spatial patterns of clustered or dispersed POI locations, which is a method to measure the actual point distribution based on the condition of random distribution [33]. The nearest neighbor distance when POI points are randomly distributed is defined as the theoretical nearest neighbor distance r_E:

$$r_E = \frac{1}{2}\sqrt{\frac{S}{n}} \quad (2)$$

where S is the grid area and n is the number of POIs in the grid. The Euclidean distance between each point and its nearest neighbor is calculated, and then the average value is taken to obtain the average nearest neighbor distance $\bar{r}$. The *NNI* can be expressed as a ratio of the average nearest neighbor distance over the theoretical nearest neighbor distance,

$$NNI = \frac{\bar{r}}{r_E} \quad (3)$$

when $NNI = 1$, the distribution of POI data is random; when $NNI < 1$, the distribution tends to be an agglomerative distribution; when $NNI > 1$, the distribution tends to be a discrete uniform distribution. This index has a negative contribution to the *RUS*.

Third, the *SHDI* measures the diversity of production and service in the grid. The higher the diversity of POI data, the more balanced the different types of institutions and the more complete their functions. Drawing on the measurement method of diversity in landscape ecology, the *SHDI* can be calculated as follows:

$$SHDI = -\sum_{i=1}^{k} p_i \ln p_i \quad (4)$$

where k is the number of POI types in the grid, and P_i is the proportion of type i in the total number of types.

The *VRP* Evaluation System

According to field research and previous studies on village renewal elements [37–39], this paper constructs an evaluation system from the perspectives of geographic location, resource endowment, economic circumstance, and social condition. Among them, geographic location is further measured by location and transportation. Resource endowment is measured by production and ecological resources. Economic circumstances are measured by economic background and industrial foundation. Social conditions are measured by village scale and social services. Considering the related information of the study area, third-class indicators were determined and classified accordingly, and the details of the explanations for the index are shown in Table 2. For the weighting system, the Delphi method was used to collect experts' opinions again.

Table 2. Summary of rural vitalization potential indicators.

First-Class Index	Second-Class Index	Third-Class Index	Explaining	Weights
Geographic location	Location	R1 Average distance to the county *#	It is calculated in grid units and then counted to the village	0.0613
		R2 Average distance to township government *#	It is calculated in grid units and then counted to the village	0.0494
	Transportation	R3 Average distance to traffic trunk line *#	It is calculated in grid units and then counted to the village	0.0392
		R4 Density of roads in the village	Total length of all roads in the village/total area of the village	0.0198

Table 2. *Cont.*

First-Class Index	Second-Class Index	Third-Class Index	Explaining	Weights
Resource endowment	Production resources	R5 Proportion of cultivated land area	Cultivated land area/total area of village	0.0432
		R6 Proportion of garden area	garden land area/total area of village	0.0425
		R7 Proportion of forestland area	Forestland area/total area of village	0.0410
		R8 Proportion of industrial and mining land area	Industrial and mining land area/total area of village	0.0486
	Ecological resources	R9 Proportion of ecological land area	Ecological land area/total area of village	0.0424
		R10 Number of tourist attractions (above A-Level)	POI data statistics	0.0384
Economic circumstance	Economic background	R11 GDP per unit area	GDP/total area of village	0.0381
		R12 Urbanization rate in rural area	Urban construction land area/total area of village	0.0278
	Industrial foundation	R13 Proportion of Commercial land area	Commercial land area/total area of village	0.0607
		R14 Number of village and township enterprises	POI data statistics	0.0580
		R15 Number of entertainment and leisure venues	POI data statistics	0.0252
Social condition	Village scale	R16 Population size	Population density of the village× total area of village	0.0578
		R17 Scale of rural settlements	The land survey data are used and the data of land plots is summed up	0.0575
		R18 Vacancy in rural residential areas *	Converted to the plot according to the annual average night light brightness data	0.0664
		R19 Per capita construction land	Urban construction land area/population	0.0396
	Public services	R20 Average distance to medical institution *#	It is calculated in grid units and then counted to the village	0.0476
		R21 Average distance to primary and secondary schools *#	It is calculated in grid units and then counted to the village	0.0453

Note: (1) Indicators with * have a negative contribution. (2) The indicators with # are distance, which are calculated as follows: First, the layer of the European 100 m grid with a point or a line as the center is created, and then the value of the village scale is summed from the grid units.

Static Comprehensive Evaluation Method

The static comprehensive evaluation method is used to evaluate the suitability for rural urbanization and the potential for village renewal. First, we standardize the value of each indicator according to the following formula:

$$\text{Positive indicator}: \; u = \frac{y - y_{\min}}{y_{\max} - y_{\min}} \tag{5}$$

$$\text{Negative indicator}: \; u = \frac{y_{\max} - y}{y_{\max} - y_{\min}} \tag{6}$$

where u denotes the standardized data of a certain indicator, y is the original value, and $y_{\max}$ and $y_{\min}$ are the maximum and minimum values, respectively.

Second, the *RUS* and *VRP* are calculated by the following formulas:

$$V_{RUS} = \alpha \cdot u_{QPOI} + \beta \cdot u_{UNNI} + \gamma \cdot u_{SHDI} \tag{7}$$

$$V_{VRP} = \sum w_i u_i \ (i = 1,\ 2,\ 3,\ \ldots\ ,21) \tag{8}$$

where V_{RUS} and V_{VRP} denote the values of *RUS* and *VRP*; u_{QPOI}, u_{UNNI}, and u_{SHDI} are the standard values for *RUS*; u_i denotes the indicator of i for *VRP*; and α, β, γ, and w_i are the weights. Since the *QPOI*, *UNNI*, and *SHDI* measure the industrial and infrastructure conditions of the area according to quantity, concentration, and variety, respectively, the weight of each indicator is the same ($\alpha = \beta = \gamma = 1/3$).

