Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

Pol. J. Environ. Stud. Vol. 33, No. 5 (2024), 1-13
DOI: *10.15244/pjoes/177424* ONLINE PUBLICATION DATE:

Original Research

Coordinated Development of the Tourism Industry and Ecological Environment: A Case Study of Hubei Province in China

Yang Yue[1]*, Rao Haomiao[2]

[1]School of Economics, South-Central Minzu University,Wuhan 430070, China
[2]School of Philosophy, Wuhan University, Wuhan 430070, China

Received: 14 October 2023
Accepted: 21 December 2023

Abstract

The ecological environment provides good environmental conditions for the development of the tourism industry, and the development of the tourism industry also plays a vital role in the ecological environment, and the dependence of the tourism industry on the ecological environment leads to a complex interactive relationship between the two. Therefore, it is crucial to study the coordinated development relationship between the tourism industry and the ecological environment. This study takes 2012-2019 as the time span to construct the Pressure-State-Response (PSR) model framework of the coupling and coordination mechanism between the tourism industry and the ecological environment in Hubei Province. Comprehensively using the entropy value method, the coupling coordination degree model method, and statistical software such as SPSS, ArcGis, Excel, etc., an empirical analysis was done on the integrated development of ecological environment and tourism industry in Hubei Province, and the relationship between the two was explored. The purpose of this study is to reveal the coupling development and dynamic trend between the tourism industry and the ecological environment, and to provide insights for the realization of the coordinated sustainable development of the tourism industry and the ecological and vibrational environment in Hubei Province, as well as in regions with the same industrial characteristics. The results show that the coupling index of tourism industry and ecological environment system in Hubei Province has developed steadily since 2012, and the coordination index shows a general upward trend fluctuation. However, the coordination effect of various factors between the tourism industry and the ecological environment system in Hubei Province is not obvious enough. The coupling level between the tourism industry and the ecological environment is low. Based on the analysis results, the contradictions existing in the coordinated development of the tourism industry and the ecological environment in Hubei Province are analyzed, and countermeasures are proposed to solve them, aiming to promote the high-quality and deep integration of the ecological environment

*e-mail: 631210896@qq.com

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

and tourism industry in Hubei Province. More detailed interaction mechanisms and paths between the tourism industry and the ecological environment protection will be further explored in the future.

Keywords: tourism industry, ecological environment, coupled coordination model, Hubei Province

Introduction

Developing the tourism industry is an important means of economic prosperity, and since the reform and opening up, China's tourism industry has developed rapidly. The number of domestic tourists in 2019 was 6.006 billion [1], up 8.4% from the same period of the previous year; total tourism revenue for the year amounted to 6.63 trillion yuan, up 11% year-on-year. The tourism industry, which has suffered since the epidemic, is also beginning to recover in 2023, and it has indispensable advantages for the development of the national economy. However, the development of tourism industry is also a double-edged sword, often accompanied by the deterioration of the ecological environment, especially the rough development led by tourism resources will bring a series of environmental problems [2], the tourism industry wants to realize the sustainable development which, to a large extent, depends on the ecological environment of the tourist destination is good. A good ecological environment is one of the basic conditions for attracting potential tourists, local tourism promotion, and the development of the local tourism industry. Under the guidance of standardization and specialization of the tourism industry, local residents will pay attention to grass-roots governance and ecological environmental protection, consciously following the concept of sustainable development, and promoting urban and rural green development with the tourism industry as a model, is in line with the immediate interests of the local government, enterprises ,and residents, so as to form a community of destiny for the ecology and the environment, and to jointly push forward the high-quality and unified development of the urban and rural economic construction, environmental construction, and social construction. The tourism industry is strongly dependent on the environment, so it is inextricably linked with the ecological environment. As a "green sunrise industry" in the context of the new era, the tourism industry and the ecological environment are characterized by interactivity and promotion, which provides convenience and conditions for the coordinated development of the ecological environment and the tourism industry. On the one hand, a good ecological environment will promote the development of the tourism industry, [3, 4] and the ecological environment is an essential condition for the tourism industry, while the prosperous development of the tourism industry will also provide material conditions for the improvement and protection of the ecological environment. On the other hand, excessive pursuit of economic benefits of the tourism industry will lead to environmental degradation, which will hinder the sustainable development of the tourism industry [5]. Therefore, the coordinated development relationship between tourism industry and ecological environment has gradually become one of the research hotspots concerned by scholars at home and abroad, which has an important theoretical and guiding value.

Literature Review

Since recognizing the ecological environment problem, human beings have never stopped thinking about the relationship between the ecological environment and industrial development. Foreign countries started exploring the relationship between tourism and the ecological environment back in the 1920s, when the American scholar Meinecke [6] opened the research on this aspect of ecological environment protection. With the development of the tertiary industry and the prosperous development of the tourism economy, scholars at home and abroad began to focus on the study of the relationship between the ecological environment and the tourism industry. Stephen [7] studied the mechanism of the impact of tourism development on the natural environment, and argued that it is believed that tourism development has both positive and negative impacts on the environment of the destination. Joseph E. [8] also concluded that tourism development, although it can have a negative aspect on the regional environment, can also bring favorable aspects to the environment if tourism activities are coordinated and friendly with the ecological environment. Chali [9], Lee C and Kwon K [10] used the cointegration model to explore the relationship between tourism and regional economy, and found that the tourism industry has a role in promoting the long-term development of the region's regional economy, and there is a certain equilibrium relationship between the two. Brahmasrenen T., Lee J.W. [11] used a regression model to analyze the ecological environment generated by the development of the Southeast Asian tourism economy negative effect.

In the coordinated development of the tourism industry and ecological environment, Wall G and Wright C [12] found the coupling relationship and interaction mechanism between tourism and ecological environment in their study, which provides a new perspective for future research work. The concept of "coupling" originates from physics and refers to the relationship between two or more systems that interact and influence each other [13]. As one of the methods to measure the effect of interaction, coupling has been widely used in industry and environment research. With the introduction of coupling theory by K.E. Weick

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

in the study of social economics and its generalized application, Gelsoa et al. [14], Bestard et al. [15], Roca et al. [16] carried out the research on the coupled and coordinated relationship between tourism and ecological environment with the help of the coupled evaluation model, and assisted in the use of methods such as the Environmental Kuznets Curve to analyze the coordination between the tourism industry and the ecological environment empirically. The situation was empirically analyzed. Chinese scholars have also gradually increased the research on the relationship between environment and tourism industry, Wang Hui et al [17] used the concept of "coupling" in the relationship between tourism and environment, which paved the way for the subsequent study of the tourism industry and ecological environment protection, Ye Li [18], Wang Zhaofeng [19], Hu Jiran [20], Wang Cheng [21], Liu Zhizhi et al [22] used the coupling coordination degree model to evaluate the coordination between tourism industry and ecological environment in Guangxi, Yellow River Basin, five northwestern provinces, Sichuan, and Guizhou, respectively. They used the coupled coordination degree model to evaluate the coordination of tourism industry and ecological environment in Guangxi, Yellow River Basin, five northwestern provinces, Sichuan and Guizhou, respectively.

