THE COUPLING COORDINATION OF TOURISM-ECOLOGICAL ENVIRONMENT-URBANIZATION IN THE YELLOW RIVER BASIN OF INNER MONGOLIA: A CASE STUDY OF BAOTOU, CHINA

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Abstract: with the Yellow River basin of Inner Mongolia baotou as the research object, to construct a system of tourism, the ecological environment, the urbanization comprehensive evaluation index system, using entropy value method and the analysis of coupling coordination model 2000-2022 years, the ecological environment, tourism urbanization system coupling relationship between the coordinated development. The results show that the integrated development index of the tourism, ecological environment and urbanization subsystems is on the rise, with the urbanization index continuing to grow and the tourism and ecological environment index fluctuating. The systems of tourism, ecological environment and urbanization show a change from high coupling and low coordination to high coupling and good coordination, and the degree of coordination steadily develops from mild imbalance to good coordination in time. Due to the impact of COVID-19, the tourism industry has shown clear fluctuations, and the ecological environment is positively correlated with the degree of coupled coordination of the system. Strengthening the governance and protection of the ecological environment and enhancing the endogenous driving force of urbanization are central and key to optimizing and enhancing the coordinated development of people and land in the region.

Key words: Inner Mongolia; Yellow River Basin; Tourism; Ecological environment; Urbanization; Coupling coordination

1. Introduction

As an important part of the tertiary industry, tourism plays an important role in the new-type urbanization construction of tourist destination cities, such as industrial agglomeration, economic structure transformation and upgrading, population structure transformation, city image brand promotion, spatial layout of tourism urbanization, and urban-rural integration development. At the same time, tourism can effectively transform the economic, cultural and ecological value of tourism resources, promote the effective improvement of regional urbanization level, and drive the sustainable development of regional economy, which is an important embodiment of supporting high-quality regional development, and has become a new engine of economic growth in China's new-type urbanization construction period. However, both the development of tourism and the process of urbanization will have an impact on the ecological environment, and the sustainability of the ecological environment will also restrict the

sustainable expansion of tourism development and urbanization. Tourism, ecological environment and urbanization have formed a complex system of interaction and mutual influence. The Yellow River Basin in Inner Mongolia is an important tourist destination rich in natural and cultural tourism resources in western China, and the contradiction between human and land caused by the process of tourism urbanization is more prominent. Therefore, in-depth comprehensive evaluation of the system of tourism, ecological environment and urbanization can not only enrich and improve the coupling and coordination theory of related complex systems, but also has important practical value to promote the sustainable development of man-land relationship regional system in the Yellow River Basin of Inner Mongolia.

The study of tourism urbanization in foreign countries began in 1991. Scholar Mullins [1] first proposed the conceptual framework system of tourism urbanization. Western scholars Batty [2], Gladstone [3], T. C. Change [4] and Allen [5] respectively conducted relevant studies on the types, models and effects of tourism urbanization. The research on the relationship between "tourism" and "town" system in domestic academic circles started late, and the research content is divided on the basis of learning from the research paradigm of "tourism urbanization" in foreign countries. In terms of theoretical research, Ma Xuefeng [6], Lu Lin [7], Huang Zhenfang [8] and other scholars paid early attention to the phenomenon of tourism urbanization and focused on the research content of the concept discrimination and driving mechanism of tourism urbanization. Domestic research on tourism, ecological environment and urbanization mainly focus on the analysis and definition of coordination mechanism between the two systems and the spatio-temporal differentiation and evolution trend of coordinated development, and there is still a lack of integration of tourism, ecological environment and urbanization into a unified theoretical framework. Therefore, this paper takes Baotou of the Yellow River Basin in Inner Mongolia as the research area, constructs a coupled coordination evaluation model of tourism-ecological environment-urbanization, and analyzes the evolution characteristics of coupling degree and coupling coordination degree from 2000 to 2022, in order to provide theoretical basis and practical reference for the coordinated development of tourism-ecological environment-urbanization in the Yellow River Basin in Inner Mongolia.

2. Research methods

2.1 Establishment of index system

Based on the principles of scientificity, accuracy and accessibility of data acquisition, this study selects a total of 42 representative indicators by referring to previous relevant research results, and builds a comprehensive evaluation index system of tourism-ecological environment-urbanization system.

