Study on the Coupling and Coordination between Rural Revitalization and Rural Tourism in Xiangxi Autonomous Prefecture, Hunan Province based on the Entropy Method

Ying Liu

School of Tourism, Shandong Women's University, Jinan, Shandong, China

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Abstract: Based on the importance of the coupling relationship between rural revitalization and rural tourism to the harmonious and orderly development of the rural system, this paper takes Xiangxi Tujia (Miao) Autonomous Prefecture as the research object, constructs the evaluation index system of rural revitalization and rural tourism respectively. Use entropy method to determine the index weight. The data of 2018 is used to measure their comprehensive score, coordination degree, development degree, and coupling coordination degree. The coupling between the two systems and their spatial distribution characteristics are investigated, with a view to providing an empirical basis for the development of rural revitalization and rural tourism in Xiangxi. The results show that rural revitalization and rural tourism in Xiangxi Prefecture are at a high stage of coupling, and the two systems are closely related. The comprehensive score indexes and development degree of rural revitalization and rural tourism in the whole prefecture are in the low to medium development stage, and the coupling coordination degree is in the medium to high development stage, but the development of each aspect is uneven. In view of this, Xiangxi Prefecture should focus on exploring the coordination mechanism between the two, and adjust the development focus according to the shortcomings of each county and city.

1 INTRODUCTION

The report delivered at the 19th National Congress of the Communist Party of China proposed the rural revitalization strategy and set the general goal of "building rural areas with thriving businesses, pleasant living environments, social etiquette and civility, effective governance, and prosperity", which points out the direction for solving the "issues relating to agriculture, rural areas, and rural people" in the new era and facilitating building a moderately prosperous society in all respects. In 2019, the Central Committee of the Communist Party of China and the State Council issued the *Strategic Plan for Rural Revitalization (2018-2022)*, which pointed out that the improvement of village infrastructure and public environment should be accelerated, the village's characteristic resources should be rationally utilized, and rural tourism and characteristic industries should be developed; leisure agriculture and rural tourism boutique projects should be implemented, and new businesses such as rural sharing economy should be cultivated[1].

Coupling was originally proposed as a physical concept, mainly used to describe the phenomenon of interaction and mutual influence between two or more systems through the connection of element exchange and internal mechanism. The coupling coordination analysis of rural revitalization and rural tourism mainly refers to the interaction mechanism and coupling degree between the two systems of rural revitalization and rural tourism. At present, academic circles have paid attention to the relationship between rural revitalization and rural tourism, and have discussed them from the theoretical and empirical levels.

To sum up, the coupling relationship between rural revitalization and rural tourism plays an important role in the entire system of "agriculture, rural areas, and rural people". The effective coupling and coordinated development of the two systems of

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[1]http://www.gov.cn/zhengce/2018-09/26/content_5325534.htm

rural revitalization and rural tourism are conducive to the development of the entire agricultural and rural system and promote a virtuous circle. Therefore, in the year of realizing the goal of building a moderately prosperous society in all respects and achieving the target of poverty eradication, this paper takes 8 counties (cities) of Xiangxi Tujia (Miao) Autonomous Prefecture as the research objects to explore the coupling mechanism and coupling coordination between rural revitalization and rural tourism in the region and to investigate their spatial distribution characteristics with profound practical significance.

2 RESEARCH METHODS

2.1 Construction of Index System and Data Sources

Based on the index selection principles of comprehensiveness, scientificity, feasibility, and hierarchy, this paper divides the indexes into system level, primary indexes, and secondary indexes, and screens out 23 secondary indexes of rural revitalization and 10 secondary indexes of rural tourism with reference to previous literature [1][2] and consultation with experts. The system layer is divided into two categories: rural revitalization and rural tourism. Since the index system for rural revitalization is relatively mature, in accordance with the 20-character policy of the rural revitalization strategy proposed by the 19th National Congress of the Communist Party of China, five major categories of thriving businesses, pleasant living environments, social etiquette and civility, effective governance, and prosperity are selected for the primary index. Meanwhile, under the principle of coupled research, this paper selects the indexes of rural tourism, which are relatively linked with rural revitalization, and selects secondary indexes from rural tourism economic support, development status, tourism resources, and tourism environment. The specific index system is shown in Table 1.