At present, there are some research results on the relationship between tourism industry and ecological environment, but no scholars in Hubei Province as a research object to explore the relationship between the two, Hubei Province as a large province of tourism resources in the central region of China, in the government's policy support and encouragement, the development of the tourism industry in the number, scope and types of expanding, domestic and international influence continues to improve, but for the coordination of the tourism industry and ecological environment in Hubei Province, there is a gap in the mechanism of research. In view of this, this paper takes Hubei Province as the research object, and takes 2012-2019 as the time limit to study and explore the relationship between ecological environment and tourism industry in Hubei Province, analyze the coordinated relationship between the two, aiming to make theoretical guidance for the high-quality development of tourism industry and sustainable development of ecological environment in Hubei Province.

Study Areas and Data Source

Study Areas

Hubei Province (Fig. 1), abbreviated as "E", is a provincial administrative region of the People's Republic of China, with Wuhan as its capital. It is located in the central region of China, bordering Anhui in the east, Chongqing in the west, Shaanxi in the northwest, Jiangxi and Hunan in the south, and Henan in the north, between latitude 29°01′53″-33°6′47″N and longitude 108°21′42″-116°07′50″E, with an east-west length of about 740 kilometers and a north-south width of about 470 kilometers, with a total area of 185,900 square kilometers, accounting for 1.94% of China's total area [23]. As of the end of 2022, Hubei Province had a resident population of 58.44 million. The terrain of Hubei Province is roughly an incomplete basin surrounded by mountains to the east, west, and north, with a low level in the center and slightly open to the south. In the total area of the province, mountains account for 56%, hills account for 24%, plains and lakes account for 20%, belonging to the Yangtze River system. Hubei Province is located in the subtropics, and most of the province has a humid subtropical monsoon climate, except for the high mountainous areas, which have an alpine climate. In 2022, Hubei Province realized a GDP of 5,373,492 million yuan, of which the added value of the primary industry was 498,672 million yuan, the added value of the secondary industry was 2,124,061 million yuan, and the added value of the tertiary industry was 2,750,759 million yuan. The per capita GDP was 92,059 yuan, and the tourism revenue in 2021 was 602,828 million yuan.

Hubei Province, as a key area for economic and social development in the central region of the country, started as early as 1996, the Hubei Provincial Government clearly pointed out in the report document "Decision of the Hubei Provincial People's Government on Accelerating the Development of Tourism" that it would make efforts to promote tourism to become a pillar-type industry for the development of the national economy and society in Hubei Province, and to realize the goal of constructing a strong tourism province as soon as possible. By the end of 2019, Hubei Province had 12 5A-level tourist attractions, 1,267 travel agencies, an increase of 12.72% over the previous year, 428 A-level scenic spots, 330 starred hotels, 22 5A-level starred hotels, 82 4A-level starred hotels, 32 4A-level travel agencies, and 15 5A-level travel agencies. As the development of tourism industry continues to mature, the tourism industry chain of Hubei Province continues to deepen and the forms of tourism are rich and diversified, and the tourism industry of Hubei Province has become a comprehensive industry with complete types, long chain of industry extension and remarkable results. In order to give full play to the role of innovative tourism towns in driving the development of tourism industry, Hubei Province has increased the construction of tourism political districts, and by the end of 2020, there will be more than 40 tourism counties, more than 150 innovative towns, and more than 200 famous tourism villages and new tourism communities in Hubei Province. The effect of tourism industry in Hubei Province is remarkable, and tourism directly and indirectly drives more than 200,000 people out of poverty.

The mountainous, hilly and granular areas and the plains and lakes in Hubei Province account for 56%, 24% and 20% of the total area of Hubei Province.

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

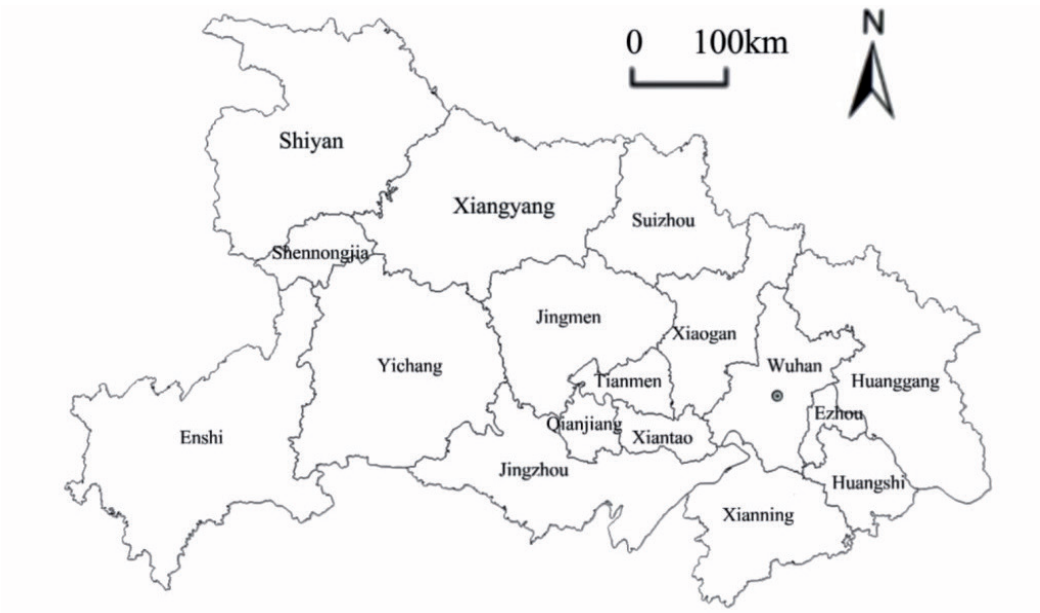

Fig. 1. The study area.

