

Study on the Ecological Efficiency of Tourism Industry in the Inner Mongolia Autonomous Region of China

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Abstract

Sustainable development of regional tourism industry is a systematic project, and its eco efficiency fundamentally of regional tourism industry fundamentally depends on the internal relationship of regional tourism industry system. During the research used the relationship model of regional tourism industry system, establishes the evaluation index system of eco efficiency of regional tourism industry, and analyzes the eco efficiency of tourism industry in Inner Mongolia Region of China by using data envelopment analysis (DEA) method. The empirical analysis shows the results that the eco efficiency of tourism industry in various regions of Inner Mongolia is continuously in increasing trend from last 15 years, but there is an obvious imbalance between regions. Therefore, the government should focus attention to the tourism industry policy constraining the tourism activities of the main tourism enterprises to actively encourage green production, promote tourist ecological travel, support residents to participate in tourism development, on the premise of respect for the natural environment, ethnic culture, and consistent improvement the level of sustainable development of regional tourism.

Keywords

Inner Mongolia; tourism industry; ecological efficiency; China

I. Introduction

At present, China is developing under the guidance of "innovation, harmony, green, open and sharing" concept. It is necessary to speed up the transformation and upgrading of industrial structure, and increase people's basic income, but also need to protect the ecological environment, inherit and carry forward the admirable traditional culture, and to gradually realize the political, economic, social, cultural and ecological civilization construction coordinated development. Inner Mongolia Autonomous Region is located in the northern border area of China, with an area of 1 million 183000 km² and it is a distance of 4200 kilometers from east to west. It is not only China's frontiers opening to the north, but also the most significant ecological barrier in northern China. In 2014, President Xi Jinping visited the Inner Mongolia Autonomous Region and pointed out that "Inner Mongolia is the largest area of North China, the most inclusive varieties of ecological function area, the ecological status of Inner Mongolia Autonomous Region is not only related to the survival and development of the ample of all ethnic groups in Inner Mongolia, but also related to the national ecological security". Meanwhile, Inner Mongolia Region is one of the richest tourism resources states in China. Tourism industry has been established as an important strategic emerging industry in the region, and also playing an important role in promoting regional economic and social development. Then, with the rapid development of Inner Mongolia growth of tourism industry, regional tourism industry development, tourism activities have become increasingly frequent. This will increase the area of energy consumption and environmental interference intensity, which requires coordination between the tourism ecological

good regional culture system, and constantly improve the level of sustainable development of regional tourism industry, so as to ensure that the Inner Mongolia Region is in the development of tourism industry in the process to achieve the coordination of tourism and ecological co-existence.

II. Literature Review

The core element of the sustainable development of regional tourism industry is to continuously improve the ecological development efficiency of this industry. In recent years, Chinese scholars have conducted some researches, and mainly focused on the ecological system of tourism industry, tourism ecological efficiency and effect of tourism ecological. Ming Qingzhong (2012) and other scholars believe that the element of ecological system of tourism industry should include the natural ecological system, economic system, cultural system of community tourism, and tourism eco industrial system is an open and efficient concurrent formation of collaboration network. It is a complex natural economic complex system and a sub-system of the social economic system; Zhen Yi (2014) based on the ecological footprint and carbon footprint of ZhangJiajie tourism eco efficiency evaluation, author proposed that, "to improve the utilization efficiency of energy and resources, reduce transportation, accommodation of carbon emissions, and improve the production of land productivity is a best way to improve the ecological efficiency"; Yao Zhiguo and Chen Tian (2016) conducted an empirical analysis of the tourism eco efficiency in Hainan Province by using tourism carbon footprint, scholars believe that tourism consumption structure of short distance, stay long and high consumption is conducive to improving the tourism eco efficiency. In addition, in recent years, scholars try to use ArcGIS spatial statistical models of eco efficiency of regional tourism industry spatial differentiation question of quantitative research (Liu Jia, Lu Ju, 2016); based on the stakeholder theory to evaluate the Ecological Tourism Health (Lu Xiaobo et al., 2017), study results have important reference value for research the ecological efficiency of regional tourism industry development. However, from the theory of ecological economics, the ecological efficiency of regional tourism industry is fundamentally dependent on the state of regional tourism system. Therefore, it is one of the most important paradigms to study the eco efficiency of tourism industry from the perspective of large ecosystem, but the related research is very limited in China. Based on the construction of regional tourism industry system model, this paper evaluates the eco efficiency of tourism industry in the Inner Mongolia Autonomous Region by using data envelopment analysis (DEA) method, in order to promote the sustainable development of regional tourism industry.

III. Data Source and Methodology

The data source in this paper is mainly derived from the Inner Mongolia Autonomous Region statistical yearbook (2016), and the official statistical data of the national statistical bulletin of national economy and social development.