Table 1: Construction of the evaluation index system for the coupling coordination between rural revitalization and rural tourism.

System index	Primary index	Secondary index	Unit	Index direction	Weights
Rural revitalization	Thriving businesses	Y1 Investment in fixed asset	10,000 Yuan	+	0.0717
		Y2 regional gross output value	10,000 Yuan	+	0.0343
		Y3 Agricultural labor productivity	Yuan /person	+	0.0371
		Y4 The proportion of secondary and tertiary industries in GDP	%	+	0.0320
	Pleasant living environments	Y5 Penetration rate of rural piped water	%	+	0.0465
		Y6 Penetration rate of rural sanitary toilets	%	+	0.0354
		Y7 Treatment rate of rural domestic sewage	%	+	0.0364
		Y8 Water quality compliance rate of Class iii or better than Class iii	%	+	0.0323
		Y9 Centralized treatment rate of rural wastes	%	+	0.0577
	Y10 Social etiquette and civility	Y10 Gross enrollment rate at senior high school	%	+	0.0459
		Y11 Average years of education of the working-age population	Year	+	0.0227
		Y12 Rural wireless TV coverage	%	+	0.0418
		Y13 Rural broadcasting coverage	%	+	0.0400
	Effective governance	Y14 General public budget expenditure	10,000 Yuan	+	0.0296
		Y15 Crime rate	%	-	0.1138
		Y16 Satisfaction with comprehensive management of social security	%	+	0.0193
	Prosperity	Y17 Per capita disposable income of rural residents	Yuan	+	0.0251
		Y18 Per capita housing area of rural residents	m2	+	0.0315
		Y19 Per capita consumption expenditure of rural residents	Yuan	+	0.1105

		Y20 Incidence of poverty	%	-	0.0431
		Y21 Urban and rural medical insurance participation rate	%	+	0.0380
		Y22 Subsidy coverage rate of basic elderly care services	%	+	0.0342
		Y23 The number of old-age beds per 1,000 elderly people	PCS	+	0.0211
Rural tourism	Economic support	Y24 County-wide tourism revenue	100 million yuan	+	0.1337
		Y25 Capital investment in the construction of rural tourism projects	100 million yuan	+	0.0656
	Development status	Y26 Rural tourism reception	10,000 people	+	0.1434
		Y27 Rural tourism revenue	100 million yuan	+	0.1260
		Y28 The proportion of rural tourism revenue in the county's tourism revenue	%	+	0.0726
	Tourism resources	Y29 The number of A-grade or above tourist attractions in the county	PCS	+	0.0473
		Y30 The number of star-rated hotels	PCS	+	0.0878
		Y31 Bus access rate in built-up villages	%	+	0.0450
	Tourism environment	Y32 Greening coverage area	Hectare	+	0.2011
		Y33 Excellent or above air quality compliance rate	%	+	0.0776

This paper mainly uses 33 indicators that can characterize the rural revitalization and rural tourism in cities and counties of Xiangxi Autonomous Prefecture in 2018 for analysis. The data mainly stems from the *Statistical Yearbook of Xiangxi Autonomous Prefecture in 2018*, the Xiangxi Autonomous Prefecture Statistics Bureau, and related statistical websites. Statistical Bulletin on National Economic and Social Development of Cities and Counties For the missing data in 2018, the data were completed by averaging the adjacent years and analyzed for spatial distribution using geographic information system (ArcGIS) software.

2.2 Entropy Method to Determine Index Weight

Standardiz ation formula of positive index:

$$Y_{ij} = \frac{y_{ij} - \min y_j}{\max y_j - \min y_j} * 0.99 + 0.01$$

Standardiz ation formula of negative index:

$$Y_{ij} = \frac{\max y_j - y_{ij}}{\max y_j - \min y_j} * 0.99 + 0.01$$

(1)

In Formula (1), y_{ij} is the variable value of each index, and Y_{ij} is the value after standardization. $i=1...n$, representing 8 cities and counties; $j=1...m$, indicating the j-th index. To calculate the entropy value of the jth indicator, the first step is to determine the weight of the i-th city and county in the jth index, as shown in Formula (2).