2.2.2. Spatial Interaction Calculation and Network Construction

Gravity Model

Inspired by the gravitational interaction between planetary bodies, the gravity model is introduced into geography to measure the spatial interaction between regions. To generalize, the scale of each area, population, or GDP is denoted by M, and the distance between two areas is denoted by D. Each pair of cities is designated by the subscripts i and j. The interaction of the two areas is represented by I_{ij}, which can be written as

$$I_{ij} = \frac{M_i M_j}{D_{ij}} \tag{9}$$

In this paper, this model is used to explore the spatial interaction between villages. Since the degree of spatial interaction is affected by many factors, it is difficult to comprehensively measure the interaction between two regions by only the population or GDP. In addition, because the development of modern transportation has improved the accessibility between regions, the spatial distance can no longer truly reflect the distance. Taking these into consideration, this paper makes the following modifications to the basic model: (1) For the scale of each area, the two indices of a comprehensive evaluation, *RUS* and *VRP*, are used; (2) the distance between two villages is measured by the time distance rather than the space distance, which is the average daily travel distance of villagers. With the two modifications, the gravity model equation becomes

$$F_{ij}^{RUS} = \frac{V_{RUS}^{i} \cdot V_{RUS}^{j}}{D_{ij}} \tag{10}$$

$$F_{ij}^{VRP} = \frac{V_{VRP}^{i} \cdot V_{VRP}^{j}}{D_{ij}} \tag{11}$$

where F_{ij}^{RUS} and F_{ij}^{VRP} represent the interaction of urbanization and rural vitalization between villages, respectively. To identify which interaction is dominant, these two values are divided by their averages $\overline{F_{ij}^{RUS}}$ and $\overline{F_{ij}^{VRP}}$, and then the interaction with the higher value is selected as the dominant interaction $F_{ij}^{\max}$ for this pair of villages. It can be written as follows:

$$F_{ij}^{\max} = \begin{cases} F_{ij}^{RUS}, if \frac{F_{ij}^{RUS}}{\overline{F_{ij}^{RUS}}} \geq \frac{F_{ij}^{VRP}}{\overline{F_{ij}^{VRP}}} \\ F_{ij}^{VRP}, others \end{cases} \tag{12}$$

Social Network Analysis (SNA)

SNA is a method used to map and measure the relationships among people, groups, organizations, and other connected entities [40]. It can clearly show the position of "actors" in the network and quantitatively reveal the interaction between entities [41]. Thus, this paper uses SNA to analyze the network characteristics between villages, focusing on the scale and closeness of the network. Among them, the network scale reflects the number of all actors and contacts included in the network. The larger the scale of the network is, the more villages there are in the cluster. The network closeness reflects the tightness between villages, which is often measured by the network density and average distance (see Table 3).

Table 3. Brief description of the measurement of SNA.

Network Description	Indicators	Measurement
Scale	Nods	The number of points in the network, expressed by n
	Ties	The number of edges in the network, expressed by m
Closeness	Density	The actual number of ties is divided by the maximum possible number of ties, and it can be calculated by $m/[n\ (n-1)]$ in the directed network
	Average distance (AD)	The distance between two nodes is defined as the number of edges along the shortest path connecting them, and AD is the average distance between all pairs of nodes.

2.2.3. Village Cluster Identification

The Markov clustering (MCL) algorithm was applied to village cluster identification since it is the original, fast, and scalable unsupervised graph cluster algorithm based on the simulation of stochastic flow on the graph [42]. The MCL process consists of two operations on stochastic matrix M, expand and inflate, which are carried out alternately. The purpose of the expansion is to connect different regions of the flow graph, and the purpose of inflation is to strengthen the intracluster flow and weaken intercluster flow. The two steps can be illustrated as follows:

Expand: Input M and the value of e, output M_{exp}

$$M_{exp} = Expand(M) = M^e \tag{13}$$

Inflate: Input M and the value of r, output M_{inf}

$$M_{inf}\ (i,\ j)\ =\ M = \frac{M(i,j)^r}{\sum_{l=1}^{n} M(i,j)^r} \tag{14}$$

In the beginning, the flow distribution of the outflow node is relatively smooth and uniform; as the number of iterations increases, the distribution becomes increasingly peaked. Crucially, all nodes in a tightly linked node group will begin to flow to one node in the group at the end of the process. All vertices flowing to the same node can be identified as a cluster.

3. Study Area and Datasets

3.1. Study Area

Laizhou is a county-level city in the northeastern part of Shandong Province, China, on the coast of Laizhou Bay in the Bohai Sea (see Figure 2). Laizhou has a land area of 1928 km^2 and a coastline of 108 km. It governs 17 towns and streets and 1013 administrative villages, with a permanent resident population of 825,000. Laizhou made full use of its advantages in port, land, and fishery fields to promote rural development and achieved great success. In 2021, the GDP of Laizhou was 70.13 billion RMB yuan, representing an increase of 4.04%. The urbanization rate is 55.3%, which is much higher than the average urbanization rate of 24.2% for the 1900 counties in China. Laizhou is not only one of the top 100 counties of China's new rural urbanization but also one of the top 100 demonstration cities of China's village renewal. It is a typical and relatively advanced sample of China's rural development.

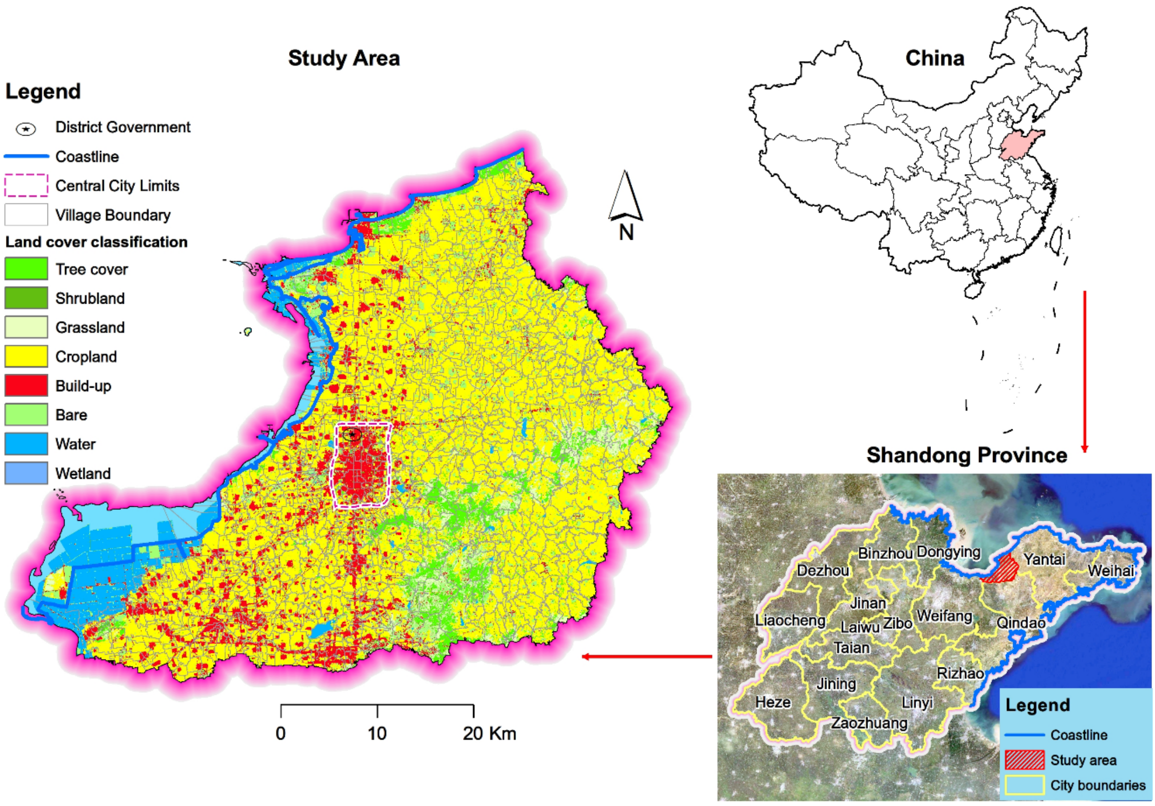

Figure 2. Location of Laizhou City.

