Research on Tourism Economic Development from the Perspective of Ecological Security: A Case Study of Xi'an

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Abstract: The research on the process of interaction between urban ecological security and tourism economy has a positive impact on the coordinated development of population, society, economy and environment. Taking Xi'an as an example, this paper uses the data from 2010 to 2015 to construct an evaluation index system, determines the weight based on the entropy method, and uses the coordinated development model to evaluate and analyse the coordinated development level of ecological security and tourism economy in Xi'an. The results show that the comprehensive evaluation index of tourism economy and ecological security in Xi'an from 2010 to 2015 is on the rise, and the type of coordinated development presents an obvious stage development, from the declining recession in 2010-2011 to the coordinated development in 2012-2015. There is a benign interaction and coordinated development relationship between the tourism economy and the ecological security system.

1. Introduction

Affected by the macroeconomic situation and social development, China's tourism industry is transformed from focusing on economic development and ignoring environmental protection to an ecological security development model. For one thing, the tourism economy must change the traditional mode of extensive development, and transform into a green, low-carbon, and circular new mode. For another thing, the promotion of urban ecological security will contribute to the development and innovation of the new tourism economy.

Foreign scholars' researches on the coordinated development of tourism economy and ecological security mainly focus on the ecosystem services of tourism cities [1], eco-tourism [2], tourism safety [3], and use factor analysis [4], regression analysis [5], cluster analysis [6] and other research methods. Domestic scholars' research in aspects such as ecological value assessment, ecological effects, optimal layout of ecological space and spatial effects of tourism ecological security. The tourism ecological footprint method, the ecological security level dynamic degree models and the grey correlation degree model are used to coordinate the tourism economy and ecological security of tourism destinations.

In summary, domestic researches focuses on the impact on tourism economy on the ecological environment, focusing on single factor [7], lacking the research on space-time evolution and interaction of ecological security and tourism economic systems [8]. This paper constructs Xi'an tourism economic and ecological security evaluation index system by means of pressure-state-response (PSR) model and entropy weight method. Based on the ecological security orientation, the evolution analysis of the coordinated development process of ecological security and tourism economy in Xi'an from 2010 to 2015 is carried out, and the suggestions and countermeasures for the coordinated development are proposed.
2. Construction of Evaluation Model of Tourism Economic Development Based on Ecological Security

2.1. Ecological security and tourism economy comprehensive benefit model

Firstly, the benefit index of the two subsystems of ecological security and tourism economy must be calculated, formulas are as follows:

\[ f(x) = \sum_{i=1}^{n} a_i x_i \]  
\[ g(y) = \sum_{j=1}^{n} b_j y_j \]

In formula (1) (2), \( a_i \) and \( b_j \) represents the weights of the evaluation indicators of the tourism economy and ecological security system. \( x_i \) and \( y_j \) is the i and j indicators describing the tourism economy and ecological security system. Standardize the raw data using the range calculation formula:

Positive: \( x_i' = \frac{x_i - \text{min}x_i}{\text{max}x_i - \text{min}x_i} \)  
Negative: \( x_i' = \frac{\text{max}x_i - x_i}{\text{max}x_i - \text{min}x_i} \)

In formula (3) (4), \( x_i \) represents the data after standardization calculation, \( x_i \) represents the original data, \( \text{min}x_i \) and \( \text{max}x_i \) represent the minimum and maximum values in the original column. The corresponding \( y_j \) is calculated in the same way.

2.2. Coordinated development degree calculation model

This paper cites the coordinated development model to measure the degree of coordinated development of ecological security and tourism economic system. The formula is as follows:

\[ D = \left( \frac{f(x)g(y)}{f(x) + g(y)} \right)^k \times T \]  
\[ T = \alpha f(x) + \beta g(y) \]

In formula (5): \( D \) is the coordinated development degree, \( T \) is the comprehensive benefit index of ecological security and tourism economic system, and \( \alpha \) and \( \beta \) are undetermined coefficients. Since tourism economy and ecological security are equally important to urban development, take \( \alpha = \beta = 0.5 \). \( k \) is the adjustment factor (\( k \geq 2 \)), taking \( k = 2 \). This paper refers to Liao Zhongbin's distribution function to determine the coordination degree [9] (table1).

Table 1. Classification criteria of tourism economy and ecological security coordination degree

| coordinated degree(D) | Coordination level            | coordinated degree(D) | Coordination level            |
|-----------------------|--------------------------------|-----------------------|--------------------------------|
| 0-0.09                | Extremely disordered           | 0.50-0.59             | Reluctantly coordinate development |
| 0.10-0.19             | Severe imbalance               | 0.60-0.69             | Primary coordinated development |
| 0.20-0.29             | Moderate imbalance             | 0.70-0.79             | Intermediate coordination development |
| 0.30-0.39             | Mild disorder                  | 0.80-0.89             | Good coordination development |
| 0.40-0.49             | On the verge of recession      | 0.90-1.00             | Quality Coordination Development |

In addition, \( f(x) = g(y) \) is the synchronous development of ecological security and tourism economy; \( f(x) > g(y) \) is ecological safety lag type; \( f(x) < g(y) \) is the lag of tourism economy.