In the wake of constructing the coupling coordination model, the weight of each index needs to be determined first. This paper adopts the entropy method, which is generally recognized in academic circles, to determine the weights of each index of rural revitalization and rural tourism. Since rural revitalization and rural tourism involve a wide range of aspects, there is no uniform unit for each index, so it is impossible to make comparisons. Therefore, this paper first adopts the range method with the de-zeroing process to standardize the indexes into dimensionless values, so that they are comparable. After standardization, all indexes are in the range of 0.01 to 1. The larger the value is, the better the index will be. The specific calculation method is as Formula (1):

$$Z_{ij} = Y_{ij} / \sum_{i=1}^{n} Y_{ij} \qquad (2)$$

After that, the entropy of the j-th index is calculated, as shown in Formula (3):

$$G_j = -(\sum_{i=1}^{n} Z_{ij} \times \ln Z_{ij}) / \ln n \qquad (3)$$

Then the entropy redundancy value is calculated to determine the weight of the *j*-th index, as shown in Formula (4):

$$W_j = (1 - G_j) / \sum_{j=1}^{m} (1 - G_j) \qquad (4)$$

To this end, the weight of each indicator is obtained.

2.3 Coupling Coordination Model

The coupling coordination model can comprehensively analyze the correlation between the two systems. On the basis of calculating the coupling degree of the two systems, the analysis of the coordination degree and development degree between the systems is added. The coordination degree mainly assesses whether the development between two or more systems is consistent, and a high coordination degree indicates that the system reinforces each other and develops harmoniously; the development degree mainly measures the comprehensive development between two systems [3]. The coupling degree evaluates the tightness of the connection between several systems. The greater the coupling degree is, the stronger the interaction of the system will be. Rural revitalization and rural tourism are mutually reinforcing, both in the sense of coordination and development. Therefore, it is more appropriate to use the coupling coordination model for analysis in this paper. Referring to the coupling coordination calculation method of scholar Li Zhilong [4], the calculation method of the coordination degree of rural revitalization and rural tourism in this paper is as follows:

U denotes the comprehensive evaluation index of the system, and U1 and U2 signify the rural revitalization system and rural tourism system, respectively. First, the integrated linear weighting method is used to calculate the comprehensive score of the index:

$$U_h = \sum_{j=1}^{m} W_j \times Y_{ij} \qquad (5)$$

Where h represents the number of systems, h=1,2. Then the coupling degree of the system is calculated:

$$C = [\frac{U_1 \times U_2}{(0.5 U_1 + 0.5 U_2)^2}]^2 \qquad (6)$$

The calculation formula of the development degree is:

$$T = \alpha U_1 + \beta U_2 \qquad (7)$$

Where T means the comprehensive development level of the two systems of rural revitalization and rural tourism, i.e., the development degree. α and β refer to undetermined coefficients, and the table represents the weight of the two systems on the overall development. Usually, for both systems, α and β are both taken as 0.5. Normally, for two systems, both α and β take the value of 0.5. Based on the coupling degree and the development degree, then the coupling coordination degree can be calculated as follows:

$$D = \sqrt{C \times T} \qquad (8)$$

In the model, the values of coupling degree and coupling coordination degree are between 0 and 1. The closer the values of C and D are to 1, the more harmoniously the two systems develop and the system moves toward an orderly structure; conversely, it indicates that there is a disconnect between the systems and they move toward disorder, which is detrimental to the overall progress.

3 EMPIRICAL ANALYSIS

According to the above calculation method, this paper selects 23 rural revitalization indexes and 10 rural tourism indexes of each city and county in Xiangxi Autonomous Prefecture in 2018, calculates the comprehensive score of the subsystems of rural revitalization and rural tourism in Xiangxi Autonomous Prefecture, as well as the coupling degree and development degree, and coupling coordination degree of the two systems, and uses ArcGIS for spatial analysis.