Hubei Province is located in the mid-latitude area and has a subtropical monsoon climate with four distinct seasons, abundant light energy, abundant heat, a long frost-free period, abundant precipitation, rain and heat in the same season, and good ecological conditions. However, affected by a number of factors, such as natural conditions and human activities, the economic and social development of Hubei Province has been unbalanced and unhealthy in the long period after the founding of New China, especially in the rural areas with backward production and living styles, destruction of vegetation, soil erosion, mountain deserts, shrinking of lakes and lakes, and the destruction of the vegetation in the countryside. Destruction, soil erosion, mountain deserts, shrinking lakes, crowded rivers, soil and water pollution, frequent floods, land disasters, the ecological environment is very fragile. This poses a serious threat to the sustainable development of Hubei Province.

Data Source

This study mainly selects the data of the ecological environment system and the tourism industry system of Hubei Province for the eight years from 2012 to 2019 to study the coupled and coordinated development status of the ecological environment and the tourism industry in Hubei Province. Because all aspects of the data after 2019 will change considerably due to the impact of the epidemic, which will have a significant impact on the validity of the findings [24, 25], only data up to 2019 have been selected for this paper. The data for the indicators involved in this study were obtained from the 2012-2019 Hubei Statistical Yearbook and China Urban Statistical Yearbook, the Statistical Bulletin of National Economic and Social Development, the Hubei Provincial People's Government website, the Hubei Provincial Bureau of Statistics website, the website of the Hubei Provincial Department of Culture and Tourism, and the website of the Department of Ecology and Environment, among other statistical data. The relevant panel data are directly quoted or reasonably calculated and processed for use. If there are still missing data after data collection in the above way, the multiple interpolation method in SPSS software is used to correct and supplement the missing data to ensure the authenticity and validity of the data.

Materials and Methods

Construction of an Evaluation Index System

The establishment of a scientific and reasonable evaluation index system is related to the accuracy and authenticity of the research results in practical application. Based on the complex relationship between the tourism industry and the ecological environment, the selection of a comprehensive evaluation index system reflecting the level of development of the ecological environment and the tourism industry should take into account not only the basic situation of Hubei Province, but also the mechanism of the interaction between the tourism industry and the ecological environment of Hubei Province, and it is necessary to follow the principles of systematicity, representativeness, and objectivity during the process of constructing a comprehensive evaluation index system of the two systems of the ecological environment and the tourism industry [26]. After analyzing the actual situation of the tourism industry and ecological environment in Hubei Province, this study chooses to use the PSR model to construct a comprehensive evaluation index system for the two systems of ecological environment and tourism

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

Table 1. Evaluation index system.

Subsystem	Target Layer	Index Layer	Index Unit	Positive /negative	Weight
Ecological environment	Ecological state	Forest coverage rate	%	+	0.0253
		Green coverage rate in built-up area	%	+	0.0298
		Average per capita water resources	Person/m^3	+	0.0207
		National Nature Reserve	/	+	0.0246
	Ecological pressure	Industrial waste gas emissions	Billion standard cubic meters	—	0.0426
		Total industrial wastewater	10 kt	—	0.0885
		Industrial solid wastes produced	10 kt	—	0.0639
	Ecological response	Rate of garbage harmless disposal	%	+	0.0326
		Investment in wastewater treatment	1,000 yuan	+	0.0707
		Investment in waste gas treatment	1,000 yuan	+	0.0327
		Investment in solid wastes treatment	1,000 yuan	+	0.1645
Tourism industry	Market scale	Domestic tourists	10,000 people	+	0.0225
		Inbound tourists	10,000 people	+	0.0395
		Total tourists	10,000 people	+	0.0605
	Industry base	Number of travel agencies	/	+	0.0427
		Number of tourist hotels	/	+	0.042
		Number of tourist attractions	/	+	0.03
		Share of service workers in accommodation and catering	%	+	0.0436
	Economic benefits	Total tourism revenue	100,000,000 yuan	+	0.0474
		Ratio of tourism revenue to GDP	%	+	0.0427
		Ratio of tourism revenue to the tertiary industry	%	+	0.0333

industry in Hubei Province. Among the indicators of the tourism industry system, 10 indicators were selected from three dimensions, namely, market scale, industry base and economic benefits, in order to comprehensively assess the level of development of the tourism economy. In terms of the ecological environment system, this paper selects 11 indexes from three dimensions based on the PSR model in order to comprehensively assess the level of development of the ecological environment. The PSR model was developed by the Organization for Economic Co-operation and Development (OECD) and the United Nations Environment Programme (UNEP) to study issues related to the environment, resources and sustainability. [27, 28] (show in Table 1) On the one hand, human activities put a certain degree of pressure on the ecological environment, thus causing changes in the ecological environment. On the other hand, human societies should respond to environmental changes by restoring the quality of the ecosystem or preventing further environmental degradation. Currently, PSR models are widely recognized and applied in environmental [29, 30] fields, ecology [31, 32] and ecological [33, 34] security.

Data Standardization

Due to the large number of indexes established and the different measurement methods, their values and dimensions vary greatly, and they need to be standardized to eliminate the influence of various metrics on the indicator data and to avoid invalidating the assessment results due to differences in metrics [35, 36]. Categorizing the indexes into positive and negative indexes, the efficacy function can be expressed as follows:

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

Positive function:

$$U_{ij} = \frac{X_{ij} - min(x_{ij})}{max(X_{ij}) - min(X_{ij})}$$

Negative function:

$$U_{ij} = \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij}) - \min(X_{ij})}$$

Entropy Method

According to the research of scholars and the use of methods, entropy is often used in comprehensive evaluation, indicating the strength of the role of an index element. The greater the entropy value, the greater the weight of the index, and vice versa. The entropy value method is an assignment method using the basic significance of entropy, matrixing the processed data and finalizing the entropy weights to arrive at the final weight values according to the basic definitions and evaluation methods [37, 38].

The entropy value method is an objective assignment method, which can avoid the bias caused by subjective factors, and the specific steps are as follows:

Weighting transformation of the index:

$$S_{ij} = \frac{X}{\sum_{i=1}^{n} X} \text{ i=1, 2, ..., m j=1, 2, ..., n}$$

Calculating the entropy of an index:

$$h_i = -\sum_{j=1}^{n} S_{ij} \ln S_{ij} \text{ i=1, 2, ..., m j=1, 2, ..., n}$$

Retrograde the index value:

$$\text{ai} = \frac{\max \text{ hj}}{\text{hj}}, \text{ ai} \geq 1$$

Calculation of the weights of the indexes:

$$W_j = \frac{a_j}{\sum_{j=1}^{n} a_j}$$

Coupled Coordination Model (CCM)

The coupling coordination degree model is used to measure the level of coordinated development between things. The degree of coupling refers to the influence of interrelationships between two or more systems to achieve coordinated development of the dynamic correlation relationship, which can reflect the degree of interdependence and mutual constraints between systems [39-41]. Coupling coordination degree refers to the size of the degree of benign coupling in the coupling interaction relationship, which can reflect the coordination status as being good or bad. In this paper, the different value ranges of the coupling degree and coupling coordination degree are divided into different types, and the specific division criteria are shown in Table 2.