However, Laizhou is still plagued by the following problems, which are also common in the vast rural areas of China: (1) The production of agricultural products is dominated by single peasant households, and the added value of the agricultural product processing industry is low, which shows that the development of the rural industry is in the primary stage and there is no scale effect and intensive effect. (2) Rural industrial development resources are scarce, which is contested among villages and lacks coordinated development planning. Therefore, it is urgent and important to explore the construction of "village clusters" based on rural resource endowment and promote the optimal allocation of production factors through cross-village coordination.

3.2. Data Sources

To fully understand rural development in Laizhou, this paper uses data from various sources. (1) Statistical data, such as population, GDP, and other economic and social data, were collected from the Statistical Yearbook of Laizhou City and the spatial grid statistical data of the Resource and Environment Science and Data Center (http://www.resdc.cn, accessed on 1 March 2020). The survey data on land use status were from the Laizhou Natural Resources and Planning Bureau. (2) For the remote sensing data, the terrain and elevation data were collected from ASTER GDEM V2 Data with a resolution of 30 m, and the night light data were from the revised light data in 2020 [43]. (3) Internet data include POI data and road data. The POI data were collected from the AutoNavi map in early 2020. The data were captured by the slice index, and a total of 32,392 SQL data lists were obtained (see Table A1 in Appendix A). On this basis, 5207 irrelevant data were deleted, such as the names of villages, towns, streets, rivers, and lakes. Finally, a total of 27,302 valid data points were obtained. Road vector data were collected from Open Street Map. (4) The survey data included the basic development characteristics of the village and the main travel modes of villagers. The research team conducted three field surveys in Laizhou from June to December 2020 and obtained basic development information through interviews with government staff (mainly the Agricultural and Rural Bureau and the Natural Resources and Planning Bureau) and local farmers. Using the GIS software platform, this paper unifies POI data and economic and social data into the projection coordinate system of CGCS2000_3_Degree_GK_Zone_40, constructing the Laizhou village database.

4. Results and Discussion

4.1. Characteristics of the Individual Village

4.1.1. Evaluation of *RUS* in Laizhou

As illustrated in Figure 3, the *RUS* index of Laizhou is divided into four levels based on the natural breaks classification (NBC). The results showed that most villages have the lowest value (0–0.13) and the second lowest value (0.14–0.37), with 654 and 52 villages, respectively, accounting for 62.01% and 7.85% of the total area, respectively, and only 14.01% of the villages have the highest value (0.55–0.89) and the second highest value (0.38–0.54), with 144 and 163, respectively. For the spatial distribution, villages with high values are distributed radially along the main traffic roads, with the core area of Laizhou as the circle. On the whole, the high-value areas along the western coast are significantly greater than those in the east. The main reason is that Laizhou has fewer POI points related to infrastructure and living services in the east since there are many mountains, which is the main obstacle to rural urbanization.

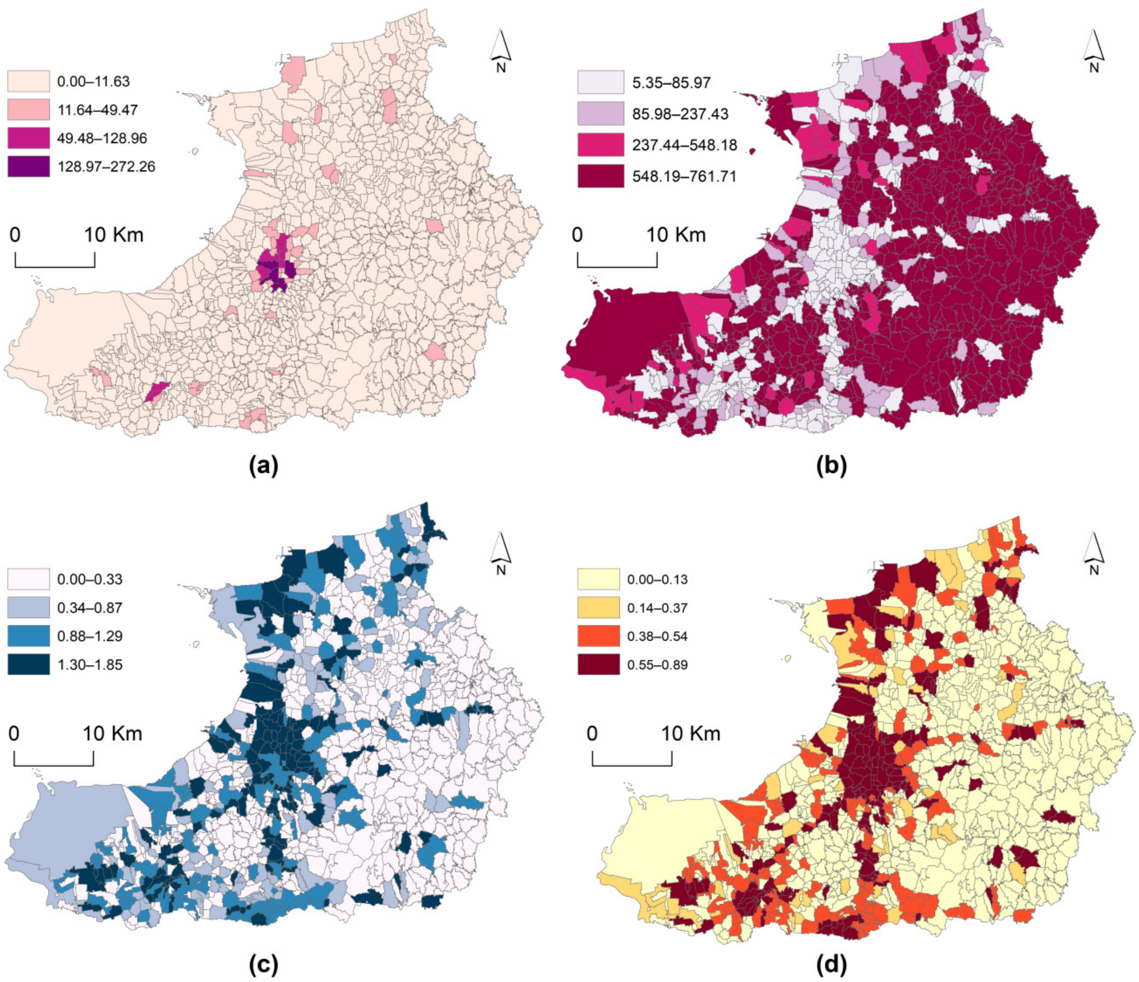

Figure 3. The distribution of the *RUS* of villages in Laizhou. (**a**) QPOI; (**b**) NNI; (**c**) SHDI; (**d**) *RUS* Index.