3.1 Comprehensive Score Results of Subsystems

In order to further explore the weak areas that affect the coupling coordination degree of cities and counties to tap their growth potential, this paper firstly analyzes the comprehensive scores of rural revitalization, rural tourism, and their subsystems (Figures 1-2, Tables 2-4). In accordance with the basic requirements of the rural revitalization strategy, this paper analyzes rural revitalization from five subsystems: thriving businesses, pleasant living environment, social etiquette and civility, effective governance, and prosperity. Table 3 presents the comprehensive score of the subsystems of rural revitalization.

Table 2: Comprehensive scores of the subsystems of rural revitalization in counties and cities in Xiangxi Autonomous Prefecture.

Comprehensive score	Thriving businesses	Pleasant living environment	Social etiquette and civility	Effective governance	Prosperity
Jishou City	0.175	0.247	0.091	0.054	0.224
Luxi County	0.049	0.060	0.046	0.065	0.079
Fenghuang County	0.065	0.073	0.014	0.030	0.130
Huayuan County	0.047	0.108	0.092	0.037	0.101
Baojing County	0.042	0.058	0.033	0.021	0.112
Guzhang County	0.030	0.076	0.108	0.043	0.101
Yongshun County	0.039	0.094	0.077	0.075	0.103
Longshan County	0.064	0.071	0.090	0.082	0.100

As can be seen from Figure 1 and Table 2, the comprehensive scores of rural revitalization in counties and cities in Xiangxi Autonomous Prefecture are currently not high. Except for Jishou City, which has a higher comprehensive score for rural revitalization, the development of other counties and cities is relatively balanced. Overall, the rural revitalization score of Jishou City is 0.79, which is considerably higher than that of other cities and counties, the scores of which are all around 0.4 or below. This is mainly due to the distinct advantages of Jishou City in terms of thriving businesses, pleasant living environment, and prosperity, with comprehensive scores of 0.175, 0.247, and 0.224 respectively. However, Jishou City relatively lacks effective governance, with a comprehensive score of only 0.054. Longshan County ranks second with a score of 0.407, mainly due to its effective governance performance, with a comprehensive score of 0.082, marking the highest score among all cities and counties. Yongshun County, Huayuan County, and Guzhang County are ranked third, with similar comprehensive scores in rural revitalization, but their main dominant domains differ a lot, indicating that the development is inconsistent among the five subsystems of rural revitalization. The county with the lowest comprehensive score for rural revitalization is Baoding County, which has the lowest comprehensive score in terms of pleasant living environment and effective governance, and there is no field with the highest score. It demonstrates that the development degree of rural revitalization in Baoding County lags far behind that of other cities and counties.
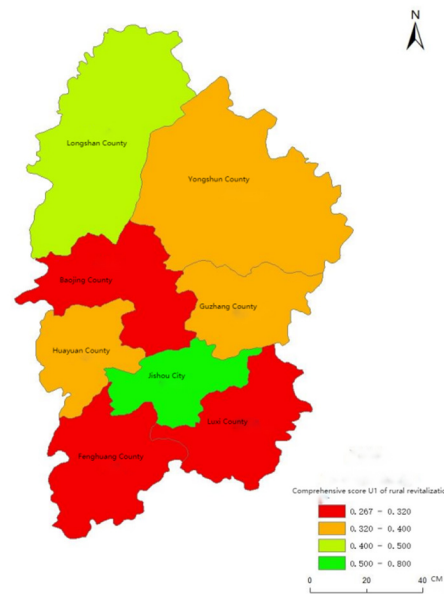

Figure 1: The comprehensive score of rural revitalization in counties and cities in Xiangxi Autonomous Prefecture.
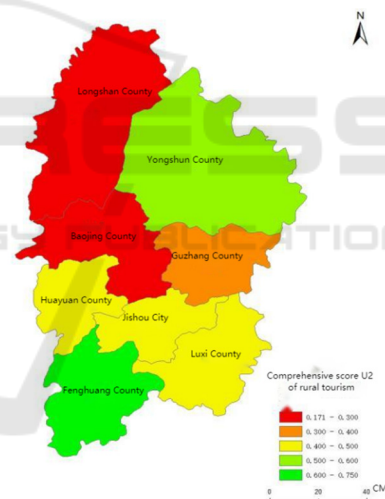

Figure 2: The comprehensive score of rural tourism in counties and cities in Xiangxi Autonomous Prefecture.

