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Following Rural Functions to Classify Rural Sites: An Application in Jixi, Anhui Province, China

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Abstract: Rural areas are a type of self-organized regional living environment, with multi-functional symbiosis between humans and land; their functional attributes are function superposition, function difference, and dominant function. The evolution of rural functions is a gradual process and follows the general law of the development of self-organizing systems, which evolutes from the state of general development, competition without rules, and, finally, to an order controlled by the dominant function. By constructing an indicator system and measurement model of rural function evaluation, this study took 11 towns in a hilly area of Jixi County as regional units to analyze the differentiation characteristics and rules of rural functions; the functions include agricultural production functions, nonagricultural production functions, life and leisure functions, and ecological functions. The results show the following: (1) The index of agricultural production functions, life and leisure functions, and ecological functions in Jixi County is higher, while the index of nonagricultural production functions is lower; (2) all towns have at least one function belongings to the "high state strong potential zone", and some towns show a weak comprehensiveness; (3) the interaction between different functions should be considered when determining the dominant functions of the towns; (4) the formation mechanism of a dominant function has a high correlation with its main influencing factors; and (5) nine types of characteristic village are determined, according to the coupling of village characteristic resources and town dominant functions.

Keywords: dominant function; regional differences; rural geography; rural territorial functions; type identification

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1. Introduction

Rural areas refer to areas outside urban built-up areas, but they are not an independent analysis category. Combined with research on existing human settlement practices in China, the definition of rural areas in China mainly refers to towns and villages that are not under urban jurisdictions (including urban suburbs and county towns). Rural function refers to the sum of all kinds of services provided to meet the needs of rural self-development and villagers' production and livelihoods, involving economy, society, culture, life, ecology, and other aspects. The evaluation of rural functions can clarify rural development status and its future development path. At present, China's rural areas are still facing the problem of regional value collapse under the long-term "urban–rural dual system" strategy [1–3]. In addition, in recent years, the urbanization tendency of villages has led to the shrinking of rural development space, as the development path of prioritizing economic efficiency has ignored the protection of rural ecological, social, cultural, and other resilient functions, leading to the degradation of traditional functions and the development of new functions that are incompatible with the environment. In 2018, the CPC Central Committee and the State Council issued the Rural Revitalization Strategic Plan (2018–2020) (Strategic Planning for Rural Revitalization (2018–2022). Available online: http://www.gov.cn/zhengce/2018-09/26/content_5325534.htm (accessed on 26 September 2018)). Since then, rural–urban integration had been in the practice stage [4]. In this paper, we propose an important topic of rural geography: how to evaluate regional value and formulate the differentiation law of China's rural functions in the new era; for only on the basis of full analysis of rural functions can rural areas carry out land use, policy making, and financial input according to the function division, and, finally, realize rural–urban integration in industry, ecology, industry, and other aspects.

Research on the multifunctionality of the agricultural sector, rural landscape, and rural space has become a core theoretical tool in the West with which to describe the characteristics of rural differences, explain the process of rural change and development, and support or refute government policies and actions [5]. Scholars have carried out a great deal of research on the spatial characteristics of rural landscape functions [6–8] and rural types [9], the impact of policies on rural landscape functions [10,11], and the interactions among rural functions [12]. Some of the research has been used in relation to evolutionary theory and scenario analysis, and other methods have been used to analyze the complexity and uncertainty of rural development from a functional perspective [13]. However, the current research primarily focuses on agricultural policies and rural revitalization in post-industrial society and the de-urbanization stage [14,15].

Due to historical and geographical reasons, there are abundant natural, ecological, and human resources in the south part of Anhui province, China. However, because the economic environment is relatively backward and the social ecology is fragile, the protection and utilization of the province's cultural and social resources could cause extreme change, leading to social crisis [16,17]. At the same time, the ecological environment in hilly areas is generally fragile, and it would be easy for the outbreak of various geological disasters to destroy natural resources. In addition, hilly areas are mostly underdeveloped and cannot enjoy equal rights in the urban–rural system, so, the development of these areas is constrained by the environment of policy and economy [18,19]. Rural areas are the most basic regional organism in China, and play a fundamental role in the social and economic development of the whole country. As such, they are important for implementing the strategy of 'Main Functional Area' and realizing the integration of urban–rural development. Therefore, at the theoretical level, a comprehensive analysis of rural functions, including function measurement, high-value function interaction analysis, and dominant function formation mechanism, will be key to realizing sustainable development and constructing the structure of urban–rural integration in hilly areas [20]. Moreover, rural areas can realize dislocation competition with urban areas [21]. In addition, comparing the differences among rural functions could improve the current rural regional function evaluation theory. On a practical level, the ultimate carrier of rural revitalization is the village organism, and the village is a rural growth pole based on the dominant function of the town and the accumulation of characteristic resource elements of the village. On the basis of understanding of the functional spatial differentiation characteristics of towns, an analysis of the characteristic types of village is helpful to accurately determine the development path of rural areas, and then improve the current support theory of rural revitalization practice.

2. Analytical Framework

2.1. Rural Regional Organism

The rural regional system is part of urban–rural integration. It is a regional open system with a certain functional structure which is formed by the interaction and connection of its subsystems. The subsystems include location conditions, natural environment, cultural heritage, policy conditions, and economic basis. The function of a rural regional system reflects its development stage, as the rural regional organism is an important carrier for factor allocation and function organization. According to the spatial production theory of Henri Lefebvre [22], the rural regional organism is space system constructed by resources, rights, society, and capital. So, based on the three-dimensional rural space system of culture, society and material proposed by Halfacree [23], from the human–land interaction perspective, this study analyzed the space system of the rural organism from the two dimensions of the inner core system and the outer periphery system [24] (Figure 1).

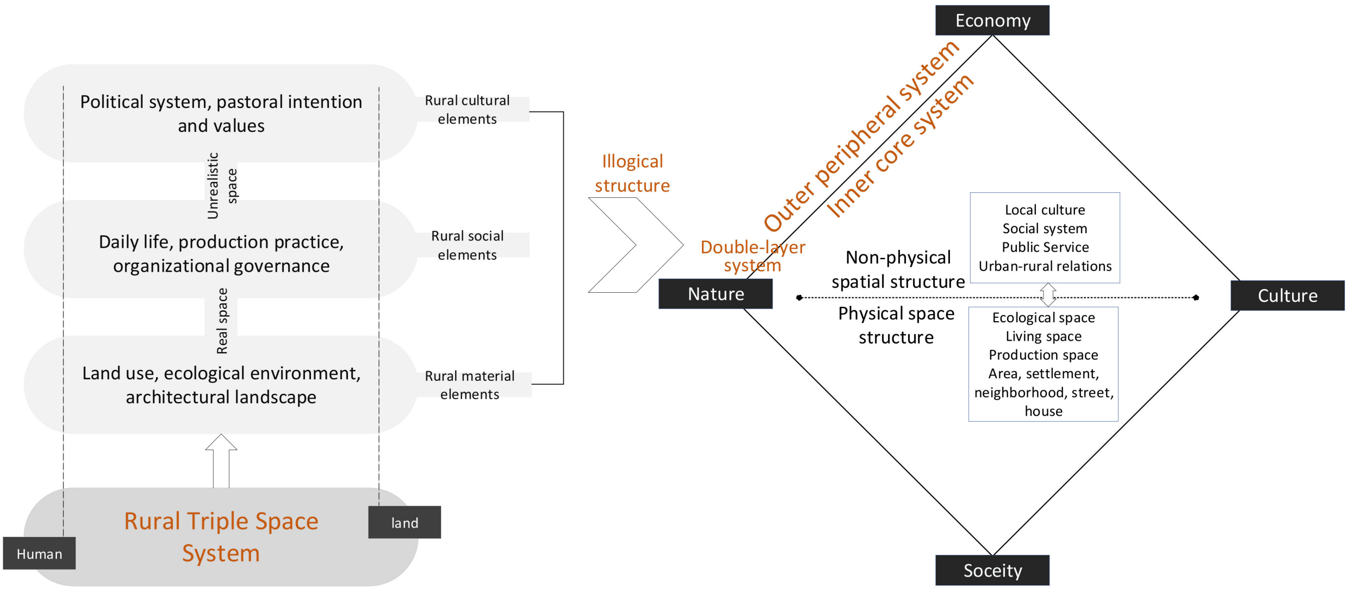


Figure 1. From three-dimensional rural space system to double-layer characteristic rural space system.

Halfacree's three-dimensional rural space system (Figure 1 left) breaks away from the limitation of material space, emphasizes the wide existence of abstract cultural and social space, and argues that there is a strict logical order among the three levels: the material space is the foundation, the social space is the practical behavior, and the system is finally manifested as cultural space. The three-dimensional space system is the evolutionary basis of the internal–external dual-core space system. In a specific period and environment, the rural organism presents the characteristics of non-general order, so its spatial structure may not be limited to the previous progressive relationship. At present, under the strong influence of material flow and information flow, the rural organism presents a spatial structure of "element–structure–function" cross-combination. The main driving factors and expression vectors of this structure are divided into two layers: the inner core system and the outer peripheral system. The main actors are divided into subject and object. The inner core system is composed of the natural, economic, social, cultural, and ecological elements of the rural organism self; the outer peripheral system is composed of national and regional environments, urban–rural relations, etc. The subject are long-resident farmers, governments at all levels, investment bodies, elites returning home, rural enterprises, etc. The objects are natural environmental elements, ecological function carriers, objective foundations for economic development, policy environment, existing social relations (network), cultural customs and heritage (Figure 2). By integrating the relevant elements into an inner core system and outer peripheral system, based on the openness of the rural regional organism, the behavioral subject promotes interactions among various subsystems in the core system and generates energy collisions with the outer peripheral system through material and information exchange. Finally, different rural organisms show developmental differences in terms of scale, industry, landscape, density, etc.; thereby, they each form an open system with specific functional structures [25].

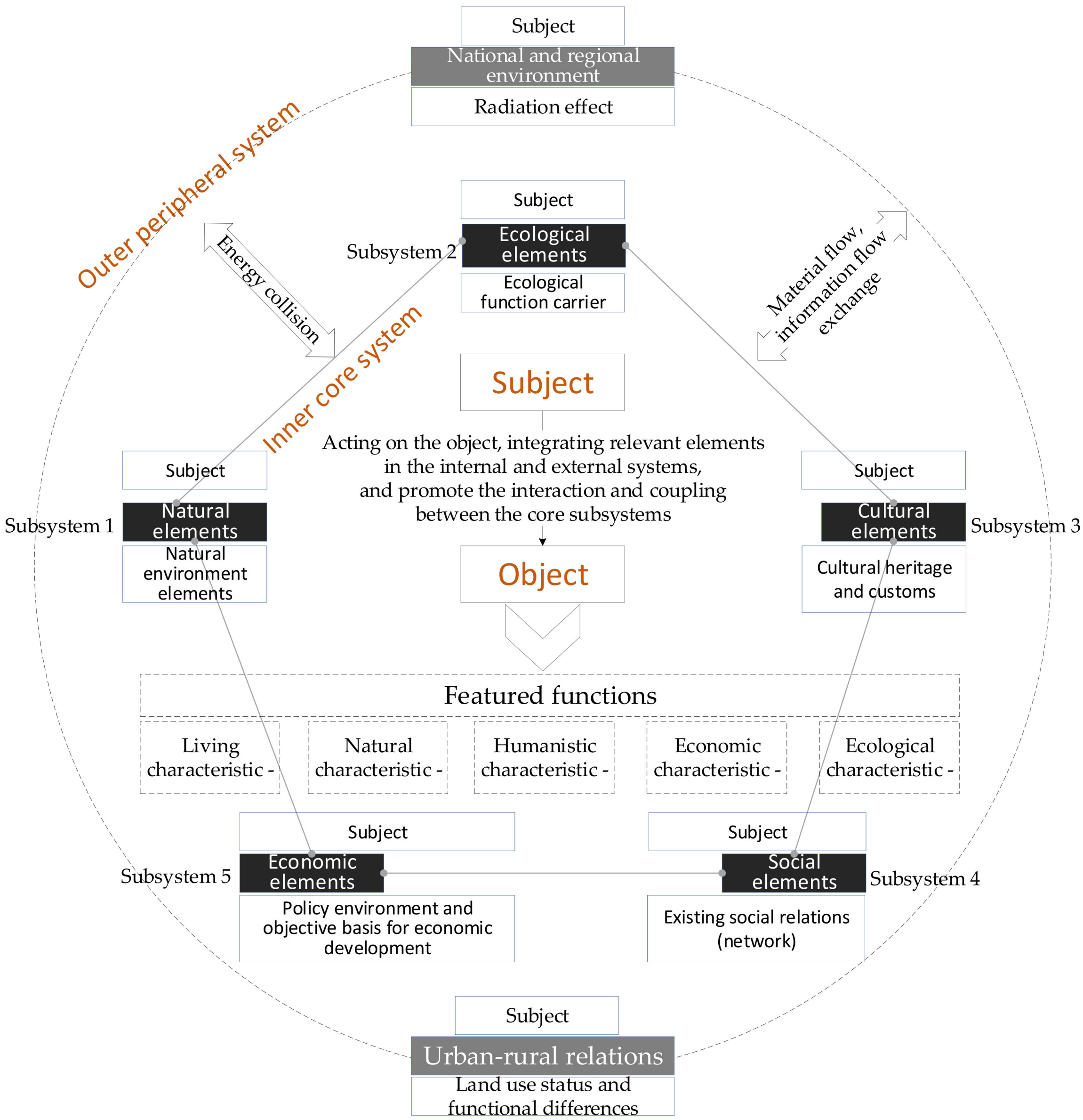


Figure 2. Elements and interactions of characteristic villages and towns.