For the three sub-indicators, the standard deviation of the POI weighted quantity is the smallest, which is 0.056, indicating that the value of this indicator is relatively centralized. As shown in Figure 3a, the high-value areas are distributed in the core area of Laizhou and the centers of various towns and townships. The standard deviations of NNI and the

POI diversity are large, which are 0.42 and 0.32, respectively. Figure 3b,c show that the distributions of these two indicators are scattered, indicating that there are great differences among villages.

4.1.2. Evaluation for *VRP* in Laizhou

The result of the *VRP* index is shown in Figure 4. As illustrated in Figure 4e, the number of villages from low to high levels is 39, 211, 472, and 291, accounting for 3.79%, 33.01%, 41.75%, and 21.45% of the area of all regions, respectively. For the spatial distribution, regions with different levels of the *VRP* index are distributed in clusters. The relatively high values, including (0.21–0.26) and (0.27–0.42), are mainly concentrated in two areas: The first is the core area of Laizhou and its surrounding areas with good geographic location and economic and social conditions; the second is the area with a good geographic location and resource endowment advantages in the east. The relatively low values, including (0–0.11) and (0.12–0.20), are mainly distributed in the southwest coastal saline alkali zone and the eastern mountainous areas, which have poor locations and economic circumstances (see Figure 4a,c).

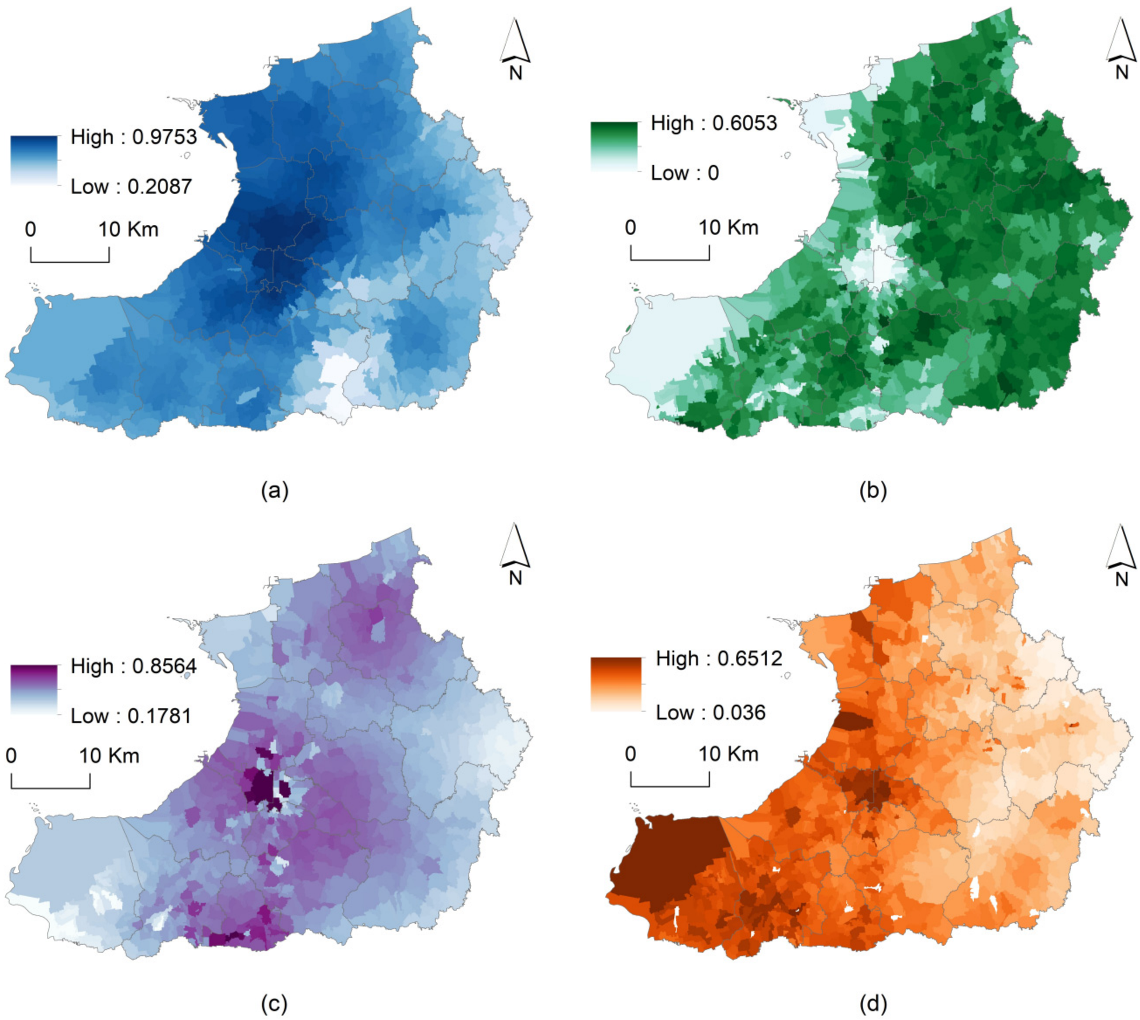

Figure 4. *Cont*.

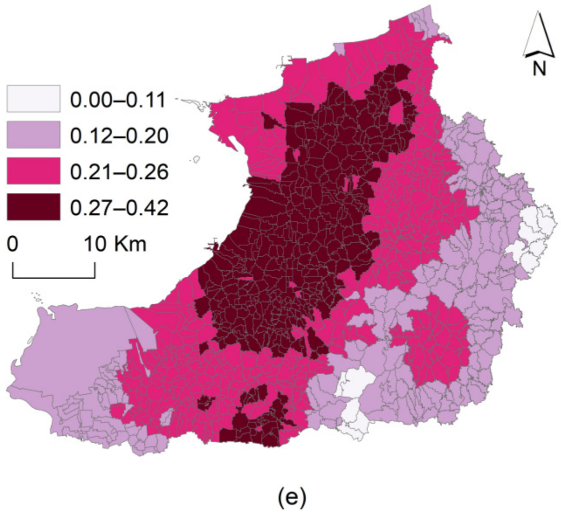

Figure 4. The distribution of the *VRP* of villages in Laizhou. (**a**) Geographic location; (**b**) Resource endowment; (**c**) Economic circumstance; (**d**) Social condition; (**e**) VPR index.