From the perspective of various subsystems, Jishou City, as the capital of Xiangxi Autonomous Prefecture, has the highest score of 0.175 for thriving businesses, which is significantly higher than other cities and counties. Jishou City ranks first in terms of investment in fixed assets, regional GDP, and the proportion of secondary and tertiary industries and labor productivity. Its pleasant living environment makes it the best among all cities and counties, which is largely attributed to the best treatment of rural sewage and garbage as well as the penetration rate of

piped water. While Baojing County and Luxi County score the lowest in this regard. With respect to social etiquette and civility, there are large differences among counties and cities, with Guzhang County scoring the highest and Fenghuang County scoring the lowest. This is mainly due to the fact that the gross enrollment rate of high school students in Fenghuang County and the average years of education of the working-age population are the lowest. The development of an effective governance index is relatively balanced, with Longshan County scoring the highest and Baojing County the lowest. Jishou City is also far ahead of other cities and counties as regards prosperity, driven by its highest per capita disposable income and lowest poverty rate. In a comprehensive view, Jishou City, Huayuan County, and Baojing County should place emphasis on improving their rural governance capacity, enhancing satisfaction with comprehensive governance, increasing general public service expenditures, and reducing crime rates. Luxi County and Fenghuang County should strive to boost social etiquette and civility, elevate rural education levels, and raise the literacy of farmers. Guzhang County, Yongshun County, and Longshan County should expand their industries, develop regional economies, and improve labor productivity.

Table 3: Comprehensive scores of the subsystems of rural tourism in counties and cities in Xiangxi Autonomous Prefecture.

Comprehensive score	Economic support	Development status	Tourism resources	Tourism environment
Jishou City	0.150	0.121	0.111	0.025
Luxi County	0.052	0.164	0.174	0.054
Fenghuang County	0.278	0.202	0.215	0.026
Huayuan County	0.020	0.198	0.060	0.133
Baojing County	0.021	0.018	0.049	0.082
Guzhang County	0.063	0.175	0.044	0.030
Yongshun County	0.126	0.129	0.178	0.096
Longshan County	0.028	0.010	0.215	0.036

Figure 2 and Table 3 render the comprehensive scores of rural tourism and its subsystems. By and large, rural tourism has a wide range of scores, with all counties and cities scoring around or below 0.5, except for Fenghuang County, which has a high score. From the perspective of spatial distribution, except for Yongshun County, the comprehensive score of rural tourism in Xiangxi Autonomous Prefecture decreases from the southwest to the northeast. Fenghuang County in the southwest is significantly higher than Longshan Cunty, Baojing County, and Guzhang County in the north, while Yongshun County in the north ranks second with a score of 0.529. Fenghuang County in the southwest registers the highest score of 0.721 for rural tourism, which accounts for the favorable development of rural tourism. On the one hand, it is due to its strong economic support, strong support of the project fund, and the high tourism revenue of the county; on the other hand, it is dependent on its unique tourism resources and ecological environment. In this regard, its tourism development is in good condition, both rural tourism revenue and rural tourism attendance are the highest among cities and counties.

From the above, it can be seen that for counties and cities with low scores in rural tourism at present, they should accelerate the improvement of their shortcomings areas in order to promote the overall development of rural tourism. For instance, Longshan County is rich in tourism resources, efforts should be intensified to invest in its projects and fully develop and excavate its rural tourism resources. Guzhang County should attach importance to the improvement of its rural environment, expand the greening area, and do a good job in pollution prevention and control to improve air quality. Baojing County and Huayuan County should focus on the economic support of rural tourism development, and increase investment to create a beautiful and attractive tourism environment, thus attracting rural tourists.