2.2. Rural Regional Function

The complex nature of the rural organism is expressed through its multifunctional net order [26]. The multifunctional net includes multiple functions, such as production, life, economy, culture, and ecology. For Chinese rural areas in the transitional period, there is a significant coordination relationship among multiple functions, so the relative pattern of different functions is always in a dynamic process of change [27]. Rural functions are a complex of natural local functions provided by the natural ecosystem and the utilized functions given by humans due to the needs of production and life [28]. With the advancement of China's urban–rural integration, urban culture and economy continue to infiltrate the countryside. Under the influence of the external system, rural areas are in the process of industrial transformation and spatial reconstruction. At present, the goal in rural areas is to protect the ecological environment, improve economic benefits, improve quality of living, and realize the sustainable utilization of resources. Therefore, this paper evaluates the rural function from four aspects: agricultural production function, nonagricultural production function, life and leisure function, and ecological function [29]. Rural areas participate in the function division of the urban–rural integration system, as they can provide superior functional services in some aspects, such as agriculture, ecology and tourism. Superior function is the dominant function, and the benefits driven by it accumulate year by year; so, rural areas have the advantage functional niche. A niche is the position and role taken by the biological unit in the process of interaction with the environment in a specific ecosystem; it represents the physical space occupied by the biological unit and the functional role it plays [30]. A function with an advantage niche will be the direction of future development.

3. Data and Functional Measure Methods

3.1. Research Area Overview

Jixi County is a county under the jurisdiction of Xuancheng City, Anhui Province, which is in the east of China, and Jixi is located in the mountainous area of southern Anhui. Jixi has a total area of 1126 square kilometers, and governs 11 towns, 5 communities, and 76 villages, with a permanent population of 159,000 in 2019 (Figure 3). Jixi belonged to the "one prefecture and six counties" in ancient Huizhou and has profound cultural heritage. Jixi was rated as a national historical and cultural city by the State Council in 2007, and won the title of the first batch of national ecological civilization demonstration counties in September 2017. Jixi has an annual average temperature of 15.9 degrees. It belongs to the subtropical humid monsoon climate zone, with annual rainfall of 1519.3 mm. The soil is mainly yellow-red and fertile. The frost-free period is 250 days and the crop growth period is 240 days, with 2–3 crops a year. Jixi is one of the three major characteristic agricultural and forestry industry demonstration bases in Xuancheng. Jixi is part of the Wanjiang Urban Belt Demonstration Zone, which aims to undertake industrial transfer. The construction and healthy development of Jixi's rural areas not only determine the degree of urban–rural integration in the region, but also have an impact on the revitalization of Anhui's villages.

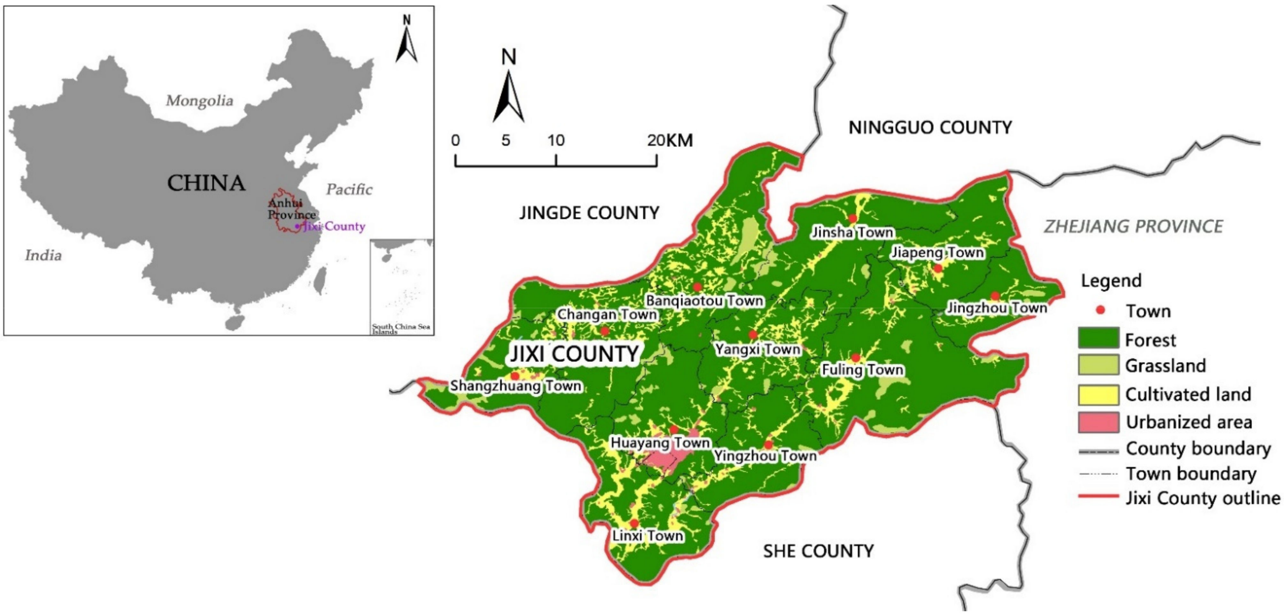


Figure 3. Divisions of administrative areas and land use in Jixi County.

The basic data used include: the sixth population census data (2010) and the second national land survey data. The yearbooks used are: *China Statistical Yearbook*, *China Regional Economic Statistical Yearbook*, *Anhui Statistical Yearbook*, and *Jixi County Statistical Yearbook*. The vector data of administrative divisions come from China's basic geographic information data. The vector data for railways and highways come from *China Railway Highway Traffic Map 2018*, and the vector data are drawn using ArcGIS 10.7 (Figure 3). Planning information comes from: *Jixi County Urban Master Plan (2005–2020)*, *Jixi Historic and Cultural City Protection Plan*, *Jixi County Land Use Master Plan (2006–2020)*, *Jixi County National Ecological*

Civilization Demonstration County Planning Revision (2020–2025), *Jixi County Rural Planning and Construction (2017–2030)*. In addition, there are survey data of 76 villages and 11 towns in Jixi County, as well as data on farmers' economic income, the types of crops planted, and the proportion of migrant workers.

3.2. Construction of Function Measurement Indicator System

(1) Function measurement indicator system

From the perspective of human–land interaction and the generation path for functions, the functions of towns are divided into production functions, life functions and ecological functions. Based on the geographical environment and human characteristics of Jixi, the production function is divided into agricultural production and nonagricultural production; the life function mainly includes cultural inheritance and residential bearing; and the ecological function is mainly based on ecological protection and landscape provision. The indicator selection adopts a combination of qualitative and quantitative methods [31]. Indicators of each function are divided into "state" indicators and "potential" indicators. Therefore, the functional evaluation value of each function is the sum of its "state" intensity index and "potential" development index. "State" is the basis for the formation of functions. Under the current policy background of urban–rural integration, "potential" constitutes the main driving force for the future development of rural areas [32].

Drawing on existing research on the classification of functions in rural area [7,33–39], and taking data availability into account, this paper constructs a function measurement system composed of four standard indicators (agricultural production, nonagricultural production, life and leisure, ecosystem services) and several descriptive indicators. Table 1 is an incomplete list for the function evaluation of a town.

Table 1. Function measurement indicator system.

Target Layer (Functional Form)	Indicator Attributes	Indicator	Indicator Explanation
Agricultural production function	State	The total agricultural output value and proportion	The total output value of agriculture, forestry, animal husbandry, and fishery reflects the level of agricultural production.
		The total area and proportion of agricultural land	Including cultivated land, garden land, forest land, and grazing land, reflecting the total resources of agricultural production space.
		The proportion of agricultural labor force	Number of people of working age and capable of agricultural work, reflecting the degree of agriculturalization of employees.
	Potential	Agricultural product original resources	Calculation of it is according to the value assignment of local agricultural production resources in the area, and it reflects the advantages of endemic varieties.
		The growth rate of agricultural total output value (average value in the past 5 years)	Reflects the development trend of agriculture.
Nonagricultural production function	State	Total industrial output value and proportion	Reflects the development level of the secondary industry.
		Total service industry output value and proportion	Reflects the development level of the tertiary industry.
		Nonagricultural employment proportion of rural employees	Reflects the degree of the nonagriculturalization of employed persons.

Table 1. *Cont.*

Target Layer (Functional Form)	Indicator Attributes	Indicator	Indicator Explanation
Nonagricultural production function	Potential	Original resources of industrial product	Calculation of it is according to the value assignment of the local nonagricultural production resources in the area, and it reflects the advantages of endemic varieties.
		Growth rate of total industrial output value (average value in the past 5 years)	Reflects the industrial development potential.
		Growth rate of total output value of the service industry (average value in the past 5 years)	Reflects the development potential of the tertiary industry.
Life and leisure function	State	Historical and cultural heritage index	Historical and cultural heritage index: $\sum H_i = N_i C_j$. N is the number of the cultural heritage of a certain level, C is the level coefficient. (level coefficients are respectively world level 0.35, national level 0.1, provincial level 0.02, city and county level 0.01, no level 0.005), reflecting the stock of historical and cultural resources.
		Landscape attractiveness index	Calculation of it is according to the value assignment of local natural landscape resources in the area, an it reflects the stock of characteristic natural and cultural resources.
		Regional population density	Population/area (square kilometers), reflecting the scale and consumption power of the town.
		Traffic advantage index	It can be found by adding both the traffic network density and the proximity of traffic facilities (refers to formula (9)).
	Potential	Tourism investment average growth rate in the past 5 years	Reflects the vitality and investment potential of the town.
		Characteristic cultural resources index	Calculation of it is according to the value assignment of the local cultural resources in the area, and it reflects the advantages of characteristic resources.
Ecological function	State	Forest cover rate	Mainly considers land types such as cultivated land, garden land, forest land, grassland, water bodies, etc., reflecting the basic level of ecological security.
		Agricultural development volume	The weight of grain output per square kilometer of land (kg/hm^2), reflecting the level of ecological occupation
	Potential	Characteristic natural resources index	Calculation of it is according to the value assignment of the local ecological resources in the area, and it reflects the advantages of regional resources.
		Characteristic ecological agriculture index	Calculation of it is according to the value assignment of the local ecological agricultural production resources in the area, and it reflects the advantages of ecological economy (refers to formula (8)).

1. Agricultural Production Function

Agricultural production is the original foundation for the existence of rural areas, and has the functions of ensuring food security, ensuring employment, ecological leisure, and generating environmental effects. The "state" indicators are the total agricultural output value and proportion, the total area and proportion of agricultural land, and the proportion of agricultural labor force. The "potential" indicators are agricultural product original resources and the growth rate of the agricultural total output value (average value in the past 5 years).

2. Nonagricultural Production Function

Nonagricultural production focuses more on production than agriculture. Especially in the stage of urban–rural integration and rural transformation, the vitality of nonagricultural production can better represent the development potential of a town. According to rural land-use data and field surveys, "state" indicators are the total industrial output value and proportion, the total service industry output value and proportion, and the nonagricultural employment proportion of rural employees. "State" indicators are original resources of industrial product, the growth rate of the total industrial output value (average value in the past five years), and the growth rate of the total output value of the service industry (average value in the past five years).

3. Life and Leisure Function

Life and leisure services are the ancient functions of rural areas and still play an important role in stabilizing rural vitality. In particular, the integration of urban and rural areas has made the realization of the coordinated development of producing and living an important direction in rural areas. Based on unique and profound cultural resources, life and leisure services mainly consider the suitability of living, residents' income, and the level of service industry. The "state" indicators are the historical and cultural heritage index, the landscape attractiveness index, regional population density, transportation network density, and facility proximity. "Potential" indicators are the tourism investment average growth rate in the past five years and the characteristic natural–cultural resources index.

4. Ecological Function

Ecological function is determined according to the ecological importance of towns. The "state" indicator is the total value of ecosystem services. The "potential" indicator is the characteristic indices of natural resource and ecological agriculture. Ecological functions should reflect biodiversity, landscape cultural services, agricultural organicity, and conservation agriculture.

(2) Standardization of Function Measurement Index

Due to the different dimensions of functional measurement indices, and the numerical differences among the indices, to enable direct comparison among the indices, various indices must be standardized. The extreme value method is used to standardize the index data to eliminate the difference in dimensions [40], and finally the values are within a range of (0, 1) with consistent polarity. For single-factor qualitative indices, discrete algebraic values are assigned according to the quality level. The indicators used in this article are all single-factor indices, so this study used min max standardization to process the data $x_1, x_2, x_3, \ldots, x_n$.

$$y_i = \frac{x_i - \underset{1 \le j \le n}{min} \{x_j\}}{\underset{1 \le j \le n}{max} \{x_j\} - \underset{1 \le j \le n}{min} \{x_j\}} \tag{1}$$

The new sequence $y_1, y_2, y_3, \ldots, y_n \in [0,1]$ is dimensionless; max is the maximum value of the sample data, and min is the minimum value. One drawback of this method is that adding new data may lead to changes in the max and min; thus, they need to be redefined.

(3) Weight of Function Evaluation Index In this paper, the index weight adopts a combination of subjective and objective weighting methods. For each function, its total

weight is 1, with "state" and "potential" each accounting for 0.5. The weight of each specific index was determined by the entropy method. The determination of the entropy method was divided into four steps:

1. First, calculate the initial standardized value a'_{ij} of the data, mainly to eliminate the dimensional influence, and make the standardized value greater than or equal to 0. The indicators in this study are all positive indicators, so the calculation formula is:
$$a'_{ij} = \frac{a_{ij} - mina_{ij}}{maxa_{ij} - mina_{ij}} \quad (2)$$
In this formula, a'_{ij}, a_{ij}, $mina_{ij}$ and $maxa_{ij}$, respectively, represent the initial standard value, actual value, minimum value, and maximum value of the $j -$ th index in the $i -$ th function of the town.
2. Second, calculate the integrated standardized value P_{ij}, so that the standardized value is between 0 and 1.
3. Third, calculate the information entropy value E_j of the j index.
$$E_j = -(\ln m)^{-1} \sum_{i=1}^{m} p_{ij} \ln p_{ij} \quad (3)$$
In this formula, m is the number of research samples. In the calculation, if $p_{ij} = 0$, in order to make $\ln p_{ij}$ meaningful, attach a minimum value to it (the article takes 0.0000001).
4. Fourth, calculate the objective weight w_j of the indicator.
$$w_j = \frac{1 - E_j}{n - \sum_{j=1}^{n} E_j} \quad (4)$$
In this formula, w_j is the weight of index j, and n is the number of indicators of the function. The weight of each functional indicator in this study area refers to Table 2.

Table 2. Function measurement indicator system.