A. Theoretical Model

Fig.1 shows that the regional tourism industry is in a certain time and space environment, the tourism enterprises, the residents of the area, tourists, government and other relevant actors to form tourism economic and social and ecological complex system. Regional tourism industry system includes the relevant enterprises, regional tourism activities, tourist destination government and residents as four main elements, human centered, the elements interact with each other, complement each other, constituting an organic whole with political, economic, cultural, ecological, and social functions. The sustainable development of regional tourism industry requires the integration of tourism industry activities into the total exchange process of material and energy in the large ecological system, protect the natural ecological tourism and regional culture, and the regional tourism industry system in each part to optimize the coupling, to achieve the efficient use of the resources within the tourism industry system, stability of the ecological environment, good heritage of the culture, and the harmonious coexistence of people and nature.

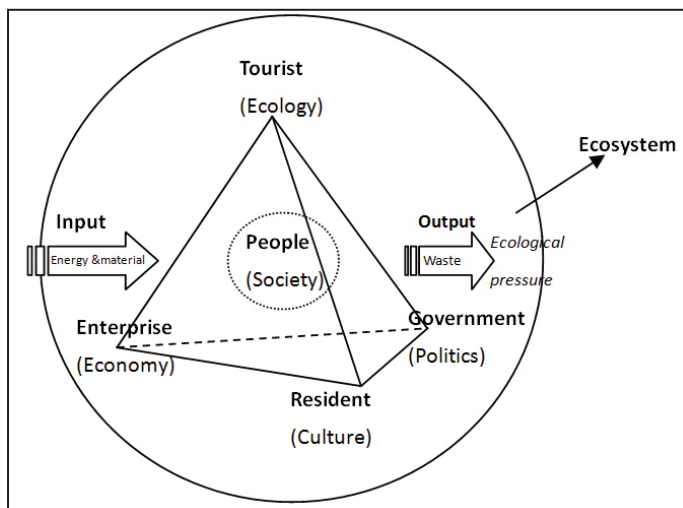


Fig. 1: Model of Regional Tourism Industry System

The tourism industry is highly dependent on nature and regional culture, the natural ecology and regional culture is the typical fund service resources from the theory of ecological economics, as far as tourism is concerned, it can be inexhaustible as long as it is used reasonably. In this sense, natural ecology and cultural resources are particular elements of the tourism industry. They constitute the core part of tourism products, but they can be reused for a long time without being exhausted. Of course, this is a prerequisite that we must follow the law of natural and cultural development, and rationally develop and utilize it in the ecological capacity of the regional tourism industry system. Otherwise, it will cause great damage to natural ecology and national culture. Moreover, no matter whether natural ecology or national culture is destroyed, it can hardly be effectively restored in a short time. In that way, it is impossible for the tourism industry to achieve sustainable development, which is also the root of the tourism industry's need for ecological development. The essence of the sustainable development of the tourism industry is to conform the natural ecological laws, respect the national culture independent evolution rule, through the ideological consciousness, institutional constraints and technology management, diminish the consumption of energy and resources, to evade the destruction of natural environment and regional culture, the tourism industry system within the ecological carrying capacity of the relationship

between the subjects and coordinate system the function of green and healthy running, so as to realize the sustainable development of tourism activities. Therefore, the study of the ecological efficiency of regional tourism industry must be analyzed in depth from the angle of regional tourism system input - output and system relationship coordination.

B. Index System

The evaluation of regional tourism industry eco efficiency is essentially a measure of the relationship between input and output of tourism industry system, all kinds of energy, resources, final output, tourism economic value, social value and ecological value of tourism industry system. Based on the regional tourism industry system relationship and follow the principles of streamlining and practicality, this paper construct an index system for evaluation of the eco efficiency of regional tourism industry.

Table 1: The Evaluation Index System for Ecological Efficiency of Regional Tourism Industry

Input		
Resources	Evaluating indicator	Indicator description
Ecological resources	Area of Nature Reserve (T1) (10 thousand hectares)	Representing the level of the input of ecological resources
Cultural resources	The number of cultural units (T2)	Including public museums, cultural museums and libraries; the number of art groups and art venues, representing the level of cultural resources input
Human resources	Tourist employment population (T3) (ten thousand)	Third industry employed population, representing the level of investment in tourism human resources
Material resources	Total energy consumption (T4) (ten thousand tons of standard coal)	The total amount of energy consumption in the third industry represents the level of tourism energy input
Output		
Value	Evaluating indicator	Indicator description
Economic value	Tourism income (C1) (billion yuan)	Representing tourism economic value output
Social value	Number of tourists (C2) (ten thousand people)	Representing the social value of Tourism
Ecological value	Waste emissions (C3) (ten thousand tons) (take the reciprocal)	Per capita emission of tourism wastes, representing the level of ecological environment protection

Above table shows that the per capita tourism waste emission index value for the ratio of waste emissions and the same area tourist trips, represents the tourism ecological environment. The eco efficiency of the regional tourism industry is higher means that the same natural resources, cultural resources, human resources and material resources can provide more tourism services for more tourists and create more revenue from tourism, and there

will be less negative impact on the ecological environment, it means that the tourism industry creates more economic, social and ecological value.

