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Coupling and Coordination of Traffic and Tourism Development in Pucheng county Region Spatio-temporal Characteristics

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Abstract: The comprehensive development evaluation system of county transportation and tourism system was constructed, and the spatio-temporal characteristics of the coupled and coordinated development of pucheng county transportation and tourism system were analyzed by using the coupled and coordinated model. The results show that:1)In terms of the time series change of comprehensive development level, the development level of county transportation and tourism system showed a trend of sustained growth or steady development from 2016 to 2019, and the tourism development improved in 2020, but the county transportation was greatly affected by the epidemic situation, and the changes fluctuated obviously, and the two changes were unbalanced.2)On the change of coupling and coordination time series, the coupling degree remained at a high level with no obvious fluctuation, and the overall level of coupling and coordination was high, which indicated that traffic development effectively promoted the development of tourism.3)In the spatial evolution of coupling and coordination development, the coupling and coordination degree of counties in Weinan City in 2019 and 2020 is quite different. Except Fuping County and Chengcheng County, the coupling and coordination of transportation and tourism systems in all counties changed from coordination to imbalance. Pucheng county developed from primary coordination in 2019 to serious imbalance in 2020, which was greatly affected by the epidemic. Finally, based on the actual situation in Pucheng county, some suggestions are put forward for the development of county transportation and tourism.

Keywords: Traffic; Tourism development; Coupling coordination; Pucheng county.

1. Introduction

Transportation is the foundation and premise of tourism development. As a bridge and link connecting tourist sources and destinations, transportation system is the support and guarantee for the development of tourism industry, which directly affects the reception level, number of tourists and tourism income of tourist destinations and is an important standard to measure the development level of tourism industry in a region[1],[2]. The rapid development of transportation system impacts and changes the original concept of time and space, and has a far-reaching impact on the spatial organization and industrial layout of tourism. The continuous reconstruction of the spatial pattern of regional tourism and the special bridge function of transportation system have attracted special attention,[4]. The development pattern of tourism industry will also have a significant impact on traffic demand, traffic network layout and development. Therefore, revealing the interaction between transportation and tourism development is of great significance for optimizing the layout of tourism industry, promoting the transportation construction of tourist destinations and promoting regional coordinated development.

At present, the research contents at home and abroad involve the influence of transportation on regional tourism development, the spatial differentiation of transportation and tourism development, and the coordination degree between transportation and tourism, and a series of quantitative analysis has been carried out. For example, Li Baochao and others. Taking Southern Anhui International Cultural Tourism Demonstration Zone as an example, this paper discusses the influence of high-speed rail on regional tourism accessibility and regional tourism links from two research perspectives: tourist destination and tourist destination. Li lingyan and others Based on the panel data of China's provincial tourism and transportation development from 2006 to 2016, this paper explores the degree of coordinated development and the evolution trend of its temporal and spatial pattern by using the coupling coordination model and exploratory spatial data analysis. Wang Haiying et al. From the perspective of coordination, taking Beijing-Tianjin-Hebei region as an example, this paper analyzes the evolution characteristics of regional transportation and tourism from 2007 to 2019 and their correlation and coupling. Ye Mao et al. built a coupling coordination model of transportation and tourism system in western Hunan based on the collaborative perspective, and empirically analyzed the spatial and temporal evolution characteristics and effects of coupling coordination of transportation and tourism system in this region.

Based on a comprehensive review of domestic and foreign literatures, it is found that the current research mainly focuses on the relationship between tourism and traffic development, and it is usually an isolated analysis of a typical case area, while the analysis of the dynamic evolution characteristics, agglomeration degree and small research scale of the relationship between them is still lacking. Taking Pucheng county, Shaanxi Province as an example, this paper analyzes the temporal and spatial characteristics of the coupling and coordination between transportation and tourism development from the perspective of time change and spatial differentiation, with a view to providing countermeasures for the high-quality and coordinated development of county transportation and tourism.