For the four sub-indicators of the RUP index, villages in Laizhou show obvious spatial differentiation. In the western coastal areas, the development level of geographical location and social conditions is high, while the resource endowment and economic circumstances are relatively low. In the central urban belt, the geographical location and economic and social conditions are relatively high. The eastern mountainous areas have obvious advantages in resource endowment, while other indicators are relatively low.

According to the evaluation results for the *RUS* and *VRP* indices, villages could be classified into different types by the double matrix shown in Figure 5. Villages in the green area have both high *RUS* and *VRP* index values, and there are 269 villages in this area, accounting for 26.55% of Laizhou. The yellow and blue areas are the villages with a low *VRP* or *RUS* index, and there are 494 villages in the yellow and 38 in the blue areas, accounting for 48.77% and 3.75%, respectively. The red area indicates very poor capacity with both low *RUS* and *VRP* indices, and there are 212 LL types, accounting for 20.93%. Obviously, villages with comparative advantages in *RUS* or *VRP* can easily determine their development strategies. However, villages may be in a dilemma if rural urbanization or village renewal strategies are chosen based on rural individual characteristics, especially for villages with both high (or low) *RUS* and *VRP*. Thus, it is necessary to further analyze the spatial interaction between the villages.

4.2. Spatial Interaction between Villages

In the previous section, the characteristics of the individual village were assessed, while the spatial interaction between villages is analyzed in this section. To obtain the spatial distance between villages, the way and time of villagers' daily travel were investigated. The results showed that the main travel modes of villagers in Laizhou were walking (5 km/h), bicycle (10 km/h), electric vehicle (20 km/h), motorcycle (40 km/h), and car (60 km/h), accounting for 26%, 15%, 41%, 7%, and 11%, respectively. The acceptable travel time was approximately 20 min. Accordingly, the travel radius of villagers in Laizhou was calculated to be 6.8 km. Therefore, taking each village as the center and 6.8 km as the radius, this paper measures the spatial interaction relationship between the center village and its surrounding ones and obtains a total of 39,434 pairs of villages.

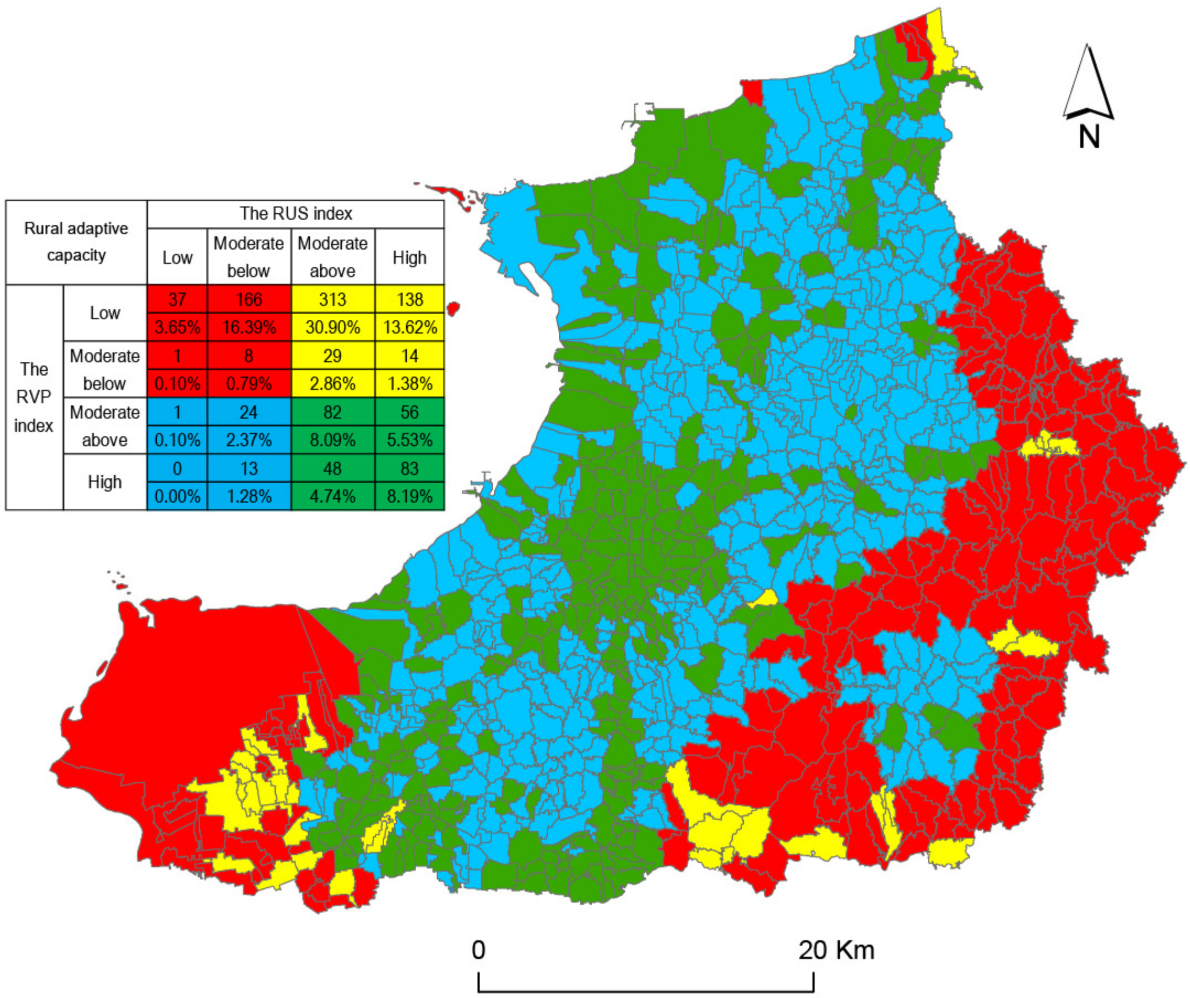

Figure 5. Classification of villages in Laizhou based on the *RUS* and *VRP* indices.

According to Formulas (9)–(12), the spatial correlation of *RUS*, *VRP*, and the maximum links between villages is calculated (see Figure 6). The lines with different colors represent the top 10%, 10–20%, 21–50%, 51–80%, and 81–100% network rankings. Due to the large number of ties in the network, this paper focuses on the networks ranking in the top 20%. The results show that (1) the spatial association of *RUS* has three concentrated areas, namely, the central Laizhou urban core area, Shahe town in the southwest, and Xiaqiu town in the south and the surrounding villages (Figure 6a). These three areas play an important role in leading the development of county urbanization and driving the revitalization of villages. (2) *VRP* spatial interaction has obvious cluster characteristics, which are manifested in the spatial association between village nodes and their nearby nodes (Figure 6b). (3) The Fmax spatial interaction (Figure 6c) shows obvious core periphery characteristics. The urban core area of Laizhou is closely connected to surrounding villages, which is consistent with the reality that Laizhou, as the location of the central urban area, radiates other villages in terms of public services and economic development. On the whole, the regions with strong spatial interaction are concentrated in the west of the county, while the villages in the east of the county have weak and scattered spatial correlation, which need to be further integrated into the overall spatial correlation of the villages.