3.2 Analysis of Coupling Coordination Degree

Through the comprehensive scores of each system, this paper measures the coupling degree and coupling coordination degree between rural revitalization and rural tourism in Xiangxi Autonomous Prefecture, as shown in Figure 3 and Table 4. In general, the coupling degree between rural revitalization and rural tourism in Xiangxi Autonomous Prefecture is relatively high. Except for Fenghuang County and Jishou City, other cities and counties are above 0.9, which is a highly coupled stage. However, the uneven development of cities and counties is obvious. Jishou City Baojing County, Guzhang County, and Longshan County have higher comprehensive scores for rural revitalization than rural tourism, while the

other four counties are the opposite. It shows that the development of cities and counties is uneven on the one hand, and the focus of development differs on the other hand.

Table 4. Analysis of coupling degree and coupling coordination degree between rural revitalization and rural tourism.

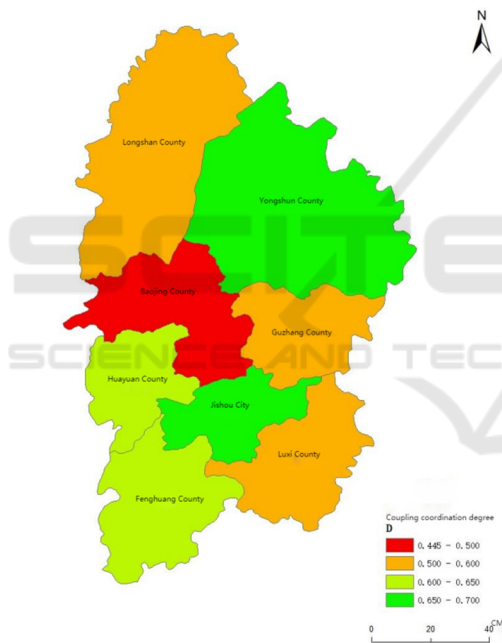| Cities and Counties	Comprehensive score U1 of rural revitalization	Comprehensive score U2 of rural tourism	Coupling degree C	Development degree T	Coupling coordination degree D
Jishou City	0.790	0.407	0.805	0.599	0.694
Luxi County	0.299	0.443	0.926	0.371	0.586
Fenghuang County	0.313	0.721	0.712	0.517	0.607
Huayuan County	0.384	0.411	0.998	0.397	0.630
Baojing County	0.267	0.171	0.905	0.219	0.445
Guzhang County	0.357	0.313	0.991	0.335	0.576
Yongshun County	0.388	0.529	0.953	0.459	0.661
Longshan County	0.407	0.288	0.942	0.348	0.573

Figure 3: Coupling coordination degree of counties and cities in Xiangxi Autonomous Prefecture.

Above all, the development degree of each county and city is average. The cities and counties with higher development degree mainly include Jishou City and Fenghuang County, but their areas of advantage are different. Jishou City has a high comprehensive score for rural revitalization, while Fenghuang County has a high comprehensive score for rural tourism. Both places have advantages and disadvantages. Attempts should be made to further compensate for weak areas, enhance comprehensive development capabilities, and form high-coupling

development, thereby promoting the improvement of the entire rural system. While Baojing County has the lowest development degree, which is only 0.219. The reasons for this are mainly manifested in two aspects. First, the rural infrastructure is not perfect, compared with other cities and counties, the investment in rural tourism development is not enough, and homogenization is serious, lack of their characteristics. Second, the tourism industry development strategy has not been highlighted. Its rural tourism revenue accounts for 8.8% of the county's tourism revenue, and its whole county's tourism revenue only accounts for 24% of the county's GDP, which still has a certain gap compared with other counties and cities.