Target Layer (Functional Form)	Indicator Attributes	Indicator	Weight
Agricultural production function (AF)	State	The total agricultural output value and proportion	0.1821
		The total area and proportion of agricultural land	0.1698
		The proportion of agricultural labor force	0.1481
	Potential	Agricultural product original resources	0.3642
		The growth rate of agricultural total output value	0.1358
Nonagricultural production function (NF)	State	Total industrial output value and proportion	0.1297
		Total service industry output value and proportion	0.2234
		Nonagricultural employment proportion of rural employees	0.1469
	Potential	Original resources of industrial product	0.3471
		Growth rate of total industrial output value	0.1209
		Growth rate of total output value of the service industry	0.0320

Table 2. *Cont.*

Target Layer (Functional Form)	Indicator Attributes	Indicator	Weight
Life and leisure function (LF)	State	Historical and cultural heritage index	0.2041
		Landscape attractiveness index	0.1412
		Regional population density	0.1136
		Traffic advantage index	0.0411
	Potential	Tourism investment average growth rate	0.1105
		Characteristic cultural resources index	0.3895
Ecological function (EF)	State	Forest cover rate	0.3000
		Agricultural development volume	0.2000
	Potential	Characteristic natural resources index	0.2500
		Characteristic ecological agriculture index	0.2500

3.3. Functional Calculation and Analysis Model

(1) Single Function Calculation

The calculation formula for each function is as follows. The sum value of the "state" indicators is as follows:

$$I_{IFS} = \sum_{j=1}^{n} X'_{ij} w_j \tag{5}$$

The sum value of the "potential" indicators is as follows:

$$I_{DFP} = \sum_{f=1}^{k} Y'_{if} w_f \tag{6}$$

So,

$$S_i = I_{IFS} + I_{DFP} = \sum_{j=1}^{n} X'_{ij} w_j + \sum_{f=1}^{k} Y'_{if} w_f \tag{7}$$

Among them, I_{IFS} represents the "state" intensity index of a certain single function in a town, and I_{DFP} represents the "potential" development index. S_i represents the value of the $i-$ th function in a town; X'_{ij} denotes the j indicator in "state" of the $i-$ th function; w_j represents the weight of j indicator; and n is the number of "state" indicators. Y'_{if} denotes the f indicator in the "potential" of the $i-$ th function; w_f represents the weight of f indicator; and k is the number of "potential" indicators.

Each function can be represented by several indicators, and the value of each indicator can be solved by the function corresponding to the indicator. A certain indicator function of a certain town can be expressed either by material quantity or value quantity. For example:

1. The index function of characteristic ecological agriculture in a town can be expressed as:

$$A_f = \sum_{i=1}^{n} S_i V_i P_{wi} \tag{8}$$

In the formula, A_f is the value of characteristic ecological agriculture; S_i is the area of the i-th type of ecological agriculture; V_i is the unit average increase in the $i-$ th ecological agriculture in the past 5 years (m^2 or kg); and P_{wi} is the unit value of the $i-$ th ecological agriculture (Yuan/m^2 or Yuan/kg)

2. The traffic network density and transportation facility proximity can be expressed as:

$$T_f = D_i + E_i = \sum_{i=1}^{4} \frac{L_i}{R_i} + \sum_{i=1}^{3} E'_{ij} \omega_j \tag{9}$$

In the formula, T_f is the degree of traffic advantage; D_i is the density of a town's traffic network; and E_i is the proximity of traffic facilities. L_i is the total length of a certain traffic network; R_i is the land area of the town administrative area; and there are four types of traffic networks: railway, national road, provincial road, and county road. E'_{ij} is the proximity value of a town with a certain traffic facility j, and ω_j is the weight. There are three types of transportation facilities: ordinary railway station, high-speed railway station, and highway station. Similarly, for any function indicator of a town, the corresponding measurement can be constructed and fitted. All the identified functions constitute the town functions group, which is used to measure the functions of the town.

(2) Determination of High-Value Function

Among the four types of rural functions, high-value function is the one with a high evaluation value, and it reflects regional characteristics and development needs, so it plays a decisive role in the development of towns. Therefore, high-value function has a higher "state" intensity index and "potential" development index. In the identification of high-value function, a 4-quadrant analysis model was used. The horizontal axis was the "state" intensity index, and the vertical axis was the "potential" development index, with 0.25 as the midpoint for distinguishing whether the index was high or low. The plane coordinate system was divided into four areas: "high-state strong-potential area", "low-state strong-potential area", "low-state inferior-potential area", and "high-state inferior potential area". This article proposes that the function entering the "high-state strong-potential area" has the possibility to be a high-value function, and whether the function is high-valued is an important basis for judging whether it is the dominant function (Figure 4).

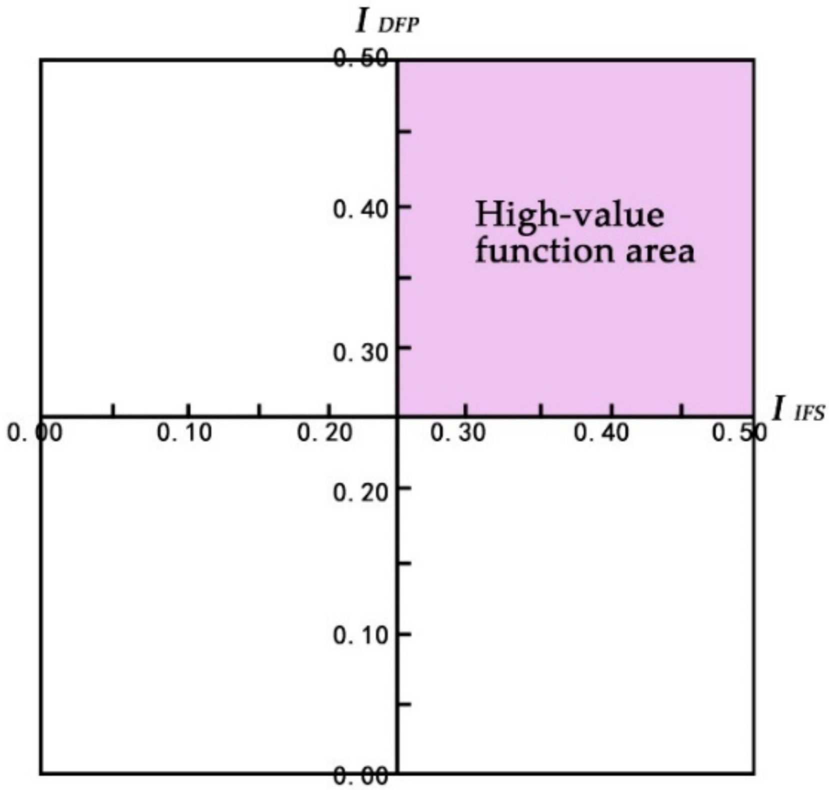


Figure 4. A 4-quadrant analysis model for high-value function.

(3) Analysis of the Interaction between High-Value Functions

As an organism, there are considerable interactions among different functions in a town. For towns with two or more high-value functions, the final dominant function will be determined by the analysis of the interaction among/between different high-value functions [41].

Using Arcgis10.2 to visualize the functions of towns [42], in the spatial visualization result of the four functions, it could be seen that there was a certain interaction between the functions. The interaction between functions referred to the impact of one function on others, including conflict, collaboration and compatibility [43]. Conflict refers to a competitive relationship between two functions, where one is reduced and another grows; collaboration refers to mutual enhancement between two functions; compatibility refers to the existence of two functions at the same time that do not weaken or enhance each other. This paper used Spearman's rank correlation coefficient to quantitatively describe the interaction between rural functions. According to the interaction between high-value functions, the dominant function of a town was determined.

(4) Identification of Main Factors Affecting Dominant Functions The classification of characteristic villages needed further identification of the factors influencing the dominant functions of the town, and to quantitatively analyze the influence degree and intensity of different influencing factors on different dominant functions. This paper comprehensively coordinated the impact factors on various functions, and finally selected several impact factors to analyze the dominant functional mechanism of the regional unit.

1. Moran's I index was used to analyze the local spatial correlation, aiming to reveal the spatial dependence, spatial correlation or spatial autocorrelation between the data related to geographic location, and, finally, to establish the statistical relationship between the data through the spatial location [44]. The local Moran's I index was defined as:

$$I_i = \frac{\mathrm{n}(x_i - \overline{x})\sum_j w_{ij}(x_j - \overline{x})}{\sum_i (x_i - \overline{x})^2} = \frac{\mathrm{n}z_i \sum_j w_{ij} z_j}{z^T z} = z_i' \sum_j w_{ij} z_j' \tag{10}$$

In the above formula, I is the Moran index, which is often used to measure the degree of spatial difference between the regional unit i and other surrounding units. The value of I is usually between -1 and 1. When the value is less than 0, the two units are negatively correlated, and the smaller the value is, the higher the correlation is. When the value is 0, the two units are not correlated. When the value is more than 0, the two units are positive correlated and, the larger the value is, the greater the correlation is. Moran index calculation can analyze the correlation between specific functions and impact factors in regional units. x_i is the value of a certain function of the $i-$ th unit, and x_j is the value of a certain function of the $j-$ th. z_i is the function value deviation of i from its average value $(x_i - \overline{x})$, and w_{ij} is the spatial weight between elements i and j. n is the number of units. $Z(I_i)$ was calculated in the following way:

$$Z(I_i) = \frac{I_i - E(I_i)}{\sqrt{V(I_i)}} \tag{11}$$

$$E(I_i) = -1/(n-1) \tag{12}$$

$$V(I_i) = E\left(I_i^2\right) - E(I_i)^2 \tag{13}$$

2. From the spatial visualization level, the Moran scatter diagram can further distinguish the functional correlation between a specific research unit and its neighboring units. The Moran scatter plot is generally used to study the instability of local space, and its four quadrants correspond to the four functional connection forms between the research unit and its adjacent units. The first quadrant represents the spatial connection form that the unit with a high observed value is surrounded by the same high-value units. The second quadrant

represents the spatial connection form that the unit with a low observed value is surrounded by high-value units. The third quadrant represents the spatial connection form that the unit with a low observed value is surrounded by the same units. The fourth quadrant represents the spatial connection form that the unit with a high observed value is surrounded by low-value units.

3. In addition to the Moran scatter diagram, the Local Indicators of Spatial Association (LISA) index clearly shows the correlation of each spatial unit through images. If the Moran scatter diagram is a qualitative description of the correlation between the spatial units, the LISA cluster diagram is a quantitative understanding of the relationship degree between the spatial units. For scattered points in the same quadrant, the difference between them may be very large, and Moran cannot reveal this difference—that is, the significance of spatial autocorrelation. Therefore, it is necessary to use LISA to further analyze the degree of correlation between the research units. By combining Moran's four-quadrant scatter diagram with the LISA significance level, we can obtain a Moran significance level map.
4. Next, we dealt with local autocorrelation and factors. By taking a specific value, the Moran's I index between the function type and the influencing factors can be obtained, and the influencing factors with the largest positive correlation and the largest negative correlation can be judged. Combined with the dominant function and the influencing factor LISA cluster diagram, the main factors that affect the corresponding function can be determined.

3.4. Decision Tree of Village Type Identification

The decision tree judgment method is as follows: (1) Towns have multiple functions for the measurement of multiple functions and the judgment of dominant functions; the function group method must be obtained. (2) The decision tree method can be used to express the process of how to zone the dominant function, and the high-value function must be determined in the zoning process. (3) After determining the dominant function, the main factors affecting the dominant function need to be further identified. (4) Finally, for the characteristic type of a specific village, the dominant function of the town should be coupled with the characteristic resources of the specific village [45]. The following four factors need to be considered in the coupling process: (1) the "state" value and "potential" value of the dominant function; (2) the LISA cluster map of function and influencing factors; (3) the effect of the positioning of the county/city relative to the town on social, natural and economic functions; and (4) the sensitivity of the village to resources, policies, and the environment. The above four factors are included in the evaluation of the characteristic type of any village. A complete decision tree method involves three parts: selecting the dominant function according to the function calculation value, forming several different functional advantage areas in space, and then determining the characteristic village type according to the total characteristic resources of the village and other production capacity performances (Figure 5).

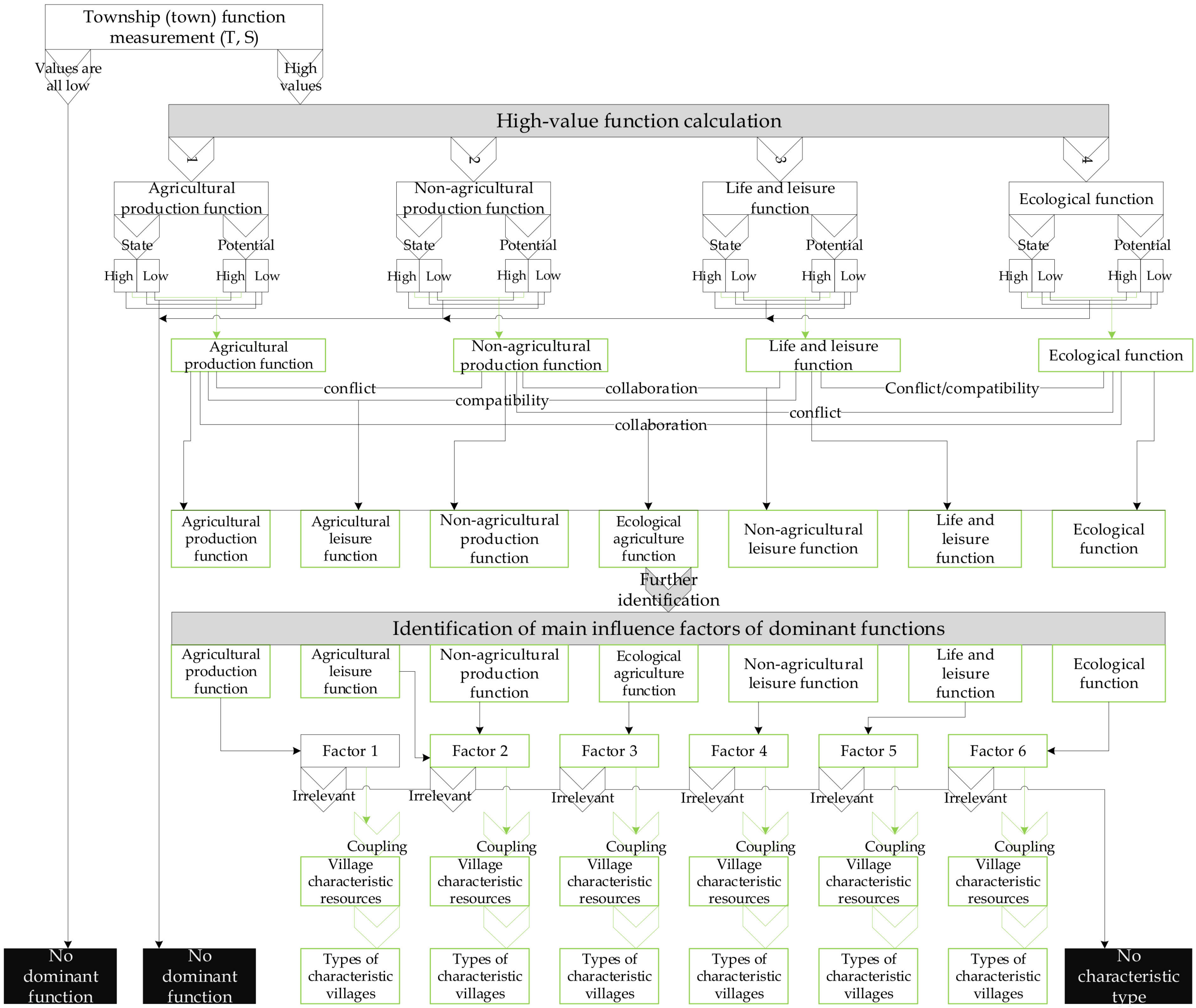


Figure 5. Decision tree for the identification of the village type.