2. The general situation of the study area

Pucheng county is located in the east of central Shaanxi Province, in the middle of Weinan City, with an east longitude of 109°20′17″~109°54′48″ and a north latitude of 34°44′50″~35°10′30″. The maximum distance between east and west is 55 kilometers, and the maximum distance between north and south is 49 kilometers, with a total area of 1,583.58 square kilometers. Now it has jurisdiction over 15 towns, 2 sub-district offices and 275 administrative villages, with a total area of 1,584 square kilometers and a population of 800,000.

In 2016, Pucheng passed the establishment of a national public cultural service system demonstration zone on behalf of Weinan. In December, 2021, Pucheng county was awarded the qualification to establish the first batch of demonstration counties with high-quality development of public cultural services in Shaanxi Province. Pucheng county is rich in tourism resources, with 35 provincial-level cultural relics protection units, 17 scenic spots open to the outside world, and five Tang emperors' tombs, such as Qiaoling, Tailing, Huiling, Jingling and Guangling. Compared with the development of tourism, the construction of transportation infrastructure in Pucheng county lags behind. On the one hand, after the construction of rural roads, it is necessary to continue to promote the construction of rural roads, and the accessibility of scenic spots is low, which increases the travel time cost of tourists; On the other hand, with the planning adjustment of national highway and provincial highway network, after the 106.96 km rural highway is adjusted to national highway, the rural highway network is not reasonable, which cannot fully connect the national and provincial trunk road network and cannot meet the new rural development needs. Many scenic spots and scenic spots with high quality and good potential are only connected by national highways and provincial highways. In recent years, with the construction and operation of national and provincial trunk highways G108 and S313 and high-speed rail, the county traffic level has been greatly improved. At present, there are many studies on the relationship between tourism and transportation, but there are relatively few studies on the coordinated development of county transportation and tourism coupling.

3. The index system and research methods

(1) Index selection and data sources

Draw lessons from the related research results of the coupling and coordination measurement of regional transportation and tourism development[10][11], [12][13]Combined with the actual situation of transportation and tourism development in Pucheng county, six evaluation indexes of transportation system and six evaluation indexes of tourism development system are selected to construct the comprehensive evaluation index system of county transportation and tourism development respectively (Table 1).

The original data of the number of tourists received, tourism comprehensive income, passenger turnover, passenger volume and the proportion of tourists to GDP required for this study are all from the statistical bulletin of national economic and social development of counties and districts in Weinan City from 2016 to 2020. The number of service industries above designated size, the average number of people engaged in service industry activities, the total length of rural delivery routes and urban delivery routes are from the Statistical Yearbook of Weinan City from 2016 to 2020. Passenger turnover comes from Pucheng Yearbook 2017-2020. The administrative divisions in the graphic data come from the national 1:4 million basic geographic information system.

Table 1. Evaluation Index System of County Traffic and Tourism Development

subsystem	evaluating indicator	unit	weight
County traffic system	passenger capacity	Ten thousand people	0.107
	Passenger turnover	Ten thousand kilometers	0.113
	volume of goods transported	Ten thousand tons	0.121
	Cargo turnover	Ten thousand tons and kilometers	0.29
	Total length of rural delivery route	kilometer (km)	0.262
	Urban delivery section	strip	0.107
Tourism development system	Tourists	Ten thousand people	0.187
	tourist income	hundred million yuan	0.216
	volume of passenger transportation	Ten thousand kilometers	0.133
	Proportion of tourism revenue to total GDP	%	0.161
	Number of service industries above designated size	individual	0.139
	Average number of people engaged in service industry activities	human	0.164

(2) Determination of index weight

Entropy method uses the inherent information of evaluation index to evaluate the utility value of index, and avoids the deficiency of subjective weighting. Entropy refers to the measure of the disorder degree of the system. The smaller the entropy value, the greater the difference between indicators, and the greater the information contained, which should be given greater weight, and vice versa[5]. The formula is as follows:

$$e_j = -k \sum_{i=1}^{m} y_{ij} \ln y_{ij} \quad (1)$$

$$w_j = (1-e_j) / \sum_{j=1}^{n} (1 - e_j) \quad (2)$$

Where ej is the index entropy value, $0 \leq ej \leq 1$; Yij is the standardized value of the ith sample and the jth index, which is obtained by standardizing the original data by the forward range standardization method; M and n are the number of samples and the number of indicators respectively; k=1/lnm; Wj is the index weight.