Coupling function:

$$C = \frac{2\sqrt{U1 \times U2}}{U1 + U2}, \quad 0 \leq C \leq 1$$

C is the coupling degree of the two systems of ecological environment and tourism industry development, the value of C is between 0 and 1 [42], the larger the value of C indicates that the coupling is better.

Since the coupling degree is not sufficient to reflect the degree of coordination of the system, a coupled coordination degree model is introduced:

$$D = (C \times T)^{\theta}$$

D is the coupling coordination degree, C is the coupling degree, and T is the coordination index. θ is the reconciliation coefficient.

In order to reflect the degree of coordination development more intuitively, the degree of coupling coordination is categorized into the following types [43-45].

Results

Analysis of Coupled and Coordinated Development of the Tourism Industry and Ecological Environment in Hubei Province

This part utilizes the coupling coordination degree model to empirically analyze the relationship between tourism industry and ecological environment in Hubei Province. The tourism industry and the ecological environment affect each other and constrain each

Table 2. Classification of the degree of coupling coordination.

Coupling Coordination Degree (D)	Coordination Level	Coupling Coordination Degree (D)	Coordination Level
0-0.09	Extreme disorder	0.5-0.59	Grudging coordination
0.1-0.19	Severe disorder	0.6-0.69	Primary coordination
0.2-0.29	Moderate disorder	0.7-0.79	Intermediate coordination
0.3-0.39	Mild disorder	0.8-0.89	Good coordination
0.4-0.49	On the verge of disorder	0.9-1	Quality coordination

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

Table 3. Results of coupled coordinated development calculations.

Year	Coupling Degree Index C	Comprehensive Development Index T	Coupling Coordination Degree Index D	Coordination Level
2012	0.244	0.233	0.239	Moderate disorder
2013	0.539	0.329	0.421	On the verge of disorder
2014	0.803	0.412	0.575	Grudging coordination
2015	0.599	0.361	0.465	On the verge of disorder
2016	0.583	0.507	0.543	Grudging coordination
2017	0.780	0.592	0.680	Primary coordination
2018	0.699	0.490	0.585	Grudging coordination
2019	0.439	0.681	0.547	Grudging coordination

other. This part analyzes the relationship between the two systems according to the coupling coordination development degree measurement model in the research method, and calculates the coupling degree C, coordination index T and coupling coordination development degree D. The results obtained through the model are shown in the Table 3.

As can be seen from Table 3 the coupling degree C between the tourism industry and the ecological environment system in Hubei Province was gradually increasing during the study period, and it even reached 0.78 in 2017. The coupling coordination degree D is more responsive to the relationship between the tourism industry and the ecological environment in Hubei Province. From the coupling coordination degree D, the coordinated relationship between the tourism industry and the ecological environment in Hubei Province has continued to improve during the study period, and the coordinating ability of the two has been increasing, and although there is a phenomenon of falling back, it is still in the upward stage in general. This trend can be seen more clearly in Fig. 2. According to the results of the model, the tourism industry and ecological environment system in Hubei Province went from a moderate disorder in 2012 to a primary coordination in 2017, and there was a fallback phenomenon in 2018, and there is still a certain risk of fallback. It shows that the tourism industry in Hubei Province has developed greatly and the protection of the ecological environment has been effective, but there is still room for further optimization.

The degree of coupling and coordinated development of the tourism industry and the ecological environment system in Hubei Province from 2012 to 2019 can be calculated based on the data obtained. From the results (Table 3), it can be seen that the coupling degree index of the tourism industry and ecological environment system in Hubei Province has developed steadily since 2012, and the coordination degree index shows a general upward trend fluctuation. The degree of coupling between the tourism industry and the ecological environment in Hubei Province was mainly in the opposing stage before 2014, i.e., the degree of coupling coordination was between 0.3 and 0.5.

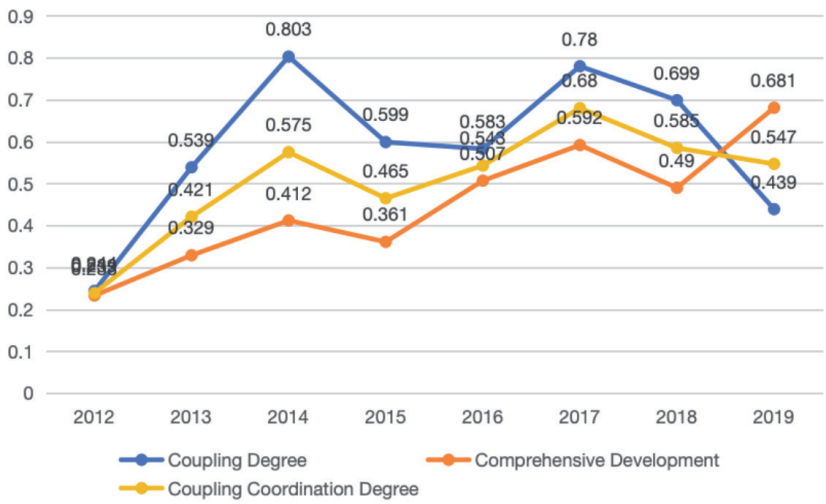

Fig.2. Coupling Coordination Diagram.

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

The above can be interpreted as implying that the coordinating effect of various factors between the tourism industry and the ecological environment system in Hubei Province is not obvious enough. The coupling level between the tourism industry and the ecological environment is very low, and the negative impacts of the growing tourism industry on the ecosystem are becoming more and more obvious. This is mainly due to the fact that Hubei Province's economic growth relies mainly on traditional manufacturing, an industry characterized by high energy consumption and pollution, so Hubei Province has paid a heavy price for environmental pollution along with economic growth. However, throughout the study period, the coupling between the tourism industry and the ecological environment in Hubei Province was generally in a state of growth (0.239 to 0.547), which suggests that the mutual influences and interactions between the two are gradually increasing.