4. Results

4.1. Single Function Calculation

(1) Calculation Result

According to the aforementioned data processing method, the weight of each functional index based on the study area is listed in Table 2.

The value of individual functions and ranking of 11 towns in Jixi County are as follows (Table 3):

A single function with value greater than 0.5 will be the comparative advantage function. So, according to Table 2, it can be seen that each function has a comparative advantage in several towns. There are four towns with a comparative advantage in agricultural production functions, six for life and leisure, five for ecosystem services, and four for nonagricultural production. This result is consistent with the main function positioning of Jixi in the Wanjiang Economic Belt. Each town basically has one or two high-value functions; it shows the diversified development pattern of the Jixi rural area.

Table 3. Calculation results of individual functions.

Function	Agricultural Production Function (AF)		Nonagricultural Production Function (NF)		Life and Leisure Function (LF)		Ecological Function (EF)	
	S1	**Order**	**S2**	**Order**	**S3**	**Order**	**S4**	**Order**
Huayang Town	0.0970	11	0.6842	1	0.5219	6	0.1033	11
	State	0.0509	State	0.2904	State	0.2993	State	0.0709
	Potential	0.0461	Potential	0.3938	Potential	0.2226	Potential	0.0324
Chang'an Town	0.5435	4	0.3884	6	0.5659	5	0.2883	9
	State	0.2515	State	0.2013	State	0.3082	State	0.2239
	Potential	0.2910	Potential	0.1871	Potential	0.2577	Potential	0.0644
Fuling Town	0.1978	10	0.4412	5	0.7018	2	0.6733	3
	State	0.1357	State	0.2309	State	0.4092	State	0.3771
	Potential	0.0621	Potential	0.2103	Potential	0.2926	Potential	0.2692
Shangzhuang Town	0.2880	9	0.2843	8	0.6814	3	0.3091	8
	State	0.1802	State	0.1603	State	0.3977	State	0.2031
	Potential	0.1078	Potential	0.1240	Potential	0.3837	Potential	0.1060
Yangxi Town	0.6821	1	0.5407	3	0.4108	8	0.3621	7
	State	0.3093	State	0.2772	State	0.2471	State	0.1987
	Potential	0.3728	Potential	0.2635	Potential	0.1637	Potential	0.1634
Linxi Town	0.3799	7	0.6509	2	0.6413	4	0.2224	10
	State	0.2307	State	0.2887	State	0.3349	State	0.1405
	Potential	0.1492	Potential	0.3622	Potential	0.3064	Potential	0.0819
Yingzhou Town	0.3299	8	0.1663	11	0.7885	1	0.4278	6
	State	0.2167	State	0.1034	State	0.4577	State	0.1893
	Potential	0.1132	Potential	0.0629	Potential	0.3308	Potential	0.1385
Jinsha Town	0.3940	6	0.5012	4	0.3261	9	0.5699	4
	State	0.2279	State	0.2709	State	0.1805	State	0.2509
	Potential	0.1661	Potential	0.2203	Potential	0.1456	Potential	0.3190
Banqiaotou Town	0.6206	2	0.3307	7	0.1991	10	0.5494	5
	State	0.2992	State	0.1892	State	0.1167	State	0.2781
	Potential	0.3214	Potential	0.1415	Potential	0.0824	Potential	0.2613
Jiapeng Town	0.5809	3	0.2092	9	0.4686	7	0.7859	2
	State	0.3236	State	0.1293	State	0.2784	State	0.4256
	Potential	0.2583	Potential	0.0799	Potential	0.1902	Potential	0.3603
Jingzhou Town	0.4603	5	0.1865	10	0.1894	11	0.8437	1
	State	0.2496	State	0.1108	State	0.1109	State	0.4738
	Potential	0.2107	Potential	0.0757	Potential	0.0885	Potential	0.3699

(2) Spatial Pattern and Evaluation of Single Function

Through ArcGIS 10.2, the four functions are visualized in space. Relying on the differentiation of natural units, by using the Natural Breakpoint Classification (NBC) method, the four functions of agricultural production, nonagricultural production, life and leisure, and ecosystem services are defined from low to high, as low, medium, higher, and highest (Figures 6–9). A function with an index of more than 0.5 is the highest, while that with less than 0.2 is low.

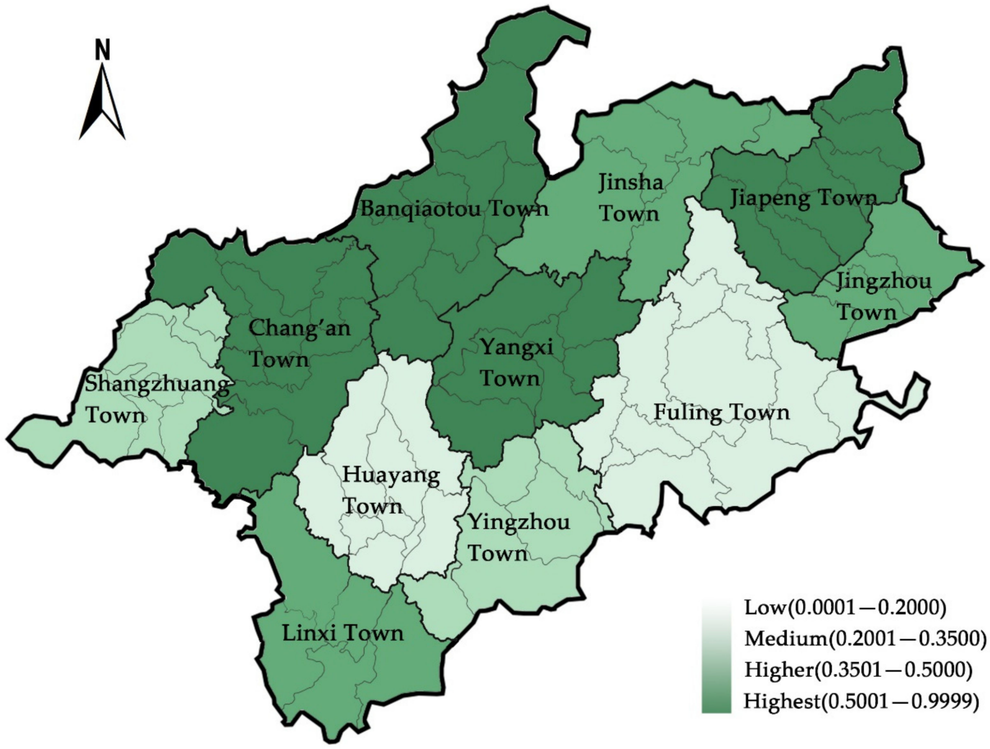


Figure 6. Spatial pattern of the agricultural production function in 11 towns in Jixi.

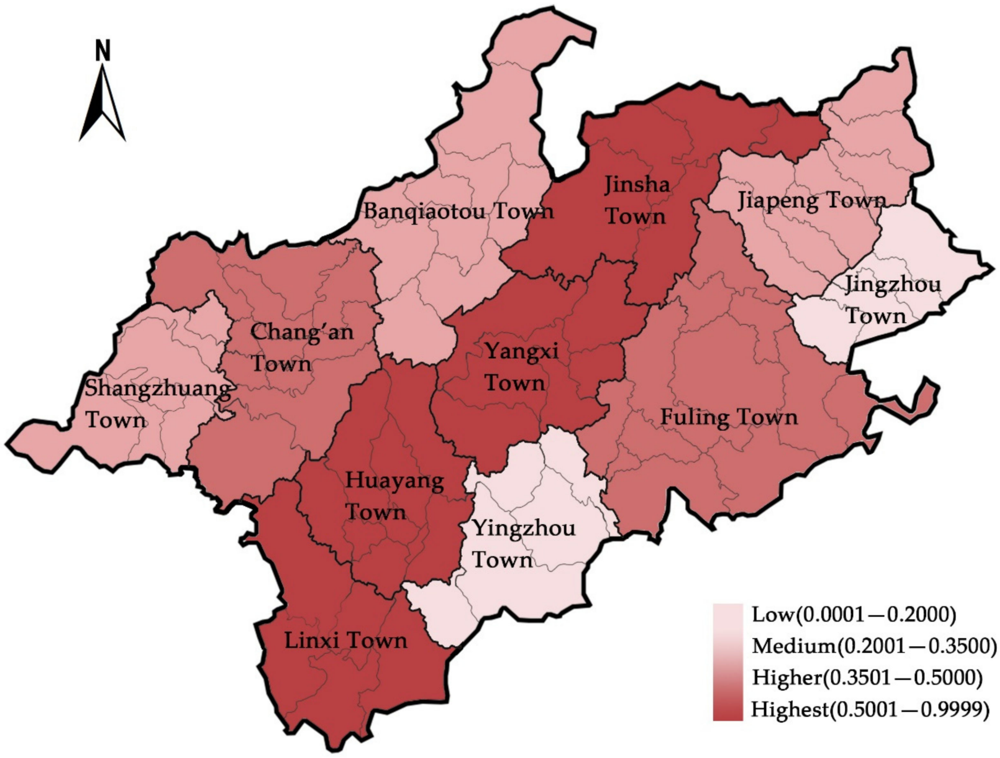


Figure 7. Spatial pattern of the nonagricultural production function in 11 towns in Jixi.

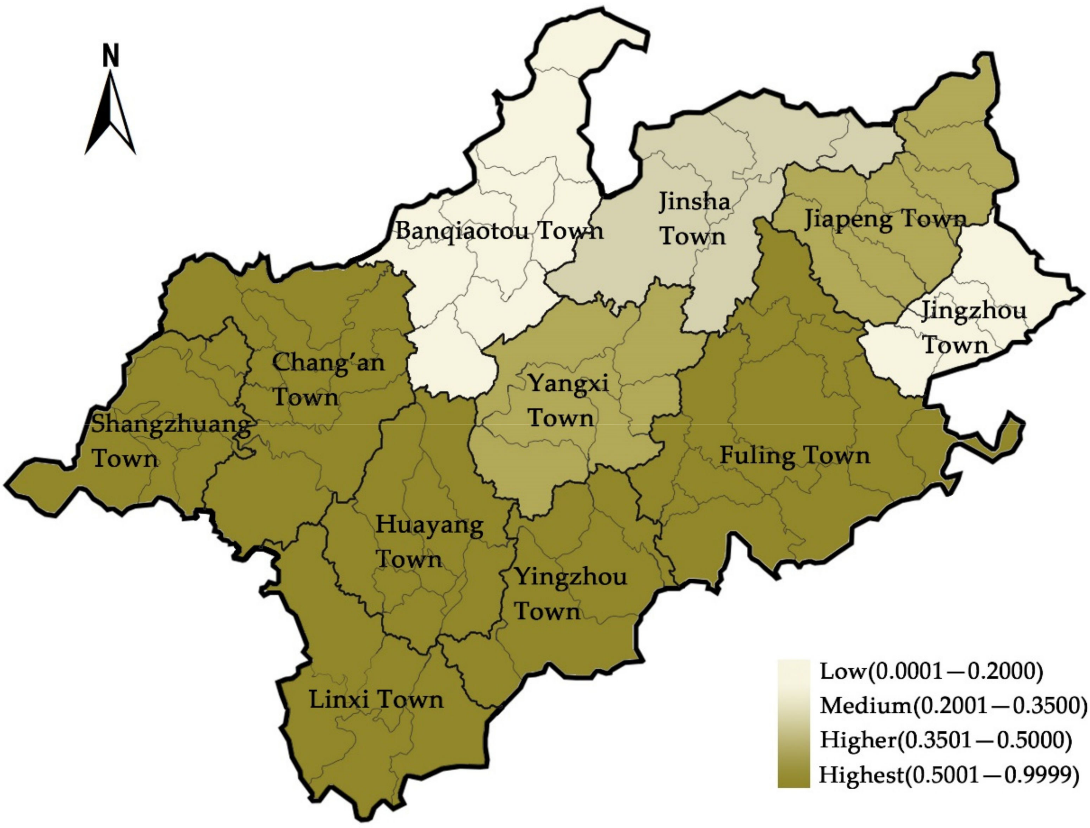


Figure 8. Spatial pattern of the life and leisure function in 11 towns in Jixi.