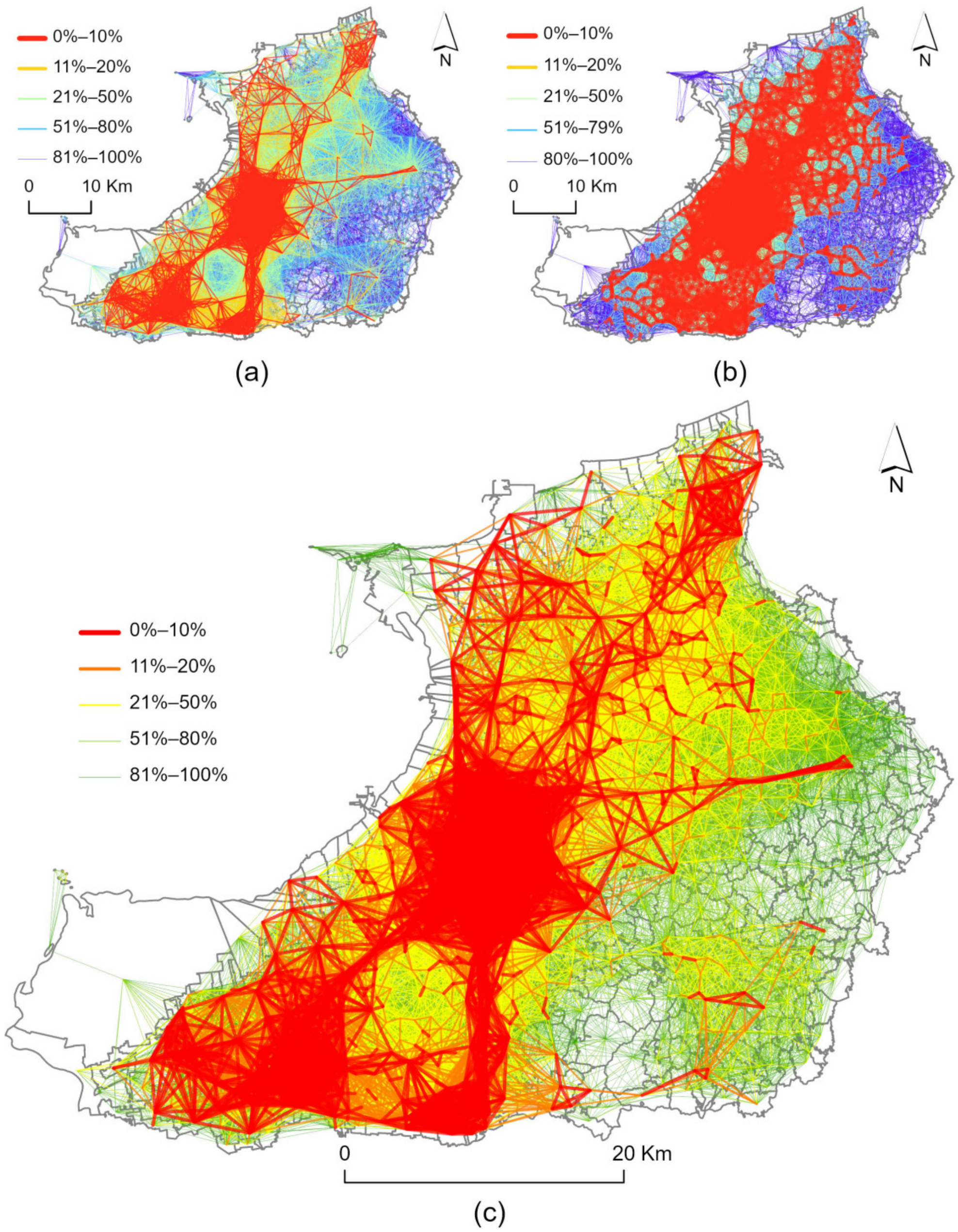

Figure 6. Spatial interaction between villages in Laizhou. (**a**) *RUS* network; (**b**) *VRP* network; (**c**) Maximum links network.

According to SNA, the characteristics of the network formed by *RUS*, *VRP*, and Fmax, for which the spatial interaction ranks in the top 20%, were calculated. The result shows that the number of nodes of the *RUS* network is 423, the density is 0.044, and the average distance is 4.461, while the three values of the *VRP* network are 919, 0.009, and 7.997, respectively. Compared with the *VRP*, the *RUS* network has a small scale and large density, which indicates that the spatial interaction of villages in urbanization is much closer. The large scale and average distance of the *VRP* network indicate that most villages have strong spatial interaction in village renewal, and villages have good cohesion. The nodes of the Fmax network are 865, the density is 0.011, and the average distance is 6.423. The number of nodes in this network accounts for 85.39% of the total villages in Laizhou, indicating that most villages were covered and that the cohesion between villages is good. However, the density of this network is small, indicating that the spatial interaction between villages is not tight and needs to be further improved.

4.3. Village Cluster

Based on the spatial interaction network of the Fmax value, MCL was used to cluster the villages in this paper. A total of 133 village clusters were obtained in Laizhou, and the main clusters, the size, and the ties of the clusters are shown in Figure 7 and Table A2. The village clusters present the following three characteristics.