From the point of view of tourism industry in Hubei Province, Hubei region is an important cultural tourism area in China, rich in tourism resources, Jing and Chu culture has a long history, numerous cultural relics, and at the same time has an extremely advantageous geographical location. At present, Hubei Province has already made certain achievements in building a first-class domestic tourism province and playing the international tourism business card of the golden belt of the Yangtze River. Therefore, with the development of tourism industry in Hubei Province and the emphasis on ecological environment, the coupling and coordinated development index of tourism industry and ecological environment system is also gradually rising, and promoting the high-quality and in-depth integration of ecological environment and tourism industry has been the inevitable trend of economic and social development in the new era. However, at present, the degree of coordination between tourism industry and ecological environment in Hubei Province is still not high enough, and the reasons for this are mainly the following: First, it was hit by the epidemic. As the hardest-hit area affected by the pneumonia epidemic, the cultural and tourism industry in Hubei Province has been hit hard, with a year-on-year loss of about 150 billion yuan in the first quarter of 2020 compared to the same period last year. Secondly, the innovative service capacity of the tourism industry is insufficient, and tourism products cannot meet people's growing cultural needs. Thirdly, the imbalance between tourism and economic development is prominent. Wuhan, Yichang, Enshi, Xianning and other regions have rapid development of tourism industry by virtue of their resource advantages and geographic advantages, but the development of tourism in other regions of Hubei Province is too slow. Lastly, Hubei Province, as a traditional industrial province, has not yet solved the long-accumulated ecological and environmental problems, such as the prominent environmental pollution problems, the crude production mode, the imperfect ecological system, and so on.

Coupling Mechanism of Tourism Industry and Ecological Environment

There are trade-offs between the tourism industry and the ecological environment in the short term, but in the long term both are key to the sustainable development of society, and the two systems promote and limit each other, so it is necessary to fully recognize the intrinsic connection between the two. This section discusses in detail the coupling mechanism between the tourism industry and the ecological environment, hoping to provide a theoretical basis for harmonizing the relationship between them. Since China's reform and opening up, the tourism industry has developed rapidly, but with ecological deterioration, which is manifested in soil erosion, forest degradation, serious acid rain, water pollution and other phenomena. The deterioration of the ecological environment in turn hinders the development of tourism economy. The development of the tourism industry needs good ecological conditions and tourism resources, and the tourism environment has a direct relationship with tourism income. The deterioration of the ecological environment and the depletion of ecological resources will make the tourist destination reduce the attractiveness of the tourism income and industrial development will be affected. Providing a good ecological environment is the fundamental condition for promoting the high-quality development of the tourism industry, and the interaction mechanism between the tourism industry and the ecological environment specifically refers to the fact that the ecological environment is the fundamental condition for the development of the tourism industry, and that the prosperity of the tourism industry is the source of motivation for ecological protection (Fig. 3).

The mechanism of the tourism industry's effect on the ecological environment is specifically reflected in:

(1) The development of the tourism industry has brought negative impacts on the ecological environment in a specific period of time. High-speed development of tourism economy and the process of commercialization of tourist cities to promote the process of economic over-expansive development, will produce a large number of "three wastes" [46], mainly including: reception service facilities emissions of dirt, such as hotels, restaurants discharged sewage, dumping of garbage and combustion of smoke and dust; tourists in the process of excursion discarded wastes; tourist car emissions of exhaust gas; aircraft and automobile noise generated by tourists, and other pollution to the water, atmosphere, and biological pollution. Emissions of exhaust gas; This has not only caused the reduction of ecological resources and the deterioration of the ecological environment in China, but also hindered the development of the tourism industry.

(2) The development of tourism industry is also the power source of ecological environmental protection and restoration [47]. Prosperous development of the tourism industry makes the rapid growth of the national economy, economic growth, and the

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

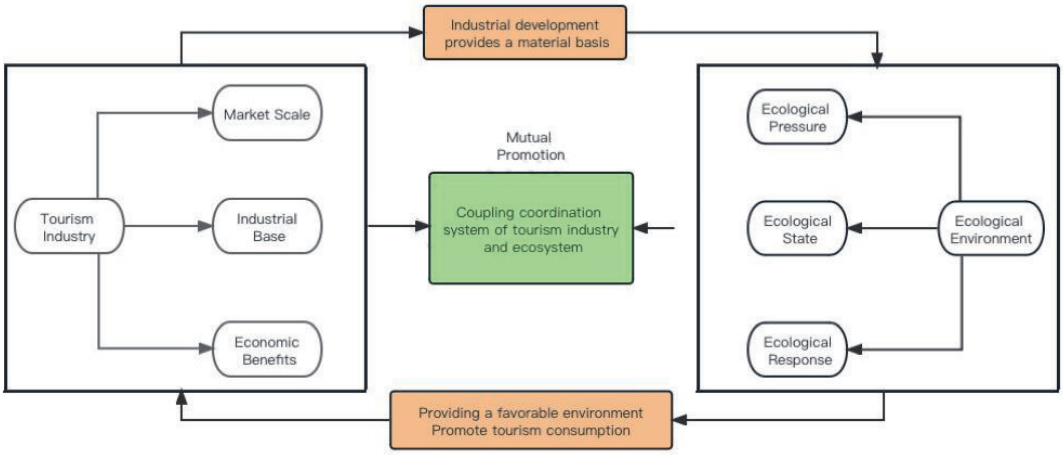

Fig. 3. Coupling mechanism of tourism industry and ecological environment.

improvement of people's quality of life, so that the economic and social basis for ecological environmental protection can be formed, people will only consider the sustainable development of the environment after improving the quality of life. Secondly, in the process of economic development, science and technology are also developing rapidly, adding technical guarantee for ecological environmental protection and restoration. Furthermore, in the process of tourism economic development, with the improvement of national quality, the high quality demand for tourism destinations and tourism experience also prompted the improvement of ecological environment can also enhance the sense of access to tourists, a sense of happiness.

The mechanism of the ecological environment on the tourism industry is specifically reflected in:

(1) A good ecological environment is an intrinsic requirement for high-quality economic development. The production resources and means of living needed for social development come from the natural environment, and transforming natural resources into economic advantages is the direct driving force for social development. Ecologically livable areas can also promote local economic development through the eco-tourism industry, and the development of eco-tourism, green tourism, organic tourism and other industries can promote local economic development and optimize the structure of the tourism industry.