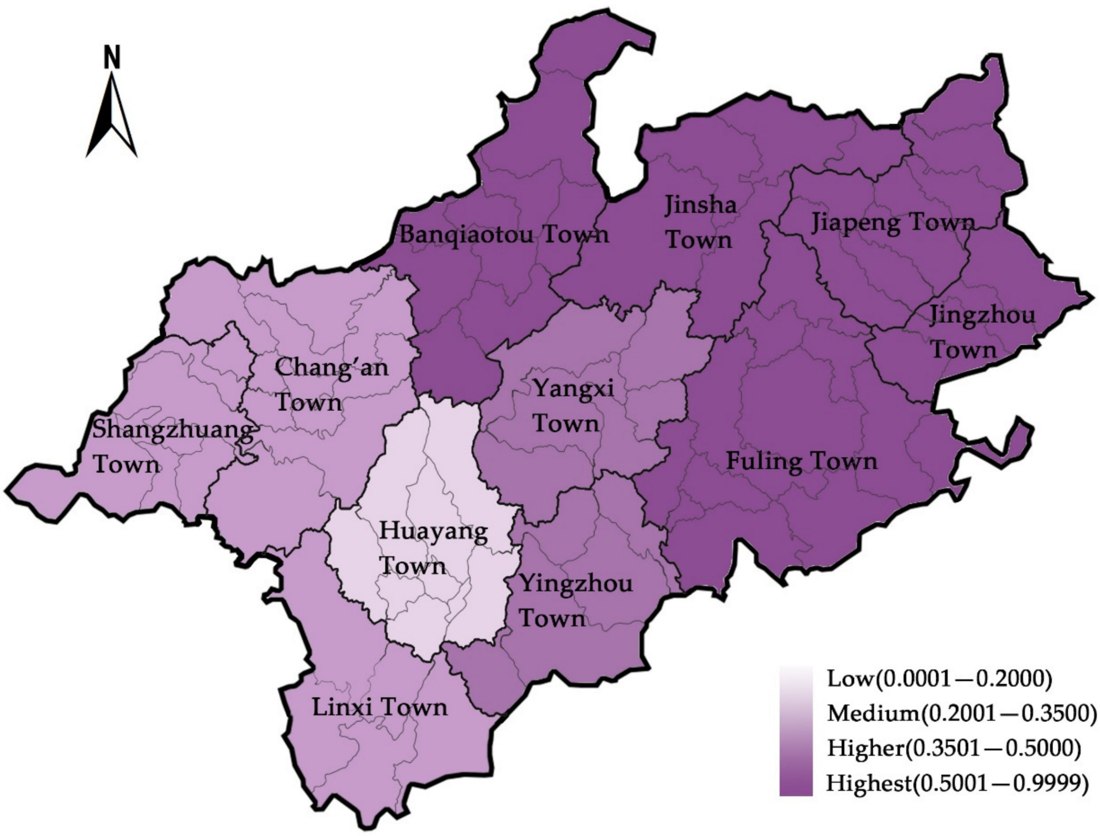


Figure 9. Spatial pattern of the ecological function in 11 towns in Jixi.

From functions visualized in space, it can be seen that the comparative advantage function presents an obvious concentrated distribution in space. Comparative advantage areas for agricultural production functions are located in the northern part of the county; comparative advantage areas for nonagricultural production functions are located in the southwest of the county; comparative advantage areas for life and leisure functions are located in the northwest and southeast of the county; and comparative advantage areas for ecological function are located in the northeast of the county.

4.2. Identification of Dominant Function

(1) Assessment of high-value function

According to the aforementioned four-quadrant function assessment method, if both the "state" and "potential" values are more than 0.25, the function will have a high value. For the four-quadrant evaluation results of 11 towns, refer to Figure 10.

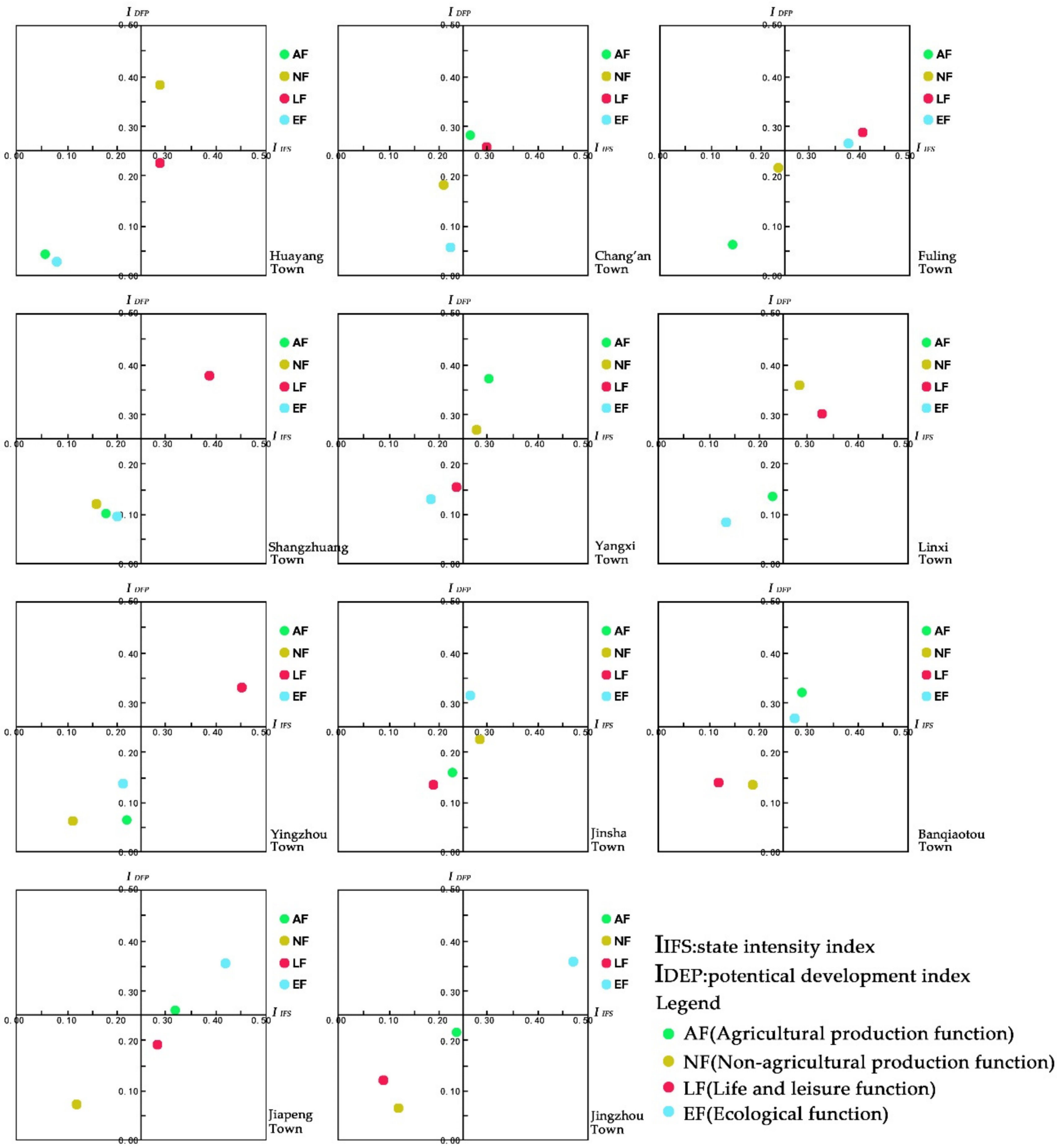


Figure 10. Four-quadrant evaluation results of 11 towns.

The high-value functions of the 11 towns in Jixi are shown in Table 4:

Table 4. Towns with high-value functions.

Types of High-Value Functions Type	Towns
Agricultural production function	Yangxi Town, Banqiaotou Town, Jiapeng Town, Chang'an Town
Nonagricultural production function	Huayang Town, Linxi Town, Yangxi Town
Life and leisure function	Yingzhou Town, Fuling Town, Shangzhuang Town, Linxi Town, Chang'an Town
Ecological function	Jingzhou Town, Jiapeng Town, Fuling Town, Jinsha Town, Banqiaotou Town

There are five towns with two or more high-value functions; they are relatively comprehensive towns, accounting for 45.45% of the total spatial units in the demonstration area. Comprehensiveness is reflected in the balanced development of agricultural production and ecological functions, balanced leisure and ecological functions, and balanced nonagricultural production and leisure functions. Comprehensive towns include Jinsha Town, Banqiaotou Town, Chang'an Town, Linxi Town, and Shangzhuang Town. These five research units all have two high-value functions. Jinsha Town and Banqiaotou Town are densely wooded, rich in ecological resources, and have a high level of development of under-forest industries. They belong to ecological function areas, so their ecological levels and agricultural production levels have high-value. The two regional units of Linxi Town and Shangzhuang Town are rich in cultural resources and have a relatively high level of development in leisure tourism, so their nonagricultural production and leisure are high-valued. Chang'an Town is rich in cultural resources, has a high level of development in terms of tourism and leisure agriculture, and its agricultural production and leisure are high-valued.

There are six towns with only one high-value function, accounting for 54.55% of the regional units in the demonstration area. These regional units have a clear functional orientation, and include Yangxi Town, Huayang Town, Yingzhou Town, Fuling Town, Jingzhou Town, and Jiapeng Town. They are mainly distributed on both sides of Dahui Mountain and Dazhang Mountain Gorge, forming a modern industrial gathering area, a characteristic agricultural production gathering area, a northern ecological conservation district, and a cultural leisure tourism district. Modern industrial industries mainly include: mechanical processing, modern logistics, e-commerce, food processing, and other industrial clusters, showing a strong tendency towards industrialization. Characteristic agricultural production mainly includes under-forest economy, the breeding industry, cash crops, etc.

(2) Interaction analysis between high-value functions

According to the calculation results for Spearman's correlation coefficient between regional functions, there is correlation between multiple pairs of regional functions. The minimum value of the correlation coefficient is 0.080 and the maximum value is 0.407 (Table 5).

There is a significant negative correlation between agricultural production and nonagricultural production functions, with a correlation coefficient of −0.407. Driven by urban–rural integration, nonagricultural production (heavy industry, light industry) has developed rapidly in rural areas, and nonagricultural construction land, production land, etc., have gradually occupied agricultural land. Farmers' lifestyle of living on agricultural production has gradually changed, and a large number of original agricultural populations have turned to nonagricultural production, which limits the structural stability of agricultural production personnel. At the same time, the red line of arable land and ecological protection requirements limit the expansion of nonagricultural production land, thereby restricting the development of nonagricultural production. Therefore, these reasons have created conflicting effects between agricultural production and nonagricultural production function.

Table 5. Spearman correlation coefficient between different functions in Jixi County. (* reprensts generally significant; ** reprensts extremely significant).

		Agricultural Production Function	Nonagricultural Production Function	Life and Leisure Function	Ecological Function
Agricultural production function	Correlation coefficient	1	−0.290 *	−0.080	0.299 *
	Significance (bilateral)	-	0.018	0.427	0.016
Nonagricultural production function	Correlation coefficient	−0.290 *	1	0.202	−0.407 **
	Significance (bilateral)	0.018	-	0.03	0.008
Life and leisure function	Correlation coefficient	−0.080	0.202	1	−0.094
	Significance (bilateral)	0.427	0.03	-	0.01
Ecological function	Correlation coefficient	0.299 *	−0.407 **	−0.094	1
	Significance (bilateral)	0.016	0.008	0.01	-

Agricultural production and leisure have a very small negative correlation, with a coefficient of −0.080. Leisure agriculture occupies a large proportion of the agricultural structure in Jixi. Leisure agriculture makes full use of the local cultural heritage and folk customs, and shows pleasant pastoral scenery and original ecological farming culture, forming rich tourism resources and producing tourism effects. Therefore, it forms the compatible effect of the agricultural production and leisure functions.

There is a general positive correlation between agricultural production and ecological function, with a correlation coefficient of 0.299. Jixi's landform has many hills and ravines, having less cultivated land but higher requirements for ecological protection. Therefore, agricultural production is mostly combined with ecological protection, and Jixi mainly develops under-forest economy. Generally speaking, the larger the biomass is, the stronger the ecological function is. As a result, it forms a collaborated effect between agriculture and ecology.

There is a general positive correlation between nonagricultural production and life and leisure, with a correlation coefficient of 0.202. This shows that nonagricultural production function has a positive synergy effect on life and leisure functions. This result is reflected in the intersection of the spatial pattern in Figures 7 and 8. Nonagricultural production is mostly in urban areas with dense populations, more residential land, and higher living functions. In addition, county towns have many cultural heritages and rich landscape resources; therefore, there is a collaborative effect between nonagricultural production and leisure functions.

There is a significant negative correlation between nonagricultural production and ecological function, with a correlation coefficient of −0.290. Areas with highest nonagricultural production function are Huayang Town and Linxi Town, where industrial distribution is dense, land development intensity is higher, human activities are stronger, and non-ecological uses of the land account for a large proportion of usage, so ecological functions and other functions are relatively weak. This creates conflicting effect between nonagricultural production and ecological functions.

There is a general negative correlation between leisure and ecological functions, with a coefficient of −0.094. Life and leisure require a large amount of construction land, which seriously threatens ecological security. In addition, Jixi has complex geology and a fragile ecology, so excessive life and leisure activities will cause pollution and damage to the ecological environment, resulting in ecological crisis. Therefore, there is conflict between leisure and ecological functions.

According to the interaction calculation result between the functions, the interaction type is obtained (Table 6).

Table 6. Interaction type between functions.