3. Analyses on the Coordinated Development of Tourism Economy and Ecological Security in Xi'an

3.1. Introduction to the study area
Xi'an is the capital of Shaanxi Province. In 2017, a total of 18,093,400 tourists were received, achieving total tourism revenue of 163.33 billion yuan, accounting for nearly 22% of the total output value. Tourism plays an important role in the development of the national economy. Therefore, it is important to coordinate the relationship between tourism and ecological security.

3.2. Concept definition and evaluation index system

The International Institute for Applied Systems Analysis (IIASA) proposes the concept of ecological security, emphasizing that ecological security is the ability of people to live, to live in health, to be comfortable, and to adapt to environmental changes, and the state of social order, sources of life security, basic rights and necessary resources are not threatened, including natural ecological security, economic ecological security and social ecological security. The coordination relationship between ecological security and tourism economic system can be defined as the interaction between tourism and economic, social and natural factors in the evolution of urban ecological security system. The specific performance is as follows: (1) Economic ecological security is the foundation of tourism economic development, which can meet the needs of tourists for transportation, interest demands, sightseeing and shopping; (2) Social ecological security provides better protection for residents in education, medical care, and health services, and provides a good cultural environment for the healthy development of tourism; (3) A good natural environment is a unique tourism resource that attracts tourists.

Based on the above analysis and pressure-state-response (PSR) conceptual model, the Xi'an tourism economic and ecological security evaluation index system was constructed [10], including 6 I-level indicators and 25 second-level indicators. Using entropy weights method to determine indicator weights (Table 2). The data sources are “Shaanxi Statistical Yearbook”, “Xi’an Statistical Yearbook”, “China Forestry Statistical Yearbook” and the State of the Environment Bulletin.

Table 2. Evaluation Index Systems and Weights

| Level I indicator | Level II evaluation index | Indicator type | Weights |
|-------------------|---------------------------|----------------|---------|
| A1                | A11 Total number of tourists(10000 person-times) | Positive | 0.1158 |
| Tourism           | A12 Number of international tourists(10000 person-times) | Positive | 0.104  |
| effect            | A13 Number of domestic tourists(10000 person-times) | Positive | 0.1161 |
| A2                | A21 Total tourism earnings(100 million yuan) | Positive | 0.1129 |
| Tourism           | A22 International tourism income(Ten thousand dollars) | Positive | 0.1431 |
| income            | A23 Domestic tourism income(Billion) | Positive | 0.1114 |
|                   | A24 Tourists' per capita expenditure(yuan) | Positive | 0.0812 |
| A3 Tourism        | A31 Tourism value added as a proportion of GDP(%) | Positive | 0.1055 |
| Industry          | A32 Comprehensive contribution of tourism to GDP (%) | Positive | 0.1099 |
| B1 natural        | B11 Public green space area per capita(m2) | Positive | 0.0726 |
|                   | B12 Solid waste harmless treatment rate(%) | Positive | 0.0733 |
|                   | B13 Wastewater treatment rate(%) | Positive | 0.0685 |
|                   | B14 Industrial waste gas treatment rate(%) | Positive | 0.0643 |
|                   | B15 Air quality index | Negative | 0.0516 |
|                   | B16 Ambient noise(db) | Negative | 0.0529 |
| B2 economic       | B21 GDP per capita(yuan) | Positive | 0.0588 |
|                   | B22 Residential investment as a proportion of GDP(%) | Positive | 0.0564 |
|                   | B23 Environmental protection investment as a proportion of GDP(%) | Positive | 0.0839 |
|                   | B24 Public service facilities as a proportion of GDP(%) | Positive | 0.0623 |
|                   | B25 Technology investment as a proportion of GDP(%) | Positive | 0.0547 |
| B3 Social         | B31 Number of doctors per 10,000 people(person) | Positive | 0.0593 |
|                   | B32 Public transports per 10,000 people(vehicle) | Positive | 0.0588 |
|                   | B33 Number of schools per 10,000 people | Positive | 0.051  |
3.3. Evaluation of the coordinated development of ecological security and tourism economy in Xi'an

This paper substitutes the weights of various evaluation indicators of ecological security and tourism economic system into formula (1) and formula (2), and calculates the tourism economic benefit index $f(x)$ and ecological security benefit index $g(y)$ of Xi'an from 2010 to 2015. According to formula (5), the coordinated development degree (D) of tourism economy-ecological security system in Xi'an from 2010 to 2015 is calculated (Table 3), and the trend of coordinated development of tourism economy-ecological security system in Xi'an from 2010 to 2015 is drawn (Figure 1).