Table 1. Comprehensive evaluation index system of tourism-ecological environment-urbanization

Target layer	System layer	Index
Tourism	Tourism Market	Total number of tourists, Domestic tourists, International tourists
	Tourism Economy	Total tourism revenue, Proportion of total tourism revenue in GDP, Domestic tourism revenue, International tourism revenue
	Tourism Industry	Number of employees in the tertiary industry, Number of star-rated hotels, Total number of travel agencies
	Tourism Support	Highway mileage, Passenger turnover, Public transport per 10,000 people, Public toilets per 10,000 people
Ecological environment	Ecological Environment Status	Per capita park green area, Green land rate in built-up areas, Total annual precipitation, Total annual water supply, Total annual electricity consumption
	Ecological Environmental Pressure	Industrial wastewater emissions, Industrial waste gas emissions, Industrial sulfur dioxide emissions, Industrial soot (powder) emissions
	Ecological Environmental Response	Sewage treatment rate, Harmless treatment rate of household garbage, Comprehensive utilization rate of industrial solid waste, Investment in construction projects completed this year, Afforestation area
Urbanization	Economic Urbanization	Per capita gross regional product, Share of gross regional product, GDP of secondary and tertiary industries, Per capita disposable income of permanent urban residents
	Population Urbanization	The proportion of employees in the secondary and tertiary industries, Urbanization rate, Number of employees at the end of the year
	Social Urbanization	Registered urban unemployment rate, Per capita expenditure on education, Number of health technicians, Number of full-time teachers in ordinary secondary schools
	Land Urbanization	Per capita urban road area, Per capita park green area, Green coverage rate of built-up areas

2.2 Source and processing of indicator data

The data in this study were all sourced from Baotou Statistical Yearbook (2001-2023) and Inner Mongolia Statistical Yearbook (2001-2023), so as to ensure the authenticity and authority of the obtained data. In order to eliminate the effect of the differences in the dimensionality of each metric within the subsystems and among the main influences on the results of the calculations, and to ensure the scientificity of the evaluation results, the original data was normalized using the range normalization method in this study.

2.3 Weight calculation

In order to eliminate as much as possible the subjective arbitrariness in the index weighting process, in this paper we adopt the entropy method in the objective

weighting method to assign weights to the original indices separately, thus improving the authenticity and accuracy of the quantitative analysis results.

2.4 Construction of coupling coordination degree model

$$c = \left\{ \frac{f(x) \cdot g(y) \cdot h(z)}{\left[\frac{f(x) + g(y) + h(z)}{3} \right]^3} \right\}^{\frac{1}{3}} ; \quad D = \sqrt{C \times T} ; \quad T = \alpha f(\mathrm{x}) + \beta \mathrm{g}(\mathrm{y}) + \chi(\mathrm{z})$$

According to the relevant research results of the coupling model, ***f(x)***, ***g(y)*** and ***h(z)*** respectively, represent the comprehensive development index of tourism, ecological environment, and urbanization, and ***T*** is the comprehensive development index of the system. ***D*** is the degree of coupling coordination, reflecting the phylogeny level; ***C*** is the degree of coupling, the strength of the interaction between the reaction systems; after thorough consideration, it was decided that the three systems were equally important, and they were assigned $\alpha = \beta = \chi$ =1/2 and =1/3 respectively.

3. Result analysis

3.1 Comprehensive horizontal time series analysis

The integrated development indexes for tourism, ecological environment and urbanization show relatively clear fluctuation trends, with the ecological environment index showing a clear fluctuation feature, fluctuating between 0.3 and 0.6 over a long period of time. The composite index of urbanization showed a steady and continuous upward trend, rising from 0.0552 to 0.9472, an annual growth rate of 3.878 percent. The comprehensive development index of the tourism industry showed an upward trend and a downward trend, from 0.0494 in 2000 to 0.8807 in 2019 and a rapid decline from 2020 to 2022 due to the impact of COVID-19 pandemic. The gap in the composite development index showed a year-on-year trend of increasing volatility, but the tourism sector showed a better trend in the future.

3.2 Timing analysis of the coupling degree

The coupling degree experience of Inner Mongolia's tourism industry, ecological environment and urbanization system from 2000 to 2022 includes three stages: high-level coupling (2000-2003), high-quality coupling (2004-2021) and high-level coupling (2022). The coupling reaches the high-coupling phase in 2000, stays in the high-coupling phase for a long time from 2004 to 2021, and falls back to the high-coupling phase in 2022. The degree of coupling continued to increase from 0.7226 in 2000 to 0.9955 in 2014, and fell to 0.8814 in 2015. The overall trend of the coupling shows a rise in fluctuations-remaining stable-and a slight decrease. The system is in the massive coupling phase for a long time and the subsystems reach a regime of benign resonant coupling and exhibit consistent and ordered structural interaction relations.