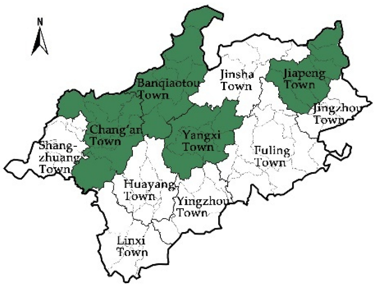
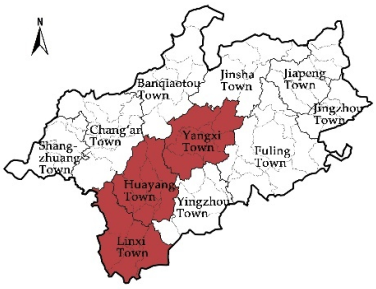
Functions	Interaction Type	Functions	Interaction Type
Agricultural production function—nonagricultural production function	Conflict	Agricultural production function—life and leisure function	Compatibility
Agricultural production function—ecological function	Collaboration	Nonagricultural production function—life and leisure function	Collaboration
Nonagricultural production function—ecological function	Conflict	Life and leisure function—ecological function	Conflict

(3) Criteria for Determining Dominant Functions

1. Function evaluation is the basis for determining the dominant function. For a town with only one function entering into "high-state strong potential area", its dominant function is determined according to the high-value function. For a town with more than two functions entering the "high-state strong potential area", its dominant function should be determined by integrating the needs of the town, the interactions between functions, and the comparative advantage of functions. For towns that do not have a function in the "high-state strong potential area", dominant functions are determined according to the resource conditions, development needs, direction of macro policies, and trend of social development [46].
2. Comparative advantage is an important support in the identification of dominant function. Only by relying on regional differences and comparative advantages can the dominant function form a unique competitive advantage and sustainable development momentum in the future development of towns [47]. There are three main criteria for the definition of comparative advantage: industrial development capacity, sustainable utilization of resources, and comprehensive quality of human settlements in towns. This means that the town can make full use of its characteristic resources for sustainable industrial development and effectively improve the comprehensive quality of human residential environment at the same time.
3. Upper-level planning determines the basic direction of the dominant function at the macro level. Therefore, the dominant function of a town should be in line with the county's overall planning, the main functional zoning of provinces and cities, and the overall planning among the provinces. Only from the perspective of the macro pattern—by considering the specific social, economic and cultural background of the town from the external system—can its dominant functions be accurately determined.

From the above calculation results, it can be seen that all the towns in Jixi have at least one function entering the "high-state strong potential area", so it is only necessary to comprehensively weigh the interaction between the different functions and the actual development environment in a town. The distribution rules and the influencing factors of "high-state strong potential area" are shown in Table 7, and they have a direct effect on determining the dominant function of a specific town.

Table 7. Visualization on the distribution of "high-state strong potential area" of town function.

Function Type	High-State Strong Potential Area	Influencing Factors of High Values	Type of Interaction with Other Functions
Agricultural production function		Terrain slope is small or moderate, suitable for planting, sufficient water source, good light, and less affected by urban development.	Significantly negatively correlated with nonagricultural production, showing a conflict effect. Taking into account the fact that Jixi's characteristic ecological agriculture is relatively developed, agricultural production is coordinated with life- leisure and ecosystem services
Nonagricultural production function		Location advantage, radiated by city expansion, transportation advantage, policy advantage, ecosystem stability.	Significantly negatively correlated with agricultural production and ecosystem services, showing conflict effects with it. Compatible with leisure.
Life and leisure function		Good industrial foundation, location advantage, profound cultural heritage, complete village layout and spatial structure.	Significantly negatively correlated with ecosystem services, showing conflicting effects with it. Synergy with agricultural production. Compatible with nonagricultural production.
Ecological function		High forest coverage, many natural scenic spots, obvious topographic features.	Significantly negatively correlated with nonagricultural production, compatible with characteristic agricultural production and characteristic natural scenery.

(4) Dominant Functions of Each Town

Integrating the distribution of "high-state strong potential area", the interactions between functions, upper-level planning, and the external environment, the dominant functions of each town are explained below (Figure 11).

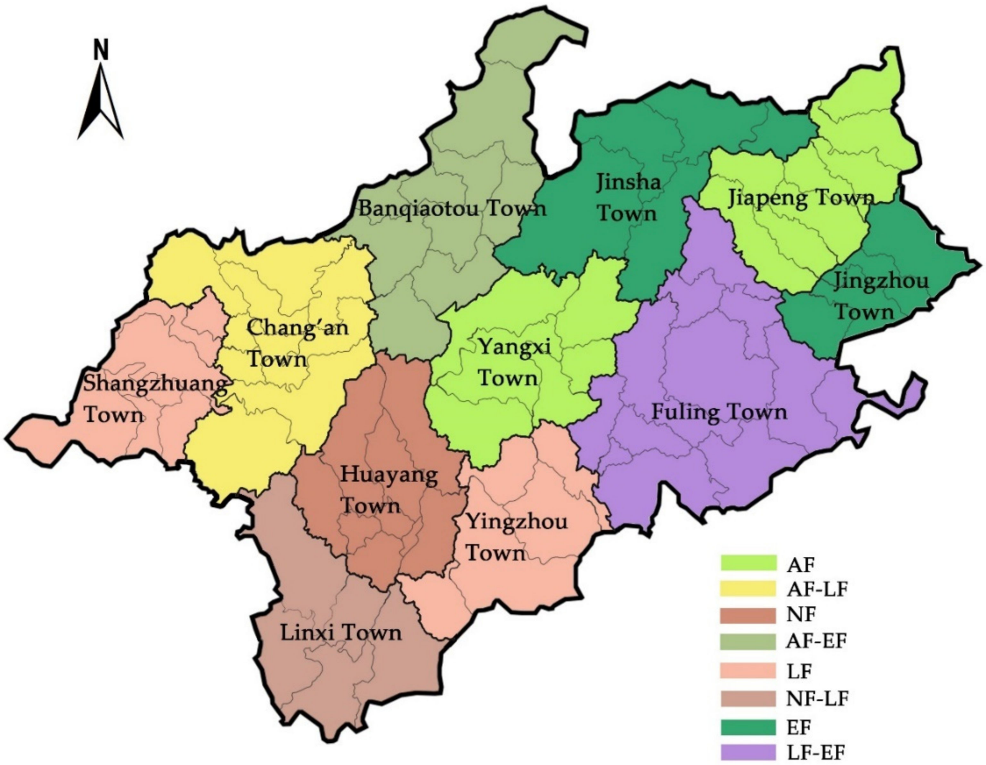


Figure 11. Dominant function of each town.

Huayang Town: nonagricultural production function. From Table 2, Figure 7, and Table 6, it can be seen that the nonagricultural production function value of Huayang Town is 0.6842, ranking first in the county. Among other functions, the leisure function stands out most. Huayang Town has the largest county high-speed railway station in China, which confers significant transportation advantages for the transportation of raw materials and products. Jixi is the main base for auto parts and mechanical processing in Xuancheng City. Huayang Town now has a high-end characteristic industrial cluster (base) of mechanical parts in Jixi County, Anhui Province. Huayang Town was named Taobao Town by the Ali Research Institute in 2019. The output value and scale of e-commerce have expanded year by year, which has established its dominant position in nonagricultural production. The old city of Huayang has a history stretching back more than 1400 years. In 2010, Huayang Town was included in China Huizhou Cultural and Ecological Protection Experimental Zone, which fully affirmed the cultural status and leisure functions of Huayang Town.

Chang'an Town: agricultural production–life and leisure function. From Table 2, Figure 6, Figure 8, and Table 6, it can be seen that the agricultural production function value of Chang'an Town is 0.5435, ranking fourth in the county. The basic farmland quantities in Chang'an Town accounts for 13.4% of the county, and Chang'an is an important camellia production base. Relying on the good natural landscape and pattern, a nicer agricultural landscape has been formed in some villages. At the same time, Chang'an Town is also the core of the Historical and Cultural Protection Area, with a complete traditional layout and structure in villages, so it has outstanding tourism services. The traffic condition in Chang'an Town is common, and the urbanization level is low, so it is less affected by industrial urbanization, which provides a natural barrier for the protection of traditional historical and cultural heritage. The simultaneous development of agricultural production and leisure in Chang'an Town shows the compatible effect of agricultural production and leisure functions.

Fuling Town: life and leisure–ecological function. Different from the general residential function that focuses on convenient living conditions, such as transportation advantage and economic development, this article focuses more on the leisure functions, such as cultural heritage, natural scenery, and cultural facilities. Fuling Town has many scenic spots, such as Huihang Ancient Road and Natural Scenery Exhibition Area, Qingliangfeng Nature Reserve, Dazhang Mountain Scenic Area, etc. It has comparative advantages in terms of natural leisure scenery that most towns do not have, so it mainly focuses on the leisure function.

Shangzhuang Town: leisure function. Shangzhuang Town is the core of the Lingbei Historical and Cultural Protection Area, and it is a key display area for the ancient villages of Lukun, Lingbei. It has a rich cultural heritage, complete traditional layout and structure of villages, and it can provide outstanding tourism services. Shangzhuang has a second-level tourist service center. Therefore, it mainly focuses on life and leisure functions.

Yangxi Town: agricultural production function. Surrounded by mountains and rivers, the soil is fertile, which is very suitable for agricultural production. Since the implementation of the "Forest Chief System", Jixi has taken advantage of its ecological advantages to develop a green economy with the improvement of forest ecological benefits. The under-forest economy is one of the important aspects in Yangxi. Yangxi Town is a production base of dual-use bamboo shoots in Jixi County, which forms the pillar industry of Yangxi Town and effectively helps villagers earn money. In 2018, the output value of bamboo shoots in Yangxi Town was as high as CNY 90 million, and the per capita income increased by more than CNY 1500. Therefore, Yangxi Town mainly focuses on the agricultural production function.

Linxi Town: nonagricultural production–life and leisure functions. Linxi Town is adjacent to Huayang Town. It enjoys the radiant function of the county, and has a higher traffic advantage and lower agricultural production and ecological functions. With its high level of urbanization, Linxi provides a good infrastructure and economy basis for life and leisure. The nonagricultural production of Linxi Town mainly comes from the tourism industry driven by cultural heritage. The nonagricultural industry creates a good economic foundation for life and leisure; the full use of life and leisure functions can also produce a certain spatial economic effect. All these factors reflect the synergistic effect of nonagricultural production and leisure.

Yingzhou Town: life and leisure function. It can be seen from Table 2, Figure 8 and Table 6 that the value of the life and leisure function of Yingzhou Town is 0.7885, ranking first in the county. Furthermore, Yingzhou Town has Longchuan National Scenic Spot.

Jinsha Town: ecological function. The vegetation types of forest ecosystem in Jinsha Town are bamboo forest, economic forest, and arbor forest.

Banqiaotou Town: agricultural production–ecological function. Banqiaotou Town is an important water–soil conservation ecological zone, and is also an ecological agricultural zone in the middle of Jixi. There is a green agricultural production base in Banqiaotou. The development of ecological agriculture will increase the effect of ecological function at the same time. The ecological function also protects the environmental atmosphere of the ecological agriculture and increases its value.

Jiapeng Town: ecological function. Jiapeng Town is an ecological conservation area in the north of Jixi. Together with Jinsha Town, it constitutes the Jiapeng–Jinsha water conservation and water–soil conservation ecological community. Its ecological function is outstanding.

Jingzhou Town: ecological function. Jingzhou Town is an ecological conservation area in the north of Jixi, which contains the Xianren Temple water conservation ecological district, and the Xiaojiuhua ecological tourism and water conservation ecological district. Its ecological function is outstanding.

4.3. Classification of Village Types

(1) Autocorrelation Analysis of Dominant Functions and Factors

1. Impact factors

The division of village types is related to dynamic factors, so the main factors that form the dominant function must be analyzed. Table 8 lists the influencing factors affecting function forming from a qualitative perspective, mainly focusing on resource allocation and environmental differences. This article adopts a quantitative method to analyze the intensity that the main influencing factors affecting on functions.

Table 8. Moran's I index between town function and various influencing factors.

Functional Categories	GDP	Traffic Superiority	Cultivated Land	Forest Coverage	Tourism Revenue	Farmer Income	Industrial Output	I-Level Eco-Scape
AF	−0.259	0.089	0.437	0.097	−0.183	−0.301	−0.261	0.156
NF	0.474	0.425	−0.216	−0.436	0.097	0.456	0.403	−0.287
LF	0.103	0.203	0.051	0.117	0.472	0.319	0.089	0.081
EF	−0.421	−0.402	0.098	0.154	−0.058	−0.342	−0.275	0.470
AF-LF	0.109	0.112	0.225	0.208	0.186	−0.095	0.105	0.128
NF-LF	0.307	0.193	−0.396	−0.267	0.201	0.246	0.093	0.091
AF-EF	−0.384	−0.277	0.267	0.191	−0.079	−0.137	−0.172	0.133
LF-EF	−0.285	0.137	0.104	0.097	0.361	0.166	−0.208	0.198

This study adopted the local correlation method in spatial autocorrelation. Based on the accuracy and difficulty of data acquisition, the influencing factors selected in this paper (Table 8) are the average GDP of a town in the most recent five years, traffic superiority, cultivated land, forest coverage, tourism revenue, net income per capita of farmers in the most recent five years, gross industrial output value, and I-level ecological function zone area.

The methods for calculating each influencing factor are as follows: (1) GDP reflects the economic development level of the unit. The data sources are the *2015–2019 Jixi County Statistical Yearbook* and the *2015–2019 Jixi County Town Government Work Report*. (2) Traffic superiority reflects traffic conditions and location levels. This paper has established a traffic superiority evaluation system for administrative villages that includes traffic network density, proximity to traffic facilities, and location dominance. The data come from the *2019 Jixi County Statistical Yearbook*. (3) The area of cultivated land reflects the level of agricultural production, and is calculated based on the 2019 Jixi Land Use Change Survey data. (4) Forest coverage reflects the level of ecological function and agricultural production, and is calculated by using the 2019 Jixi Land Use Change Survey data. (5) Tourism revenue reflects the development level of the leisure industry. The data come from the *2019 Jixi County Statistical Yearbook*. (6) Farmers' per capita net income in the past five years reflects the impact of different dominant functions on farmers' incomes. (7) The total industrial output value reflects the level of industrial development of a unit. (8) The area of the I-level ecological function zone reflects the ecological importance in the unit, and the data come from the *Jixi County Government Work Report (2015–2019)*.

2. Correlation analysis

In view of the low degree of government information at the early stage, and the poor availability of relevant statistical data, this study used data from 2015–2019 for analysis. The analysis results show that there is a more complicated relationship between the functional categories and their influencing factors, and the results are as follows (Table 8):

3. Local indicators of spatial association diagram

The multivariate LISA module of the Geoda095i software was used for statistical analysis and expressed in Moran's I index, forming a LISA cluster map (Figure A1) of the dominant functions and influencing factors.