(3) Comprehensive evaluation model

Let xi (i =1, 2, …, k) and yj(j=1, 2, …, l) be the evaluation

indexes of the county transportation subsystem and the tourism development subsystem respectively, then the comprehensive evaluation function models of the two subsystems can be expressed as follows:

$$f(x)=\sum_{i=1}^{k} a_i x_i, g(y)=\sum_{j=1}^{l} b_j y_j \quad (3)$$

Where f(x) and g(y) respectively represent the comprehensive evaluation values of county transportation system and tourism development system; ai and bj represent the weights of each index of county transportation system and tourism development system respectively; xi and yj represent the standardized values of each index of county transportation system and tourism development system respectively.

(4) Coupling coordination analysis method

The "coupling" in physics is applied to the spatial analysis of geography to explore the influence of the interaction between two or more elements or systems Coupling degree is a measure of the degree of interaction between systems. At the same time, Wang Shujia and others are adopted It is considered that the canonical formula (4) is the most suitable for the current universal coupling degree model.

$$C=\left[\frac{\prod_{i=1}^{n} Ui}{(\frac{1}{n}\sum_{i=1}^{n} Ui)}\right] \quad (4)$$

Table 2. Classification of Coupling and Coordinated Development of County Transportation and Tourism Development

D value interval of coupling coordination degree	Coordination grade	Coupling coordination degree
(0.0-0.1)	1	Extreme disorder
[0.1-0.2)	2	Serious maladjustment
[0.2-0.3)	3	Moderate disorder
[0.3-0.4)	4	Mild disorder
[0.4-0.5)	5	On the verge of disorder
[0.5-0.6)	6	Reluctantly coordinate
[0.6-0.7)	7	Primary coordination
[0.7-0.8)	8	Intermediate coordination
[0.8-0.9)	9	Good coordination
[0.9-1.0)	10	Quality coordination

Where: n is the number of subsystems (pieces); Ui is the value of each subsystem, and its distribution interval is [0,1], so the coupling degree c value interval is [0,1]. The greater the value of c, the smaller the dispersion between subsystems and the higher the coupling degree; Conversely, the lower the coupling degree between subsystems. This study includes two subsystems: county transportation and tourism development, so the value of n is 2, as shown in Formula (5):

$$\text{When n=2, } C=\sqrt{\frac{U_1U_2}{(\frac{U_1+U_2}{2})}}=\frac{2\sqrt{U_1U_2}}{U_1+U_2} \quad (5)$$

Because the coupling degree can only reflect the interaction between the two subsystems of the county transportation and tourism development system, the phenomenon of high coupling degree may occur when the comprehensive development level of the two subsystems is the same high or low, so it is impossible to measure the coordinated development degree of the county transportation and tourism development only by coupling degree. The coupling coordination model can better evaluate the coordination degree of interactive coupling between county transportation system and tourism development system, and the model is as follows

$$T=\sum_{i=1}^{n} a_i \times U_i \ , \sum_{i=1}^{n} a_i = 1 \quad (6)$$

$$D=\sqrt{C \times T} \quad (7)$$

Where T is the comprehensive coordination index of county traffic and tourism development; D is the coupling coordination degree; Ui is the standardized value of the ith subsystem; Ai is the weight of the ith subsystem. Because the county traffic and tourism development are equally important, A1= A2= 0.5; Refer to Jiang Xu's classification of coupling coordination degree, and the classification of coupling degree and co-scheduling level is shown in Table 2.

4. Analysis of the evaluation results of the coupling and coordinated development of county transportation and tourism development system

(1) Analysis of the time series change of comprehensive evaluation of county transportation and tourism development system

Calculate the comprehensive development level of county transportation and tourism in Pucheng county from 2016 to 2020 by Formula (1). From 2016 to 2020, the tourism development system showed a trend of steady improvement, but the development of the transportation development system was slow, and it declined greatly in 2020, indicating that the transportation development and tourism development in Pucheng county were unbalanced.