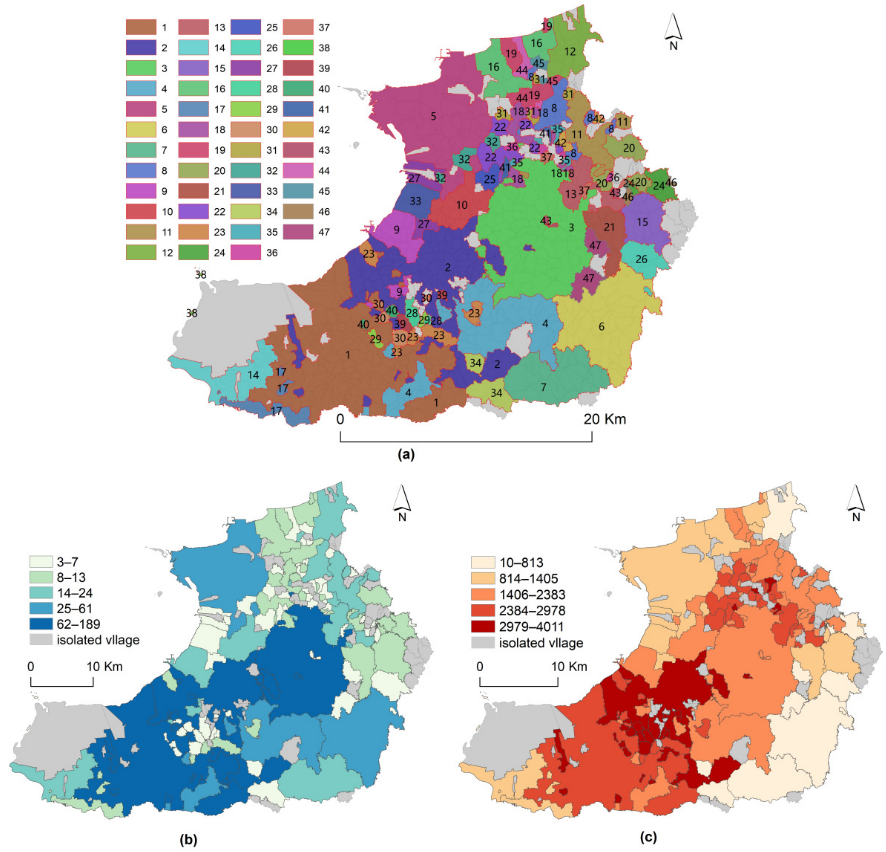

Figure 7. Village clustering in Laizhou based on MCL. (**a**) The main village clusters; (**b**) The size of village clusters; (**c**) The ties of village clusters.

First, the size of the clusters is quite different. According to the cluster identification of Laizhou, there are only 47 main clusters with 3 or more villages, while the remaining 86 clusters only have 1 or 2 villages. Among the main clusters, there are 3 super large groups (including more than 101 villages), 4 large groups (including 21–100 villages), 12 medium groups (including 11–20 villages), and 28 small groups (including 3–10 villages). This shows that a few villages have formed large-scale and close ties, while others are relatively isolated. Thus, it is necessary to formulate development policies according to the characteristics of villages in different groups.

Second, the closeness of the spatial association network for the cluster varies greatly. The average ties of the top three clusters (Clusters 24, 22, and 23) are 3721.67, while the ties of the bottom three clusters (Clusters 122, 80, and 131) are only 243.33. The average value of the top three clusters (Clusters 131, 53, and 102) in network density is more than 60% higher than that of the bottom three clusters (Clusters 7, 32, and 81). In addition, the average network density of clusters that do not cross townships is 11.93% higher than that across townships. This shows that the links between villages in some clusters need to be strengthened, especially the cross-township clusters.

Third, various clusters are composed of villages across townships. For all 47 clusters, 31 clusters span at least 2 townships, of which Cluster 2 in Figure 7 spans 9 townships with the most. This shows that the connection between villages has crossed the barrier of township boundaries, and breaking the administrative boundaries is crucial to the development of rural clusters.

4.4. Discussion

A village cluster is not a simple spatial or industrial division but a collection of villages with common characteristics or problems [44]. The core of the cluster is to make good use of internal synergy to promote the optimal allocation of resources among villages [45]. However, due to the long-term autonomy of Chinese villages, it is difficult to form a village cluster with clear objectives, close links, and the efficient utilization of resources spontaneously. In this case, planning and guidance are required according to the features of different clusters. The following section analyzes the characteristics, existing problems, and driving forces of typical rural clusters of different scales in Laizhou.

(1) The super large clusters in Laizhou are Clusters 1, 2, and 52 marked in Figure 7. The area of these three clusters accounts for 31.64% of the total area. Cluster 1 is composed of 122 villages, of which 75 have relative advantages in rural urbanization, i.e., the *RUS* index is high. This cluster is located in Laizhou city and the surrounding area and is a cluster with urbanization as the core driving force. Cluster 2 has 102 villages, of which 90 are relatively advantageous in rural vitalization. The *VRP* index is high. This cluster is located in the plain area in the central part of Laizhou, in the transition zone between the western coastal area and the eastern mountainous area, which is the main agricultural production area. The development of this group is based on modern agriculture, focusing on the development of ecological agriculture and the agricultural mechanization industry. Cluster 52 has 189 villages, of which 165 villages are relatively advantageous in rural vitalization. It is located in southwestern Laizhou, which is an industrial agglomeration area, forming the building materials industry known as the "stone capital of China", the gold industry, and the energy chemical industry. According to the above analysis, super-large clusters mainly rely on industrial advantages, so industrial transformation and upgrading are fundamental driving forces promoting the development of villages.

(2) The large groups are numbered 3, 5, 78, and 79 in Figure 7, which contain 44 villages on average, and the area of these four groups accounts for 31.64% of the total area. Some clusters have a dominant development direction, while others do not. Clusters 3 and 5 are the former and have rural vitalization as an advantage. Cluster 3 is located in southern Laizhou and is mainly for agricultural production and seedling planting. For example, Dongdasong village implemented the "Rose town" project in the form of rural cooperatives, cultivating more than 360 rose varieties, with a planting area of 607 ha, forming a close network with surrounding villages. Group 5 is located in the northern coastal area of Laizhou and mainly focuses on coastal tourism and port services. On the other hand, Clusters 78 and 79 have no dominant development direction, and the *RUS* and *VRP* are both low. These two clusters are located in the southeast mountainous area, which is an important ecological space of Laizhou, so development is limited. In total, large groups with advantageous development directions mainly rely on the project. However, compared with the super large-scale cluster, the number of villages in the large cluster is small, which indicates that the driving force of the project is insufficient. The large group with no dominant development direction is mainly subject to strict environmental constraints, and the breakthrough point of this group may be green ecological agriculture and rural tourism.

(3) There are 12 middle groups, accounting for 18.11% of the total area. Among them, 10 clusters have dominant development directions, while 2 clusters have no direction. Laizhou adopts the mode of "company + farmer + bases" to develop rural industries, which plays an important role in driving the spatial interaction between villages. In general, the middle group of Laizhou is mainly driven by the advantages of scenic spots and brand agricultural products and planting bases. For example, Group 4

mainly relies on the "Great Wall of Water" of Hutou Cliff, while Group 62 mainly relies on the "10000 mu grape base" project of China's largest wine producer (named Changyu Wine Company). The middle groups, without a development advantage, are Groups 53 and 101, which are distributed in the southern mountainous area and the eastern edge of Laizhou.

(4) The number of small groups is 28, accounting for 21.05% of the total area, mainly distributed in northeastern Laizhou and the central urban–rural ecotone. Among them, 12 subgroups have a dominant development direction and 7 do not. The number of small groups with advantages in village renewal is 75%, mainly relying on local farmers' professional cooperatives and agricultural production bases. For example, Pinglidian town has built an "Internet+" smart agricultural town, selling ginger, strawberries, and other characteristic industries through the network platform. The small groups in the urban–rural transition zone often have advantages in rural urbanization. Their development mainly relies on the radiation of the main urban area, and they have advantages in the construction of industrial parks and the reconstruction of rural industries. The small group without advantages in Laizhou is the spatial agglomeration of villages with poor rural development, which is an important area for rural spatial management.