Coordinate development evolution analysis: (1) In the stage of dysfunctional recession (2010-2011), the coordination degree of tourism and ecological security in Xi'an increased from 0.4589 to 0.4966. From 2010 to 2011, urban ecological security construction was rapid, while tourism development was lagging behind and the pace of development was inconsistent, resulting in low coordination between the two systems. (2) Coordinated development stage (2012-2015), the coordination degree of the two systems increased from 0.6744 in 2012 to 0.9181 in 2015. Although the development level of tourism economy in 2012-2013 is lower than ecological security, the rate is faster. Therefore, the coordinated development of the two systems has greatly increased, from primary coordinated development to intermediate coordinated development; from 2014 to 2015, the coordinated development level of tourism economy and ecological security has gradually improved. The coordinated development type has been optimized from good coordinated development to high-quality coordinated development. The level of tourism economic development is higher than ecological security. In total, 2014-2015 is an ecological security lag type; 2010-2013 is the lag of tourism economy.

3.3.1. Ecological security aspects. The Xi'an ecological security benefit Index rose from 0.2725 in 2010 to 0.7712 in 2015. According to Table 2, air quality index, and ambient noise have lower weights, which are the main factors threatening ecological security. The government must introduce environmental protection programs to deal with serious atmospheric and industrial pollution, adjust industrial structure, optimize energy structure, improve transportation structure, and actively respond to heavy pollution weather.

3.3.2. Tourism economic development. The Xi'an Tourism Economic Benefit Index is on the rise, from 0.1831 in 2010 to 0.9524 in 2015. According to Table 2, the international tourism income weight is the highest, at 0.1431. With the rapid development of urban social economy and the important opportunity for Xi'an as an important tourist destination and hub of the Belt and Road, the growth rate of international tourism has increased significantly. The per capita spending weight is the lowest, at 0.0812, indicating that the low cost of tourists is the most important factor restricting the development of tourism economy in Xi'an. It should deeply analyze the new characteristics of tourists' consumption demand, develop leisure, holiday and experiential tourism products, promote the transition of tourism to a new model of green, innovation, openness, sharing and coordination.

Table 3. 2010-2015 tourism economy in Xi'an - ecological security system coordination and coordination of the degree of development

| years | $f(x)$ | $g(y)$ | $T$   | $D$    | Coordinated development type                           |
|-------|--------|--------|-------|--------|--------------------------------------------------------|
| 2010  | 0.1831 | 0.2725 | 0.2278| 0.4589 | On the verge of recession; Tourism economy lag          |
| 2011  | 0.2102 | 0.3537 | 0.2819| 0.4966 | On the verge of recession; Tourism economy lag          |
| 2012  | 0.4178 | 0.51   | 0.4639| 0.6744 | Primary coordinated development; Tourism economy lag    |
| 2013  | 0.5363 | 0.5639 | 0.5501| 0.7412 | Intermediate coordination development; Tourism economy lag |
3.4. Conclusion

Coordination type evolution: From 2010 to 2015, the coordinated development level of ecological security and tourism economy in Xi'an continued to rise, and the coordinated development index increased from 0.4589 in 2010 to 0.9181 in 2015, from the dysfunctional recession (2010-2011) to coordinated development (2012-2015), with obvious phase characteristics.

Coordinate development level of ecological security and tourism economy: In 2012, Xi'an tourism economy and ecological security system reached the level of primary coordinated development. The coordinated development degree in 2010-2013 shows that the tourism economy develops behind the ecological security and the level is low. The lag of tourism economy is manifested in insufficient supply and low consumption. From 2014 to 2015, the tourism industry has led the development of ecological security, indicating that the construction of ecological security cannot meet the needs of the development of the tourism industry. The lag of ecological security is manifested in noise and air pollution.

3.5. Suggestion

Relevant tourism departments should focus on developing new products, and promote the transformation and upgrading of tourism consumption. It is a new trend of tourism economic development to explore the deep connotation of humanities tourism resources, improve the single structure of tourism products, and promote the comprehensive development of tourism.

The government and relevant departments need to promote industrial integration and innovate tourism development models. The tourism sector needs to strengthen the integration of tourism with agriculture, industry, culture, and information industry, explore the development model of tourism, information industry and cultural integration, enhance and cultivate the core competitiveness of tourism, and accelerate the transformation and upgrading of tourism.

Most scenic spots need to strengthen environmental supervision and implement green ecological management. Local governments and tourism operators can scientifically estimate the scale of
development, environmental capacity, scarcity and renewability of resources, and the impact on tourism activities on the environment through the introduction of green ecological management techniques.

4. Discussion
In this paper, the entropy weight method is used to construct a coordinated development degree model. Based on the ecological security orientation, Xi'an tourism economic development has been studied in depth, breaking through the limitations of single element as research content; the combination of macroeconomic and microdata, the study of other cities, urban agglomerations and the application of evaluation models are the future research directions.

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