(2) Ecological environment is the fundamental condition for the high-quality development of tourism industry [48-50]. The ecological environment directly affects the quality and service of tourist attractions, which in turn affects the development of the local economy. The deterioration of the ecological environment will lead to the reduction of tourism resources and threaten the development of the tourism industry. Reasonable protection of the ecological environment provides high-quality resources for the development of tourism economy, which is the fundamental condition and basic premise for the development of the tourism industry.

Conclusion

In this research, we delve into the interplay between the tourism industry and ecological sustainability in Hubei Province, a topic of increasing relevance in the context of China's strong commitment to sustainable development and the promotion of a green economy. This study is particularly pertinent, given the urgent need for the tourism sector in Hubei to modernize and meet the growing demand for high-quality tourism experiences. Our approach intertwines various theoretical frameworks, including tourism industry dynamics, ecological conservation, industrial integration, and systems coupling, to dissect the challenges and contradictions faced in integrating culture with the tourism industry in Hubei.

The paper begins by shedding light on the significance and current dynamics of the synergistic evolution of Hubei's tourism industry and its ecological milieu. Following this, we construct a comprehensive evaluation index system for assessing this interplay in Hubei. We then introduce a coupled coordination model, grounded in data from Hubei Province spanning 2012 to 2019, leading to some insightful findings. Our analysis reveals a steady advancement in the coupling coordination degree index between the tourism sector and ecological environment since 2012, marked by a generally ascending trend with fluctuations. Notably, the coupling between these two entities was predominantly antagonistic until 2014, with the coordination degree oscillating between 0.3 and 0.5. This indicates that the harmonious interaction of various factors within the tourism and ecological systems in Hubei has not been optimally realized.

The paper concludes by offering targeted recommendations and strategies to address these identified challenges, aiming to foster a more harmonious and sustainable development of the tourism industry in Hubei, in alignment with ecological conservation goals. On the basis of the above analysis of the tourism industry in Hubei Province and the

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

coordinated development of the ecological environment of the problems and contradictions: the tourism market players, overall development level is not high, the overall scale and strength of the industry needs to be improved; the industrial structure needs to be optimized and upgraded; the economic and regional development of the province of Hubei is not balanced, and the overall coordination of the development of the capacity needs to be improved.

Based on the above results, the following recommendations can be made.

First of all, we should play the role of government guidance and strengthen the supervision of departments [51]. Compared to other developed countries, China's current legal system in the ecological aspects of the relative lag, Hubei region for the green ecological development of laws and regulations are also relatively lacking, although China has pursued ecological civilization construction and green development to the level of the national policy [52], and put forward a series of related policies, there are no targeted green production laws and green tourism regulations. At present, the content of green development in the law is only scattered in the Environmental Protection Law, Air Pollution Prevention and Control Law, Solid Waste Pollution Prevention and Control Law and other laws. The imperfection of laws and regulations also leads to insufficient supervision and a low level of regulation [53]. In this regard, a series of recommendations are put forward: first of all, the government should combine the advantages of local location and development characteristics in tourism development, and correctly guide the development of tourism, and at the same time pay attention to the ecological benefits. Insist on the protection of the ecological environment, and the protection of all aspects of the implementation of policies to promote industrial optimization and upgrading. Secondly, we can strengthen the ecological civilization publicity, and put the ecological civilization into the establishment of the city image. In addition, the supervision of ecological environment should be strengthened, as ecological environment supervision ability and level directly affect the ecological environment. Analyze the current situation of ecological environment supervision in Hubei Province, and put forward suggestions according to different causes. Finally, strengthen the supervision mechanism to promote the long-term breakthrough of ecological civilization education. Accept social supervision to ensure that tourism ecological environment problems are effectively solved; play the role of public opinion supervision; further clarify the scope of public opinion supervision, processing and follow-up supervision and management; establish a public opinion supervision system for environmental protection; and promote the continuous improvement of environmental quality.

Secondly, we should strengthen the scientific and technological support [54], improve product quality and efficiency tourism development and ecological civilization construction cannot be separated from the improvement of the level of science and technology, China's ecological science and technology development is still facing many problems. In recent years, the government's investment in ecological although more and more large, but with ecological science and technology innovation needs do not match, cannot meet the needs of the development of green industry, and for the ecological protection of the basic technology research and quality supervision and other aspects of the investment is insufficient, mainly for high-tech research, however, high-tech research for the transformation of the economic benefits needs a long cycle, so it should be focused on the development of the applicable basic However, high-tech research needs a long period of time for the transformation of economic benefits, so it should also focus on the development of applicable basic technology research input.

Finally, macroeconomic control has been strengthened to promote coordinated regional development. Due to geographic location differences and different resource endowments, the regional development within Hubei Province is significantly different. In order to solve the problem of unbalanced and insufficient development of cultural and tourism integration in Hubei Province, the government coordinates the regional integrated development, realizes the flow of tourism resources in cities and villages, so as to promote the coordinated development of the urban and rural ecological environment and the tourism industry, and also makes full use of the role of tourism driven by the cities of Wuhan, Xiangyang, Yichang, Enshi, and with the help of the layout of the transportation network, promotes different regional development by strengthening the "One Belt One Road" tourism cooperation. It is also necessary to make full use of the tourism driving role of Wuhan, Xiangyang, Yichang and Enshi cities, and make use of the transportation network layout to promote the development of different regions through strengthening the "Belt and Road" tourism cooperation. Increase the introduction of green tourism projects, strengthen the role of project support, promote the spatialization of industrial layout, implement industrial layout and integrated planning into project construction, and give full play to Hubei Province's "ecological and cultural corridor", "Yichang Qingjiang Gallery" "Enshi Two Mountains Demonstration Base" and other cultural and tourism projects in Hubei Province, the radiation and driving role [55-58].

It aims to promote high-quality and in-depth integration and development of the ecological environment and tourism industry in Hubei Province. In the future, more detailed interaction mechanisms and paths between the tourism industry and ecological environment protection will be further explored.

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

Discussion

There are some deficiencies in the research process, in the selection of tourism industry and ecological environment indicators in Hubei Province, most of the selection of macro-indicators, for a comprehensive and systematic, scientific and objective collection of micro-level tourism industry and ecological environment related indicators, there is still a certain lack, in the follow-up research process, should improve the micro-level ecological environment and the tourism industry related industry indicators, expand the path to find the data indicators, and in-depth analysis of the spatial localized regional cultural and tourism integration differences. At the same time, in the process of thesis writing, due to my limited academic level, there are certain limitations in the theoretical analysis, in the specific coordinated development of Hubei Province, the actual analysis is not deep enough, the actual tourist destinations should be visited, in order to obtain first-hand information, more targeted to put forward the coordinated development of the strategy.