(2) The Formation Mechanism of Different Dominant Functions

1. Formation mechanism of agricultural production function (AF)

The factor that has the strongest correlation with agricultural production function is the area of arable land, and its Moran's I index is 0.437, indicating that the amount of arable land has a direct role in promoting agricultural production. From 2006 to 2020, the area of arable land in Jixi decreased by 150.77 hectares, which indicates an ecological tendency in Jixi for agriculture. In addition, forest coverage, area of ecological function zones, and transportation advantage are also positively correlated with agricultural production. It can be seen from the LISA cluster map (Figure A1) that the agricultural production of Chang'an Town, which has a larger per capita area of arable land, has high–high clusters of agricultural production function. Banqiaotou Town, which has more forest and ecological function land, also has high–high clusters.

2. Formation mechanism of nonagricultural production function (NF)

The influencing factors of nonagricultural production functions and agricultural production functions present an opposite pattern. Nonagricultural production functions are positively correlated with GDP, transportation advantages, total tourism income, farmer per capita net income, and total industrial output. Among them, GDP and total industrial output have the highest correlation with NF. It can be seen from the LISA cluster map (Figure A1) that Huayang Town, which has convenient transportation, complete facilities, and industrial clusters, has high-high clusters of nonagricultural production.

3. Formation mechanism of life and leisure functions (LF)

Life and leisure functions are mainly affected by the total tourism income (Moran's I index is 0.472) and farmers' per capita net income. The correlation with other influencing factors is relatively low, indicating that the influencing factors of life and leisure functions are more complicated. It can be seen from the LISA cluster map (Figure A1) that there are fewer high–high clusters of life and leisure functions, but more low–low and low–high clusters. Among the positive correlation factors, the low–low clusters are mainly distributed in Banqiaotou Town, Jiapeng Town, and Jingzhou Town.

4. Formation mechanism of ecological functions (EF)

Ecological functions are sensitive functions and have relatively high correlations with most impact factors. They are negatively correlated with GDP, transportation advantages, farmers' per capita net income, and total industrial output. Industrial development and urbanization will occupy ecological and agricultural land, which results in a decline in the ecological functions of regional units. EF is positively correlated with the area of the I-level ecological function zone. It can be seen from the LISA cluster map (Figure A1) that the high–high clusters of ecological functions are in the northeast of the county, which is densely forested.

5. Formation mechanism of agriculture–leisure function (AF–LF)

The influencing factors of agriculture–leisure function are more complex and include almost all the elements, so the correlation with the influencing factors is not significant. The three factors with a higher correlation are cultivated land area, forest coverage area, and total tourism revenue. It can be seen from the LISA cluster map (Figure A1) that the high–high clusters of agriculture–leisure functions are in Chang'an Town, where tourism and agriculture are more developed.

6. Formation mechanism of nonagricultural–leisure function (NF–AF)

Nonagricultural–leisure functions mainly refer to the modern functions of rural areas, so, compared with the influencing factors of AF, NF–AF presents an opposite pattern. It can be seen from the LISA cluster map (Figure A1) that the high–high clusters of nonagricultural and leisure functions are in Linxi Town, where industry and cultural tourism are more developed.

7. Formation mechanism of agricultural–ecological functions (AF–EF)

Agricultural–ecological functions have a high correlation with GDP, transportation advantages, and cultivated land area, but a low correlation with other factors. It can be seen from the LISA cluster map (Figure A1) that the high–high clusters of agricultural-ecological functions are in Banqiaotou Town.

8. Formation mechanism of leisure and ecological function (LF–EF)

Ecological leisure requires the coexistence of a good infrastructure environment and ecological resources. It can be seen from the LISA cluster map (Figure A1) that the high-high clusters of life and leisure–ecological functions are in Fuling Town.

(3) Classification of characteristic villages

Among the measures proposed by the Chinese government to establish a "five-level three-category" Spatial Planning of National Land (Opinions of the CPC Central Committee and the State Council on establishing and supervising the implementation of the Spatial Planning of National Land. Available online: http://www.gov.cn/zhengce/2019-05/23/content_5394187.htm (accessed on 23 May 2019)), town planning belongs to the last level and focuses on implementation, while the village is non-planned and detailed. In the current large-scale rural revitalization and urban–rural integration development practice in China, village planning focuses more on regional adaptability and characteristics, so the village should be a practical carrier with sufficient operability. After determining the dominant function and the main influencing factors of towns, performing the characteristic classification of villages from a functional perspective is an important prerequisite for ensuring the implementation of the national *Main Functional Area Strategy*. The classification of villages can improve the competitiveness of villages effectively, and mobilize the enthusiasm of villagers to participate in rural construction.

Competitiveness stems from ontological elements, functional structure, and political environment [48]. In a town, spatial pattern determined by the dominant function—characteristic resources of the village are the main driving force for shaping the characteristic type and competitiveness [49]. The characteristic resources of the village help the rural regional system win higher scores in dominant functions. Characteristic resources mainly refer to natural ecological resources, agricultural production resources, tourism landscape resources, historical and cultural resources, and industrial production resources. The coupling result of characteristic resources with the main influencing factors of functions is the classification of characteristic villages.

In a village with a good human–land relationship operation environment, the essence of coupling is to dig deeper into the potential energy of characteristic resources, fully grasp the tolerance and stability threshold of characteristic resources, and, finally, to realize the optimal energy-efficient allocation of resources. The binding force in the coupling process mainly includes urban–rural relations, economic bases, and environmental policies (Figure 12). The spatial pattern of coupling is a characteristic mode of production, and it is also a resource expression of village spatial order. According to the characteristic resources of Jixi County and the coupling process, the types of characteristic village are classified as follows (Table 9).

The expression of the spatial pattern of nine characteristic villages in Jixi County is shown in Figure 13. According to the dominant function of the town, the division of the spatial pattern at the village level is helpful for a more precise and suitable assessment and classification of rural land. Villages are divided into types, and their development is divided into types. For example, the characteristic villages of industrial production should follow the concept of integration of primary, secondary, and tertiary industries, based on rural space, cultivating leading industries, strengthening the village economy, and building rural communities that are livable and professional. For large-scale villages with agricultural or ecological landscapes, it is necessary to improve infrastructure and public service facilities as the prerequisite, and focus on integrating land resources, developing characteristic industries, and improving living conditions to build central rural communities. Therefore, whether a village achieves differentiated development according to its foundation, ability, or level has become a landmark indicator to measure the effectiveness and quality of rural revitalization.

Table 9. Classification of characteristic villages.

Dominant Function of Town	Characteristic Resources Coupled	Types of Characteristic Villages
Agricultural production function	Agricultural production resources	Agricultural production characteristics
Nonagricultural production function	Industrial production resources	Industrial production characteristics
Life and leisure function	Historical and cultural resources	Settlement landscape characteristics
	Natural ecological resources	Natural landscape characteristics
Ecological—leisure function		
Ecological function	Natural ecological resources	Ecological characteristics
Ecological–agricultural production function	Ecological agricultural resources	Ecological agriculture characteristics
Agricultural production–leisure function	Agricultural landscape resources	Agricultural landscape characteristics
Nonagricultural production–leisure function	Local cultural resources	Local and folk custom characteristics
	Technology information resources	New industrial characteristics

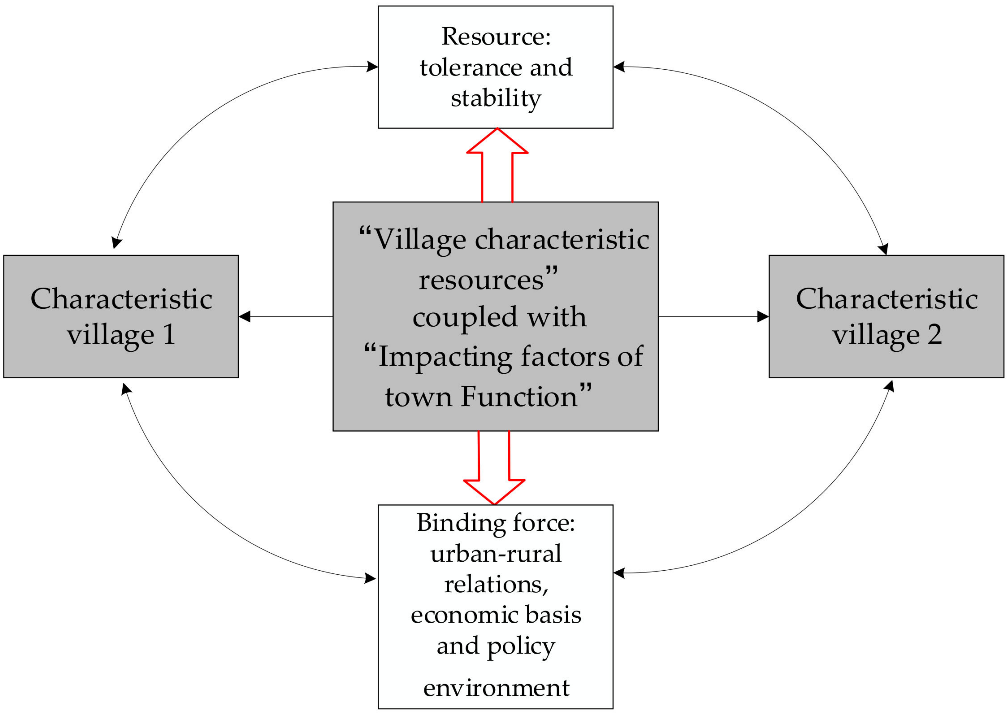


Figure 12. Coupling process of "village characteristic resources" with "impacting factors of town function".

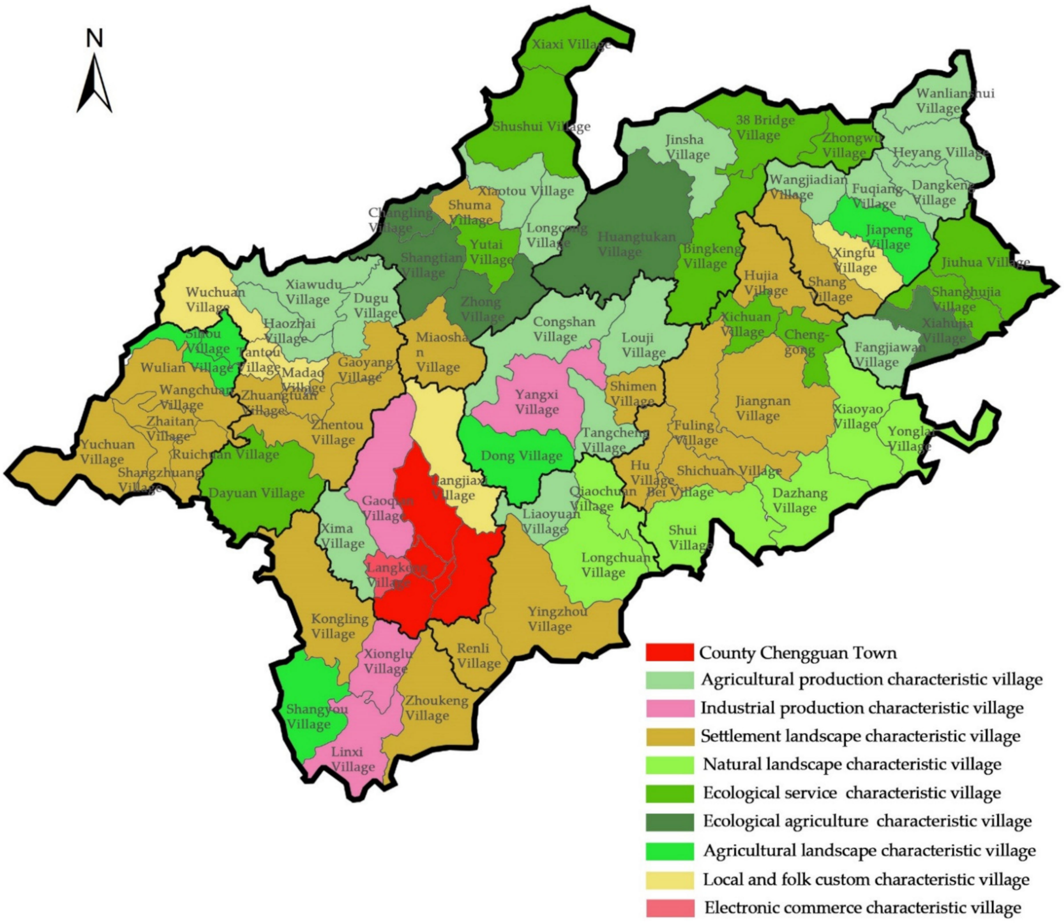


Figure 13. Spatial pattern map of characteristic village types.

5. Discussion

China's large-scale urbanization in the past 40 years has caused drastic turbulence and changes in the rural sociocultural structure and economic environment. Most villages are facing poverty and decline. In the process of economic globalization and rapid urbanization, the question of how to solve increasingly serious rural problems has become an important topic of global sustainable development. From the perspective of the diversification of rural regional functions, this paper provides guidance for the regulation of rural functions through the evaluation of rural functions and the study of regional differences. The result can promote rational division in the urban–rural integration system, and provide a scientific basis for the implementation of the Rural Revitalization Strategy and rural sustainable development.

At present, there are many studies on rural function, but the existing studies mainly focus on rural function classification and evaluation [20,50–53] and rarely introduce methods for measuring regional differences in rural function; as such, it is difficult to reveal the reasons behind rural regional differences. From the perspective of rural organism theory and regional difference measurement, this study extends the previous studies by using an evaluation model and GIS to measure and evaluate rural functions in south Anhui Province, China, and using Spearman's correlation coefficient and Moran's I index to analyze the interaction, spatial difference, and influencing factors between rural functions. Not only are the types of rural function divided, but the mechanisms leading to the difference are analyzed. After exploring the spatial differentiation law of regional functions, this paper provides a scientific basis for perfecting the spatial layout of rural functions, and improves the study logicality of rural function.