3.3 Timing analysis of coupling coordination degree

From 2000 to 2022, the tourism-ecological environment-urbanization system in Inner Mongolia has shown a fluctuating trend of rising and slightly decreasing coupling coordination evolution. From 0.3485 in 2000, it continued to increase to 0.8055 in 2017, followed by a fluctuating decline in 2018. The type experience of coupling coordination degree: there are four evolution processes of coupling coordination degree, including mild disorder (2000-2003), moderate coordination (2004-2011), good coordination (2012-2021), and moderate coordination (2022), and they are in the stage of good coordination evolution for a long time, and show a good development trend. This is comprehensively reflected in the fact that the overall coupling and coordination among tourism, ecological environment and urbanization subsystems in Inner Mongolia has shown a good trend of continuous improvement in the process of continuous optimization and regulation, but there is still a large gap between achieving high-quality coordination.

4. Conclusion and discussion

4.1 Conclusion

In this paper, the comprehensive evaluation index system of tourism, ecological environment and urbanization is constructed comprehensively, and the comprehensive development level and interactive coupling relationship of the three systems of tourism, ecological environment and urbanization in Baotou during 2000-2022 are studied by using the coupling degree model, and the following conclusions are drawn: (1) From the perspective of the comprehensive development level of the system, the comprehensive development index shows a trend of continuous slow fluctuation and rise, and the comprehensive development index of urbanization has a prominent trend of continuous growth. The ecological environment has advanced from 2000-2009, urbanization from 2010-2022, and tourism has lagged for a long time; (2) From the perspective of coupling degree evolution process, the coupling degree evolution process has three stages: high-level coupling (2000-2003), high-quality coupling (2004-2021) and high-level coupling (2022), reflecting that the subsystems of tourism, ecological environment and urbanization have been in the process of collaborative interaction and mutual adaptation for a long time; (3) From the perspective of coupling coordination degree evolution characteristics, coupling coordination type experience: The overall development level of the coupling coordination degree is low, and there is still a big gap from the realization of the high-quality coordination stage. There are four coupling coordination processes, namely mild disorder (2000-2003), moderate coordination (2004-2011), good coordination (2012-2021) and moderate coordination (2022).

4.2 Discussion

Through a comprehensive analysis of the time evolution of the above coupling and coordination degrees, it can be seen that the tourism industry, ecological environment and urbanization system in Inner Mongolia are always in an interactive adaptation process of mutual integration and coordinated development. Tourism, ecological environment and urbanization are closely coupled and interactive. As

material carriers of tourism and urbanization development, the ecological environment supports the synergistic and interactive development of tourism and urbanization in terms of the abundance of tourism resources and creates the conditions for spatial scale expansion and spatial pattern evolution of urbanization. The development of the tourism industry can effectively improve regional economic benefits, promote the optimization and upgrading of the industrial structure of tourist destination cities, and promote the process of green new urbanization. Urbanization is an important support for the development of the tourism industry, which can promote the continued growth of the tourism economy, improve the image of the tourism industry, and enhance the quality of the development of the tourism industry. In short, tourism, the ecological environment and urbanization complement each other, promote each other, interact with each other and constrain each other. Realizing the coupling and coordination of the three is crucial to establishing the harmonious coexistence of human-land relations. Improving the efficiency of the utilization of natural resources and strengthening the governance and protection of the ecological environment are central and key to enhancing the system's capacity for coordinated development.

The 2019-2022 COVID-19 pandemic is the main reason for the continuous improvement in the degree of coupled coordination of constrained systems. In addition, through the comparative analysis of the 2000-2022 comprehensive index of tourism, ecological environment and urbanization system, it is found that the lagging coupling coordination type of tourism is more dominant, which can also reflect that the rapid development of social economy is an important premise and foundation for the continuous promotion of urbanization in Inner Mongolia and the rapid growth of tourism demand of urban and rural residents. The sustainable growth capacity of the regional economy and the management and protection of the ecological environment are the main limiting factors that limit the coupling and coordinated development of the system. Tourism will certainly be a new engine for the high-quality development of the regional economy in the future. The coupling coordination of the system is highly positively correlated with the level of development of the ecological environment, with a downward trend with the quality of the ecological environment. Recommendations: strengthen the governance, protection, restoration and improvement of the ecological environment, and effectively promote the overall tourism, ecological environment and urbanization system to a high-quality coordination stage; strengthen the protection and restoration of the ecological environment and improve its carrying capacity; strengthen the internal driving force behind urbanization and foster a balanced relationship between human-land.

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