The coupling coordination degree of the cities and counties in Xiangxi Autonomous Prefecture is at a medium level, with the highest being 0.694 in Jishou City and the lowest being 0.445 in Baojing County, and the overall gap is not large. From the perspective of regional distribution, there is no obvious regularity in the coupling coordination between rural revitalization and rural tourism in Xiangxi Autonomous Prefecture. Except for Jishou City and Yongshun County, which have the highest coupling coordination degree, the southern region is basically higher than the northern region, that is, Huayuan County and Fenghuang County are generally higher than Longshan and Guzhang in terms of coupling coordination degree. From the view of coupling and coordination, the two systems of rural revitalization and rural tourism in Xiangxi Autonomous Prefecture are closely linked and mutually reinforced.

As mentioned above, although the coupling degree of rural revitalization and rural tourism in

cities and counties of Xiangxi Autonomous Prefecture is high, their development degree and coupling coordination degree are still at an intermediate stage, indicating that these two systems have a strong degree of mutual influence, but lack a corresponding coordination mechanism. Accordingly, the mutual promotion effect of rural revitalization and rural tourism is weak and does not give full play to its promotion effect on the whole rural system. Especially the development of rural tourism in the northern region is weak, while the development of rural revitalization in the southern region is weak. In view of this, the southern regions such as Fenghuang County and Luxi County should further catalyze rural revitalization, while the northern regions such as Longshan County and Baojing County should further develop rural tourism.

4 CONCLUSION AND DISCUSSION

This paper conducts an empirical analysis on the relationship between rural revitalization and rural tourism and its spatial distribution characteristics in eight cities and counties in Xiangxi Autonomous Prefecture through the coupling coordination model. By screening out 23 representative rural revitalization indexes and 10 rural tourism indexes, the comprehensive development degree, coupling degree, development degree, and coordination degree of rural revitalization and rural tourism were calculated. Finally, the following conclusions are drawn:

The comprehensive index score of rural revitalization is not high. Except for Jishou City, which is relatively high, all other counties and cities are at a medium level of development. It shows that the level of rural revitalization and development in each county and city in Xiangxi Autonomous Prefecture is uneven, and all counties and cities have their advantages and disadvantages in various aspects of rural revitalization and development. For example, Jishou City and Fenghuang County have obvious shortcomings in the field of rural governance, which is mainly reflected in the low satisfaction of their comprehensive governance for each county and city. With regard to this, these two regions should improve the rural governance system as soon as possible, enhance their rural governance capabilities, and promote the integration of three governance for agriculture, rural areas, and rural people, so as to improve their comprehensive governance

satisfaction. Baojing County, taken as another example, has the lowest comprehensive score for rural revitalization, without any outstanding areas but with obvious shortcomings in ecology and governance. Therefore, the county should concentrate on enhancing its rural ecological livable environment and improving governance capabilities.

The comprehensive score for rural tourism is not high. Except for Fenghuang County, rural tourism in other cities and counties is at a low-to-medium development level. Moreover, the regional differences in the comprehensive development of rural tourism in Xiangxi Autonomous Prefecture are obvious. Except for Yongshun County, the comprehensive score of rural tourism decreases from the southwest to the northeast, showing the characteristics of low-value aggregation in the north and high-value aggregation in the south. Although all indexes of rural tourism in Fenghuang County have developed well, the tourism environment is indeed a shortcoming of its development. Thus, attention should be paid to pollution prevention and treatment and improve air quality and green coverage.

The coupling degree of rural revitalization and rural tourism in the counties and cities of Xiangxi Autonomous Prefecture is extremely high. Except for Fenghuang County and Jishou City, the coupling degree of all counties and cities is above 0.9, which is a high coupling stage. It suggests that there is a close relationship between the two systems, rural tourism cannot be separated from the driving and promoting role of rural revitalization, and rural revitalization also relies on rural tourism to activate the endogenous power of rural development. The development degree and coupling coordination degree of Xiangxi Autonomous Prefecture are both in the intermediate development stage, and their spatial distribution characteristics are consistent with rural tourism. Among them, Jishou City is in a leading position in terms of development degree and coupling coordination degree and has strong development potential. In addition, Yongshun County, Fenghuang County, and Huayuan County are at the top of the ranking. The coordination mechanism of rural revitalization and rural tourism should be further explored to promote the harmonious and orderly development of the rural system.

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