(5) The 86 villages excluding the cluster are scattered in Laizhou, and the relatively concentrated areas are mainly on the northeast and southwest coasts of Laizhou. These isolated villages have the following three situations: First, their own *RUS* and *VRP* are low, while the surrounding areas are strong, accounting for approximately 47.37%. Second, their own *RUS* is high, but the surrounding areas have advantages in *VRP*, accounting for approximately 38.95%. Third, their own *VRP* is high, but the surrounding areas have advantages in *RUS*, accounting for approximately 11.58%. The possible reason for the isolation of these villages is that the development mode of these villages is different from that of the surrounding villages, which leads to weak spatial interaction, thus not forming a village cluster.

5. Policy Implications and Conclusions

5.1. Policy Implications

To realize the integration of rural urbanization and village renewal strategies, it is necessary to formulate rural cluster planning with the goal of achieving the overall development of rural groups. The first task is to determine the development strategy and investment focus of the village cluster according to its scale and characteristics. The case study of Laizhou shows that large-scale clusters are based on advantageous industries, so the formulation of incentives to attract advantageous industries and promote industrial transformation and upgrading should be strengthened. Specifically, improving the efficiency of traditional industries and actively cultivating the new material industry and high-end equipment manufacturing industry are the main development directions of this group. Large and medium-sized groups are based on certain industrial or agricultural projects. To enhance the leading role of existing projects, the diversity and complementarity among individuals in the region should be strengthened. Through the optimized allocation of capital, labor, and land resources, the efficient utilization of resources in the group will be improved, and the competitive advantage of the project will be continuously increased. Moreover, it is also important to improve public infrastructure to provide more convenient conditions for transportation and trade.

In particular, villages without advantageous directions deserve special attention when developing practical policy measures. These village clusters are often located in areas with poor living conditions or fragile ecological environments. If the problems can be improved by ecological restoration projects, the village cluster strategy can be adopted. However, for those villages that cannot be improved by projects, such as those located in the core area of the National Nature Reserve, those with frequent disasters, and those with serious population loss, it may be a better choice to demolish and merge the villages.

5.2. Conclusions

As a large developing country based on agriculture for an extended period of time, China is facing not only the development needs of an increasing urbanization rate but also the practical problems of solving rural development. This is a comprehensive problem of China's development in the new era [46]). This paper constructs a research framework for the integration of rural urbanization and village renewal, reveals the comparative advantages of rural individuals in rural urbanization and village renewal through advantage evaluation, measures the spatial interaction between villages, and finally identifies rural clusters based on the network characteristics of spatial interaction among villages. Typical village clusters are selected for analysis, and this paper reveals the development characteristics and driving forces of different scale groups.

The findings of this paper suggest that villages may be in a dilemma if rural urbanization or village renewal strategies are selected according to individual characteristics, especially for villages with both high (or low) *RUS* and *VRP*. In contrast, by combining villages with similar characteristics and close spatial interaction, this paper suggests that the rural development strategy be determined from the perspective of village clusters. This is conducive to optimizing the allocation of resources in the region and transforming the comparative advantages of rural areas into competitive advantages.

Some limitations of this study need to be noted. Because different clustering methods may obtain different results, other methods, such as k-means, can be further used to verify the results. The MCL method used in this paper can process noise data well and does not need to set the number of groups in advance. Although this is an objective clustering method, the theoretical clustering results should be combined with the actual development of the village. The final determination of the village cluster should be further adjusted in combination with the industrial layout and project construction in the region.

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Data Availability Statement: The data are proprietary or confidential in nature and may only be provided with restrictions. The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. The Data in Laizhou

Table A1. Statistics of Laizhou POI data.

No.	First-Level Classification	Quantity	Proportion
1	public facilities	900	2.78%
2	Institutional unit	1381	4.26%
3	educational institution	1105	3.41%
4	tourist attraction	95	0.29%
5	enterprise	3802	11.74%
6	Life service place	6144	18.97%
7	Entertainment places	12,970	40.04%
8	Residential	788	2.43%
9	others	5207	16.07%
In total		32,392	100.00%

Table A2. Summary of the Characteristics for Village Clusters in Laizhou.

Number	Towns	Villages	Types of Villages				Ties	Pairs	Density
			HH	HL	LH	LL			
1	9	122	74	1	43	4	3238	10,368	31.55
2	5	102	14	1	76	11	2203	7543	29.24
3	5	61	12		37	12	1919	5950	31.99
4	3	20	8		12		2383	7441	33.28
5	3	50	17		33		1193	3833	33.05
6	2	5			5		1865	6323	29.88
7	3	9	7		2		2835	9800	28.85
8	3	5			5		2172	7063	31.03
12	3	13	2		10	1	950	2850	34.38
17	1	6	6				1405	4270	34.30
18	2	18	9		9		2344	7941	29.57
19	1	5	3		2		1262	3932	32.32
22	2	5			5		3649	12,526	29.17
23	2	5			5		3505	11,953	29.33
24	2	3			3		4011	12,891	30.99
32	2	5			5		3382	11,910	28.29
52	5	189	77	7	88	17	2751	8618	33.03
53	2	13		5		8	899	2376	40.69
56	2	3	1		2		3191	10,857	29.44
57	2	20	3		15	2	2262	7198	31.99
58	2	11	2		9		1752	5521	33.18
60	2	11			11		2896	9677	29.95
61	2	3	1		2		1933	6181	32.42
62	2	18			9	9	2095	6589	32.47
63	2	16	2		13	1	2656	8854	30.10
64	2	10			1	9	1738	5352	33.64
65	2	4			4		3177	10,510	30.22
66	1	3			2	1	2551	8307	31.97
73	2	3			3		2978	9914	30.02
75	3	4			3	1	2945	9671	30.52
78	1	41	3	2	16	20	648	2075	32.41
79	1	24		4	4	16	508	1504	35.03
80	1	7				7	263	852	31.70
81	2	3				3	798	2881	27.52
83	1	17	10	1	5	1	684	1817	40.06
84	1	3			3		1315	3889	33.80
90	1	7	3		4		2571	8722	29.49
97	2	4			3	1	2713	9006	30.38
98	1	10	2		1	7	1314	4465	29.23
101	1	13		4		9	1079	3274	32.89
102	1	8				8	813	2072	40.11
103	1	3				3	1216	3389	37.92
114	2	3			2	1	2107	6811	30.98
120	3	9	4		5		2810	9340	30.77
122	1	5		3		2	430	1313	33.17
126	1	16		8		8	979	2611	38.96
131	1	4				4	10	23	45.83

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