Conflict of Interest

The authors declare no conflict of interest.

References

1. XIAN L.D., SHAN G., AI R.X., ZHI K.L., BEI B.H. Research on Tourism Carrying Capacity and the Coupling Coordination Relationships between Its Influencing Factors: A Case Study of China. Sustainability. **14** (22), **2022**.
2. CHEER J.M., MILANO C., NOVELLI M. Tourism and community resilience in the Anthropocene: Accentuating temporal overtourism. Journal of Sustainable Tourism. **27**, 554, **2019**.
3. FU B.J., LIU G.H., WANG X.K., OUYANG Z.Y. Ecological issues and risk assessment in China. International Journal of Sustainable Development & World Ecology. **11**, 143, **2009**.
4. ZHOU X.H., CHEN W.W. The impact of informatization on the relationship between the tourism industry and regional economic developmen. Sustainability. **13**, 9399, **2021**.
5. LIU X., XIE N.A. nonlinear grey forecasting model with double shape parameters and its application. Applied Mathematics and Computation. **360**, 203, **2019**.
6. MEINECKE E.P.A. Report upon the Effect of Excessive Tourist Travel on the California Redwood Parks Sacramento. CA: California State Printing Office. 20, **1928**.
7. STEPHEN L. Recreation Geography: Theory and method. Beijing:Hinger Education Press. **1992**.
8. JOSEPH E. The Socio-economic and Environmental Impacts of Tourism Development on the Okavango Delta, North-western Botswana. Journal of Arid Environments. **54**, 447, **2003**.
9. CHALI M.A. Tourism and economic growth, an empirical study. Journal of Economic Development tand Cultural Change.**23** (3), 527, **1976**.
10. LEE C., KWON K. Importance of secondary impact of foreign tourism receipts on the South Korean economy. Journal of Travel Research. **34**, 50, **1995**.
11. TANTATAPE B., JUNG W.L. Assessing the dyamic impact of Tourism, industrialization, urbanization, and globalization on growth and environment in Southeast Asia, International Journal of Sustainable Development. World Ecology. **24** (4), 362, **2017**.
12. WALL G., WEIGHT C. The Enviromental Impact of Outdoor Recreation [R]. Ontario: University of Waterloo. **1977**.
13. VEFIEE L. The penguin directionary of physics. Beijing: Foreign language Press. 92, **1996**.
14. GELSOA B.R., PETERSON J.M. The Influence of ethical attitudes on the demand for environmental recreation:incorporating lexico-graphic preferences [J]. Ecological Economics. **53** (1), 35, **2005**.
15. BESTARD A.B., ROSSELL N.J. Modelling environmental attitudes to-ward tourism [J]. Tourism Management. **28** (3), 688, **2007**.
16. ROCS E., VILLARES M., ORTEGO M.I. Assessing public perceptions on beach quality according to beach users profile:a case study in the coastal Brava [J]. Tourism Management. **30** (4), 598, **2009**.
17. WANG H., YANG Z.P., HAN F. Research on Kanasi Lake's "tourism-environment" couling pattern under water environment stress.Journal of Huazhong Normal University (Natural Sciences). **43** (2), 345, **2009**. [In Chinese].
18. YE L., XIA W.Y., ZHONG X. Research on the Coupled and Coordinated Development of Guangxi Tourism Economy-Ecological Environment. Journal of Reformation & Strategy. **38** (04), 132, **2022**. [In Chinese].
19. WANG Z.F., LI J.Y. Verify and Study the Coupling Coordination Development and the Interactive Stress between Tourism and Eco-environment in the Yellow River Basin.Joural Resources and Environment in the Yangtze Basin. **31** (02), 447, **2022**. [In Chinese].
20. HU J.R., YAO J. The Coordinated Development of Tourism Economy and Ecological Environment in Five Northwest Provinces (Regions). Journal of Tourism Research. **13** (01), 85, **2021**. [In Chinese].
21. WANG C., LIU K.L. Analysis on Coordinated Development of Coupling of Regional Economy, Tourism Industry and Ecological Environment - A Case Study of Jialing River Basin in Sichuan Province. Journal of Heilongjiang Vocational Institute of Ecological Engineering. **33** (04), 44, **2020**. [In Chinese].
22. LIU Y.Z., HU Z.Y. Research on the Coordination of Tourism Development and Protection Coupling of Ecological Environment Based on PSR Model: The Empirical Evidence from Guizhou Province. Journal of Ecological Economy. **36** (03), 132, **2020**. [In Chinese].
23. NAN H., YONG Z., LI W., QING L., QIAN Z., JING Y.L., Spatiotemporal differentiation and the coupling analysis of ecosystem service value with land use change in Hubei Province, China. Ecological Indicators. 145, **2022**.
24. SHI Q.F., KAI H.O., JING X., RONG M.T., LI F.H., XU F.Z., HONG Y.M. The coupling coordination between rural public services and rural tourism and its causative factors: The case study of southwestern China. PloS one. **18** (8), **2023**.