From the perspective of tourism development, the comprehensive evaluation score of tourism development rose from 0.133 in 2016 to 0.461 in 2022, with an average annual increase of 0.082, indicating that Pucheng county's tourism development is relatively rapid. Further analysis shows that the development fluctuated greatly from 2019 to 2020, mainly due to the implementation of a series of policies in Pucheng county. For example, in 2019, the comprehensive tourism income of the county ranked first in Shaanxi Province, and famous scenic spots such as Qiaoling ranked 4A. The development level of tourism development system has been slightly lower than that of transportation system in 2016-2019, but it has rapidly improved after 2019 and surpassed the development level of transportation in 2020, which further shows that the government's tourism planning and a series of policies have outstanding effects.

From the analysis of the development of county traffic, the comprehensive evaluation score of county traffic is from 0.49 in 2016 to 0.489 in 2020, which is relatively flat, but further analysis shows that it fluctuates greatly in 2019-2020, which is mainly affected by the epidemic situation in COVID-19 in 2019. The construction of county transportation infrastructure has stagnated, and a series of indicators such as passenger traffic and freight volume have dropped sharply.

(2) Analysis of the coupling and coordination time series changes of county transportation and tourism development

system

Use formulas (5)-(7) to calculate the coupling degree and coordination of Pucheng county's transportation development and tourism development system from 2016 to 2020. It can be found that: a). On the whole, the coupling degree of county transportation and tourism development system is relatively high in the past five years, and the change is not obvious, fluctuating around 0.9. The coupling and coordination degree of county transportation and tourism development showed a steady upward trend before 2019. b). From the numerical analysis of coupling degree and co-scheduling, the overall change of coupling degree is not obvious, with the minimum value of 0.80 in 2020, the maximum value of 0.95 and the average value of 0.875. It shows that the interaction between county traffic and tourism development is high and stable, and it is in an orderly state. The minimum value of coupling coordination between county traffic and tourism development is 0.56, the maximum value is 0.67, and the average value is 0.615, which is in the primary coordinated development stage as a whole. c). From the analysis of the change process, the development of county transportation and tourism can be divided into two stages. From 2016 to 2019, due to the high coupling stability period, the coupling degree did not change obviously. From 2019 to 2020, affected by the epidemic situation in COVID-19, the county traffic declined, and the coupling degree fluctuated obviously. The coupling coordination degree can be divided into four development stages, 2016-2017 is the primary coordinated development stage, 2017-2018 is the intermediate coordinated development stage, 2018-2019 is the good coordinated development stage, and 2020 is the barely coordinated development stage.

Spatial differentiation characteristics of coupling and coordination of transportation and tourism development in Pucheng county.

Due to the limited data acquisition, this paper takes the counties and districts of Weinan City as the basic unit, selects two cross-sectional data in 2019 and 2020, and draws the spatial differentiation map of the coupling and coordinated development of county transportation and tourism to analyze the spatial differentiation characteristics of the coupling and coordinated development of transportation and tourism in Pucheng county. It can be found that:a)From the analysis of coupling coordination degree, the coupling coordination degree of Pucheng county changed greatly in 2019 and 2020. In 2019, the transportation system and tourism system were in primary coordination, and in 2020, due to the impact of COVID-19 epidemic, the coupling coordination degree of Pucheng county was seriously out of balance. At the same time, except Fuping County and Chengcheng County in other counties of Weinan City, the coupling and coordination situation of county transportation and tourism development system has decreased to varying degrees, which shows that the coupling and coordination development situation of counties in Weinan City is basically similar. b) From the analysis of various sections, Chengcheng County and Fuping County were in an extremely unbalanced development trend in 2019, Dali County was in a serious unbalanced development trend, Pucheng county and Huayin city were in a primary coordinated development trend, and the other six counties and districts were in a good coordinated development trend. In 2020, Fuping County was in a good coordinated development trend, Huayin city was in a primary coordinated development trend, Pucheng county, Chengcheng County and Huazhou District were in a serious unbalanced development trend, and the other six counties and districts were in an extremely unbalanced development trend. It can be seen that in 2019 and 2020, the overall coupling degree of transportation and tourism development in Weinan City is not coordinated, and transportation development will promote the development of tourism in a certain period of time. However, due to the lag of transportation construction, with the development of tourism, this promotion may turn into inhibition.