In addition, the research scale on rural function tends to be meso and macro (regional, provincial, municipal, etc.) [41,43,45], and less from the micro level (town, village). The lack of current micro-level studies has led to a gap in theories at the implementation level, such as the determination of village characteristics and development direction. On the meso–micro scale of town and village, this paper extends the previous studies by demonstrating division of the spatial pattern at the village level, which points out the most likely development paths of specific villages in the future. The micro level study has theoretical value for the refined understanding of versatility in rural area, and also has important practical significance for policy formulation and investment planning during the transition period.

6. Conclusions

(1) At the county level, the spatial differences and agglomeration characteristics of rural regional functions are significant in Jixi. The highest-value and higher-value areas of agricultural production are concentrated in the canyons between Dahui Mountain and Dazhang Mountain in the northeast of the county, which shows an obvious centralized distribution trend. The nonagricultural production function has an extremely high spatial accumulation, and there is a trend of decreasing outward from the county center to the surroundings. The highest-value and higher-value areas of life and leisure function are mainly concentrated in the southwest of the county, adjacent to the central area of the county. The highest-value and higher-value areas of ecological function are mainly concentrated in the north of Huiling Mountain and Dazhang Mountains.

(2) Combining the evaluation results of rural functions, the characteristics of functional differences, the interaction between functions, and the actual needs of town development, this paper divided the rural area in Jixi into eight functions: agricultural production function, agricultural production–life and leisure function, nonagricultural production function, agricultural production–ecological function, life and leisure function, nonagricultural production–life and leisure function, ecological function, and life and leisure–ecological function. According to the dominant functions of different towns, this paper puts forward some development suggestions for south Anhui Province, China, so as to promote rural transformation and urban–rural integration development.

(3) The difference of rural functions in the county is obvious. At the county level, considering the classification of characteristic villages, we can see that the differences within towns > between towns, which indicates that the overall differences in rural functions mainly come from differences within towns. From the contribution rate in function level, the contribution rate of difference in agricultural production function is east > west > middle, the contribution rate of difference in nonagricultural production function is west > east > middle, the contribution rate of difference in life and leisure function is east > west > middle, and the contribution rate of difference in ecological function is east > west > middle. This result indicates that the function difference in the west and east of the county has the greatest impact on regional differences, while the function difference in the middle has the least impact on regional differences.

(4) With the deepening implementation of urbanization and rural modernization in China, in addition to the four basic functions mentioned in this paper, there are still new functions emerging, and the indicator system needs to be improved further. Further research should also focus on how characteristic villages can enhance their competitiveness.

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

Appendix A

LISA cluster map of regional functions and influencing factors in Jixi 11 towns (Section 4.3) is now supplied.

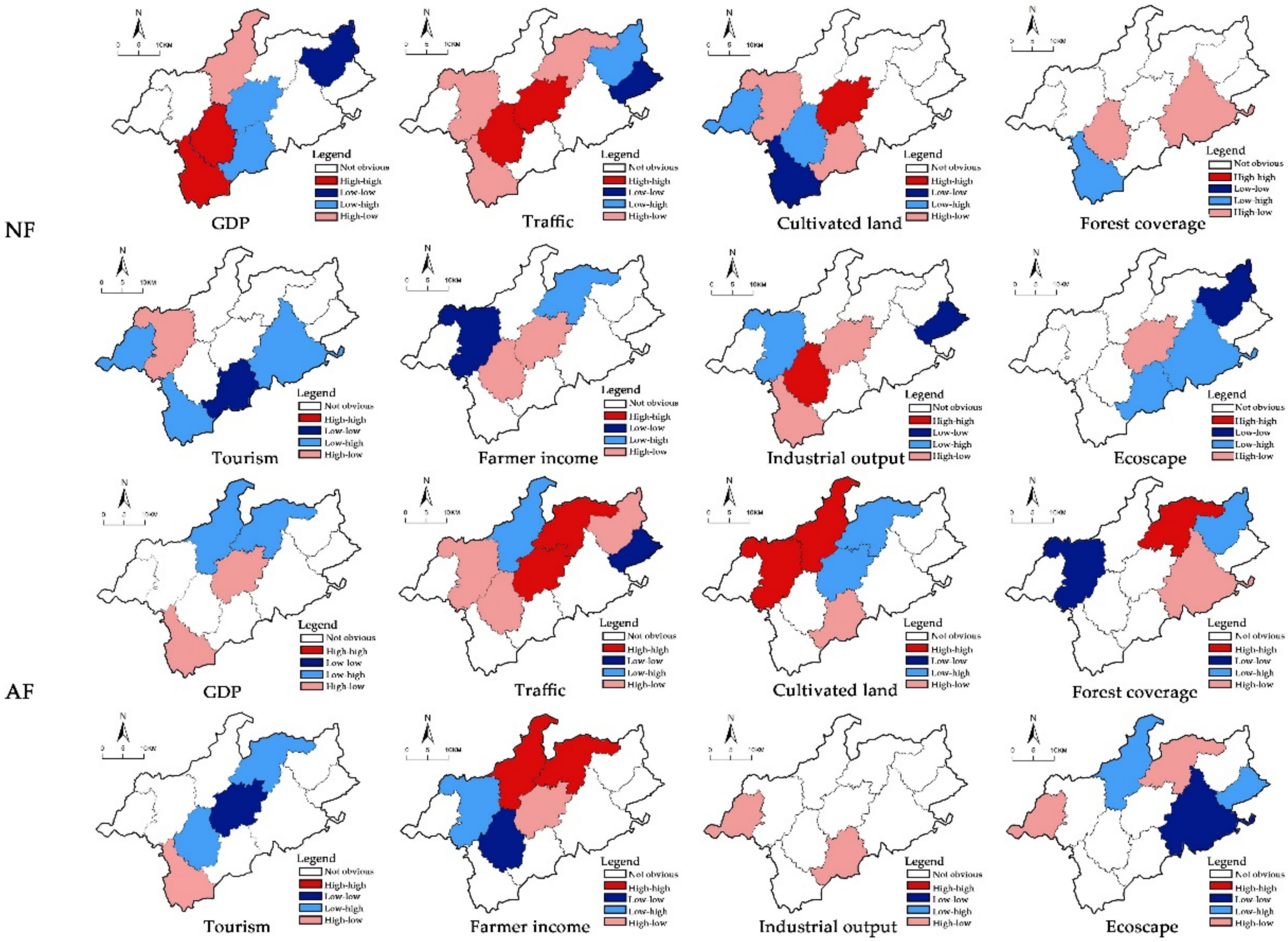

Figure A1. *Cont.*

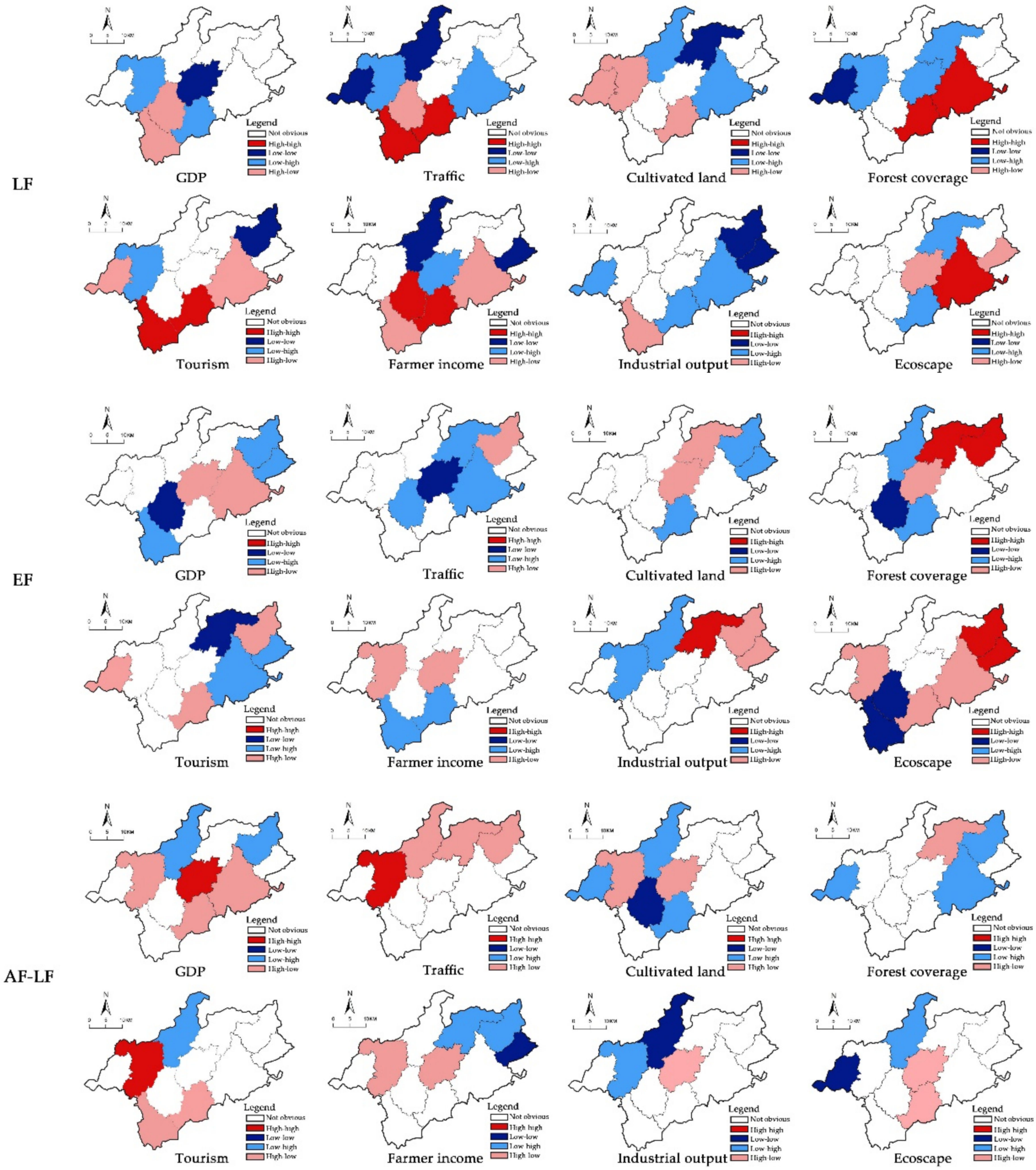

Figure A1. *Cont.*

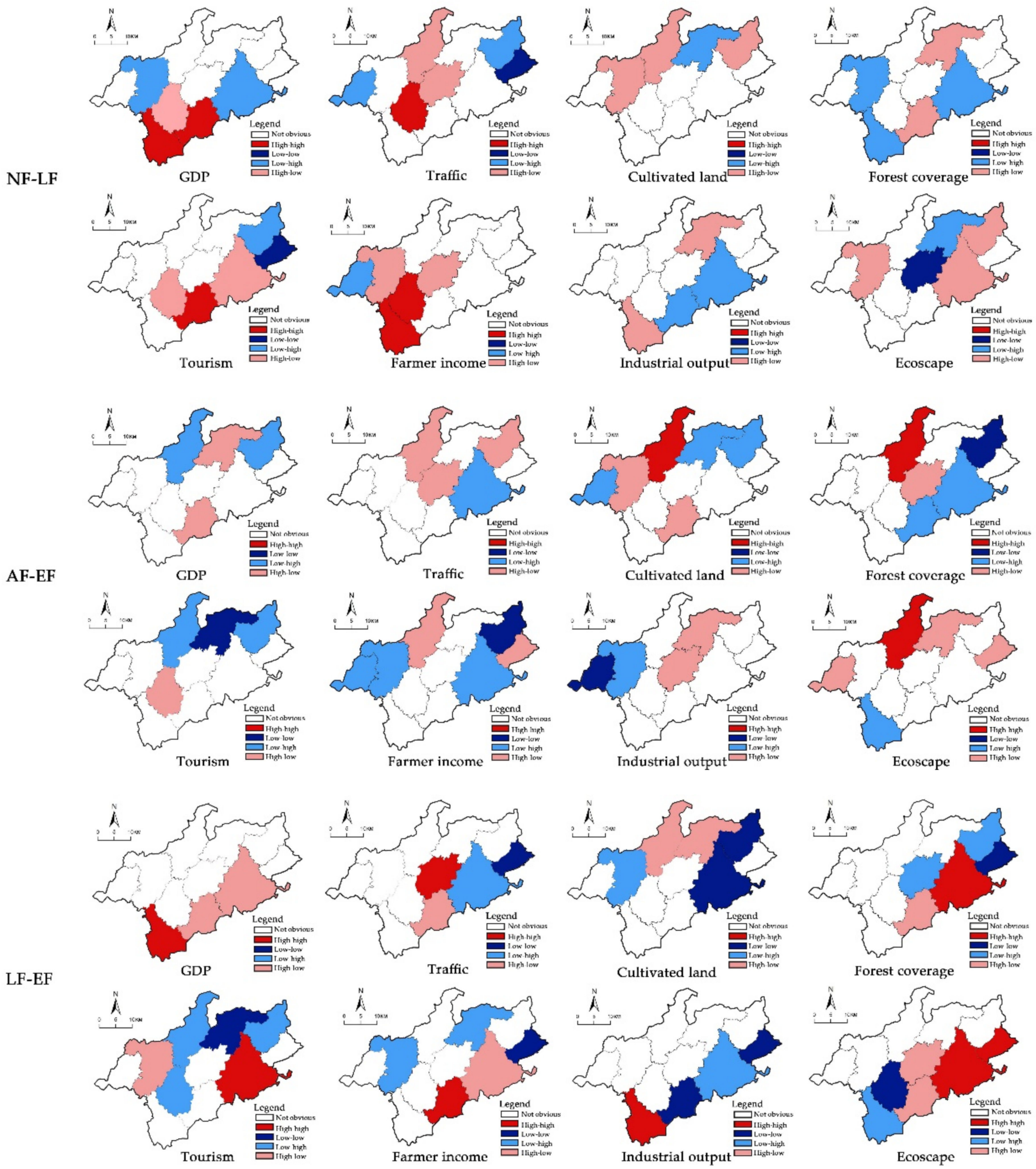

Figure A1. Cluster map of regional functions and influencing factors in 11 towns in Jixi County.

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