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

25. MING Q.Z., ZHAO J.P. The Impact of the Novel Coronavirus Epidemic on China's Tourism Industry and Its Countermeasures. Academic Exploration. **3**, 124, **2020**. [In Chinese].
26. TIAN Y.P., XIANG Q.C., WANG P. Regional coupled human-natural systems vulnerability and its evaluation indexes. Geographical Research. **32** (01), 55, **2013**. [In Chinese].
27. WALZ R. Development of environemntal indicator systems:experiences from Germany [J]. Environmental Mangement. **25** (6), 613, **2005**,
28. YU S., YANG L.L., SONG Z.J., LI W.B., YE Y.M., LIU B. Measurement of Land Ecological Security in the Middle and Lower Reaches of the Yangtze River Base on the PSR Model. Sustainability. **15** (19), **2023**.
29. MEN B., LIU H. Water resource system vulnerability assessment of the Heihe River Basin based on pressure-state-response (PSR) model under the changing environment. Water Supply. **18**, 1956, **2018**.
30. WANG Q., YUAN X., ZHANG J., MU R., YANG H., MA C. Key evaluation framework for the impacts of urbanization on air environment–A case study. Ecological Indicators **24**, 266, **2013**.
31. YE Y., QIU H. Environmental and social benefits, and their coupling coordination in urban wetland parks. Urban Forestry & Urban Greening. **60**, 127043, **2021**.
32. ZHANG M.A., BORJIGIN E., ZHANG H. Mongolian nomadic culture and ecological culture: On the ecological reconstruction in the agropastoral mosaic zone in Northern China. Ecological Economics. **62**, 19, **2007**.
33. LIANG P., LI M.D., GUI J.Y. Ecological security assessment of Beijing based on PSR model. Procedia Environmental Sciences. **2**, 832.**2010**.
34. ZHANG J., SU W., ZHANG F. Regional land ecological security evaluation in the case of Chongqing Three Gorges Reservoir ecological economy area based on the PSR model. China Environmental Sciences. **31**, 1039, **2011**.
35. FAN Y., FANG C., ZHANG Q. Coupling coordinated development between social economy and ecological environment in Chinese provincial capital cities-assessment and policy implications. Journal of Cleaner Production. **229**, 289, **2019**.
36. BROWN G., RHODES J. Dade An evaluation of participatory mapping methods to assess urban park benefits Landsc. Urban Plan. **178**, 18, **2018**.
37. MA Y.M., WU Y.M., WU B.J. Comprehensive evaluation of sustainable urban development of Yangtze River Delta based on entropy method and quadrant method. Economic Geography. **35** (6), 47, **2015** [In Chinese].
38. WANG Y., CHENG X., YIN P.H., ZHANG X.H. Research on regional characteristics of China's carbon emission performance based on entropy method and cluster analysis. Journal of Natural Resources. **28** (7), 1106, **2013**. [In Chinese].
39. HUANG J., SHEN J., MIAO L. Carbon Emissions Trading and Sustainable Development in China: Empirical Analysis Based on the Coupling Coordination Degree International Journal of Environmental Research and Public Health. **18**, 89, **2021**.
40. YANG M., JIAO M., ZHANG J. Coupling Coordination and Interactive Response Analysis of Ecological Environment and Urban Resilience in the Yangtze River Economic Belt.International Journal of Environmental Research and Public Health. **19**, 11988, **2022**.
41. WANG Y., LI X., ZHANG Q., LI J., ZHOU X. Projections of Future Land Use Changes: Multiple Scenarios-Based Impacts Analysis on Ecosystem Services for Wuhan City, China.Ecological Indicators. **94**, 430, **2018**.
42. SONG Q., ZHOU N., LIU T., SIEHR S.A., QI Y. Investigation of a "coupling model" of coordination between low-carbon development and urbanization in China Energy Policy. **121**, 346, **2018**.
43. BIN L., JING G. Regional Tourism Economic Forecasting Model Based on GM Grey Forecasting Method. Mathematical Problems in Engineering. **2022**.
44. WENG G.M., LI L.Y. The Coupling Coordination Degree and Spatial Correlation Analysis on Integrational Development of Tourism Industry and Cultural Industry in China. Economic Geography. **36** (01), 178, **2016**. [In Chinese].
45. LIAO C.B. Quantitaive Judgement and Classification System for Coordinated Development of Environment and Economy: A Case Study of the City Group in the Pearl River Delta. Tropical Geography. **19** (2), 171, **1999**. [In Chinese].
46. YANG J.J., ZHU Y.T. Study on the System Dynamics for the Coordinated Development of Tourism, Economy, Ecology in Turpan Area [J]. Hubei Agricultural Sciences. **56** (03), 583, **2017**. [In Chinese].
47. QU X.S. Research on the Coupling Degree and Coordinated Development Mechanism of Tourism Economy and Ecological Environment: Taking the Provincial Capital Cities in the Yellow River Basin as an Example. Ecological Economy. **38** (10), 125, **2022**. [In Chinese].
48. XUE M.Y. The spatial and temporal pattern of coupling and coordination between economic development and ecological environment in the Yellow River Basin. World Regional Studies. **31** (06), 1261, **2022**. [In Chinese].
49. HOU P., GAO J.X., CHRN Y., ZHAI J., XIAO R.L., ZHANG W.G., SUN C.X., WANG Y.C., HOU J. Development process and characteristics of China's ecological protection policy. Acta Ecologic Sinica. **41** (04), 1656, **2021**. [In Chinese].
50. DENG X.Z., YANG K.Z., SHAN J.J., DONG S.C., ZHANG W.G., GUO R.X., TAN M.H., ZHAO P.J., LI N., MIAO C.H., HOU Y.P. Urban agglomeration and industrial transformation and development in the Yellow River Basin [J]. Journal of Natural Resources. **36** (02), 273, **2021**. [In Chinese].
51. WANG Z.Z., WANG J. Performance evaluation of pro, poor tourism in ethnic minority areas of China based on sustainable development [J]. Journal of Yunnan Minzu University (Social Sciences). **35** (05), 89, **2018**. [In Chinese].
52. ZHAO Q.G., HUANG G.Q., MA Y.Q. The ecological environment conditions and construction of an ecological civilization in China [J]. Acta Ecologica Sinica. **36** (19), 6328, **2016**. [In Chinese].
53. LU C.Y., LI W.L., PANG M., XUE B., MIAO H. Quantifying the Economy-Environment Interactions in Tourism: Case of Gansu Province, China. [J] Sustainability, **10** (3), 711, **2018**. [In Chinese].
54. LIU B.B., ZUO Q.T., DIAO Y.X. The value and pathways of green technology innovation for ecological conservation and high-quality development of the Yellow River Basin [J]. Resources Science. **43** (02), 423, **2021**. [In Chinese].
55. ZHAO M.Z., YE P. Analysis on the coupling coordination degree of tourism industry and regional development in Yichang City [J]. Journal of Hubei University (Natural Science). **42** (02), 185, **2020**. [In Chinese].

Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy • Author Copy

56. KAN R.L., FAN Y.Y., ZHANG X.Y. Evaluation of Tourism Value of Characteristic Town Based on Functional Satisfaction Measurement. Take Longquan Town of Yichang City as an example [J]. Journal of China Three Gorges University (Humanities Social Sciences). **41** (01), 103, **2019**. [In Chinese].
57. PI P.C., ZENG M., HUANG C.S., SHI H.H., HOU Q.Q., PENG H.X. A research on susyainable development od Enshi forest therapy tourism based on SWOT-AHP model [J]. Journal of Central China Normal University (Nat. Sci.). **56** (01), 127, **2022**. [In Chinese].
58. SANG Z.N., FENG S.X., SHI P.F., DONG Y.Y. Tourism Bed and Breakfast Perception Based on IPA Theory: Importance, Satisfaction and Difference A Case Study of EnShi Prefecture of Hubei Province. Resource Development, Market. **34** (07), 992, **2018**. [In Chinese].