5. Pucheng county county transportation and tourism development system coordinated development countermeasures.

(1) Pay attention to the coordinated and optimized development of county transportation and tourism.

Since the outbreak of COVID-19 at the end of 2019, the coupling and coordination of transportation and tourism development in Pucheng county and even other counties in Weinan City has been in a state of extreme imbalance and serious imbalance. As a major tourist province, Pucheng county should actively publicize the local history and culture of tourism and speed up the construction of county transportation infrastructure while actively developing tourism in the province. In terms of county traffic development, the construction of county roads and village roads in Pucheng county is relatively backward. With the adjustment of national highway network planning, the rural highway network is not reasonable and cannot fully connect with the national and provincial trunk road network, so the scenic road network cannot be fully connected. In the aspect of tourism development, we should improve the quality of tourism service and the optimization of tourism reception capacity, so as to enrich the tourist experience and meet the diversified tourism needs of tourists; Pucheng county has five tombs of Tang emperors, such as Qiaoling, Tailing, Huiling, Jingling and Guangling. Among them, the 4A-level Qiaoling Scenic Area is known as one of the top ten most magnificent tombs of emperors in China, with profound historical origins. However, the development link between scenic spots and scenic spots is weak, so we should fully explore and publicize the local history and culture, enhance its tourism popularity and attraction, and promote the development of county tourism.

(2) Emphasize the synergy between the traffi-c management department and the tourism management department.

On the one hand, give full play to the leading role of planning. The transportation department should strengthen cooperation and communication with the tourism department in the planning process. In the process of tourism planning, pedestrian walkways, slow lanes, etc. can be combined with fast traffic roads to effectively promote the accessibility of the "last mile" of scenic spots. At the same time, when planning tourism development, traffic should be integrated into tourism elements such as recreation, entertainment, leisure and shopping. Integrate "travel" with "eating, living, traveling, buying and entertaining". On the other hand, transportation departments and tourism departments should speed up the construction of smart tourism and improve the level of coordinated development of transportation and tourism[4]. Using big data, cloud computing and other technologies, we

will build a smart tourism platform, develop a smart platform for transportation and tourism, comprehensively integrate tourism resources and tourism transportation, and release tourism information and tourism transportation information to tourists in time to ensure that transportation departments and tourism departments can guide tourists reasonably, so as to improve the synergy between county transportation and tourism development and realize the high-quality development of county transportation and tourism.

6. Conclusion and discussion

In this paper, the comprehensive development index system of county transportation and tourism system is constructed, and the coupling model is used to analyze the temporal and spatial characteristics of the coordinated development of Pucheng county transportation and tourism. The following conclusions are drawn: a) In terms of the time series change of comprehensive development level, the development level of county transportation and tourism system showed a trend of sustained growth or stable development from 2016 to 2019, and the tourism development improved in 2020, but the county transportation was greatly affected by the epidemic, and the changes fluctuated obviously, and the two changes were unbalanced. b) On the change of coupling and coordination time series, the coupling degree remained at a high level with no obvious fluctuation, and the overall level of coupling and coordination was high, which indicated that traffic development effectively promoted the development of tourism. c) In the spatial evolution of coupling and coordination development, the coupling and coordination degree of counties in Weinan City in 2019 and 2020 is quite different. Except Fuping County and Chengcheng County, the coupling and coordination of transportation and tourism systems in all counties changed from coordination to imbalance. Pucheng county developed from primary coordination in 2019 to serious imbalance in 2020, which was greatly affected by the epidemic.

In this paper, when calculating the spatial differentiation characteristics of coupling coordination degree, due to the limited data acquisition, only the spatial differentiation characteristics of coupling coordination degree of transportation and tourism development in counties and districts are calculated, and further research in this field will be carried out in the future.

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