C. Evaluation Method

In this paper, the C²R model in the generalized DEA and the MaxDEA statistical software are used for quantitative evaluation.

Assuming that there are *n* decision units, their production can be represented by *m* input and *s* output indicators, in which the input index of the *p* decision unit is $x_p = (x_{1p}, x_{2p}, \dots, x_{mp})^T > 0$, and the output index is $y_p = (y_{1p}, y_{2p}, \dots, y_{sp})^T > 0$. At the same time, another sample unit is the object or standard used by the evaluator. The input and output index of the sample unit is $\bar{x} = (\bar{x}_{1j}, \bar{x}_{2j}, \dots, \bar{x}_{mj})^T > 0$, $\bar{y} = (\bar{y}_{1p}, \bar{y}_{2p}, \dots, \bar{y}_{sp})^T > 0$, *d* is a positive number, called a moving factor, and there is a generalized DEA model with the following non Archimedes infinitesimal ϵ .

$$(M_\epsilon) \begin{cases} \min \theta - \epsilon(\bar{e}^T s^- + e^T s^+), \\ s.t. \sum_{j=1}^{\bar{n}} \bar{x}_j \lambda_j + s^- = x_p(\theta - \lambda_0), \\ \sum_{j=1}^{\bar{n}} d\bar{y}_j \lambda_j - s^+ = y_p(1 - \lambda_0), \\ \delta \sum_{j=0}^{\bar{n}} \lambda_j = \delta, \\ \lambda_j \geq 0, j = 0, 1, 2, \dots, \bar{n}, \\ s^- \geq 0, s^+ \geq 0. \end{cases} \quad (1)$$

Theorem 1: Set the optimal solution for the linear programming problem (M ϵ) with $\lambda^0, s^-, s^+, \theta^0$ and if $\theta^0 = 1$, then the decision unit *p* is weakly effective for G-DEA (d), and if $\theta^0 = 1$, and $s^{-0} = 0, s^{+0} = 0$,

The decision unit *p* is valid for G-DEA (d).

The above model can be further written as follows:

$$(M_\epsilon) \begin{cases} \min \theta - \epsilon(\bar{e}^T s^- + e^T s^+), \\ s.t. \sum_{j=1}^{\bar{n}} \bar{x}_j \lambda_j + s^- = \theta x_p, \\ \sum_{j=1}^{\bar{n}} d\bar{y}_j \lambda_j - s^+ = y_p, \\ \delta \sum_{j=1}^{\bar{n}} \lambda_j = \delta, \\ \lambda_j \geq 0, j = 1, 2, \dots, \bar{n}, \\ s^- \geq 0, s^+ \geq 0. \end{cases} \quad (2)$$

The above sample unit based G-DEA model is evaluated by the sample data envelopment plane as a reference set. If the input-output index of the evaluated unit is not worse than the point of the data envelope surface. It is G-DEA effective unit. Among them, the C²R efficiency value represents the overall efficiency level, when the efficiency value is equal to 1, show the scale efficiency and technical efficiency evaluation units have reached the optimum level (with excellent sample unit), and the greater the efficiency value, the higher the efficiency of the evaluation unit.

IV. Results

Considered that to improve the eco efficiency of regional tourism industry is a long-term dynamic process, In this paper data collected of the ecological efficiency evaluation index of regional tourism

industry from 12 cities of Inner Mongolia Region in 2005, 2010 and in 2015 with a time span of 15 years, then used Max-DEA statistical software to calculate input-output (output oriented) comprehensive efficiency, the evaluation results are shown in the following Table 2 below:

Table 2: The Ecological Efficiency Value of Tourism Industry in the Inner Mongolia Autonomous Region

S. No	City	Efficiency value			Average efficiency value	Average ranking
		2005	2010	2015		
1	Hohhot	0.3432	1.0000	1.0000	0.7811	1
2	Baotou	0.2466	0.4352	0.9240	0.5353	6
3	Hulunbuir	0.2824	0.6250	1.0000	0.6358	3
4	Hung	0.1732	0.2879	0.8245	0.4285	9
5	Tongliao	0.1586	0.3073	0.9027	0.4562	8
6	Chifeng	0.7327	0.3729	0.9891	0.6982	2
7	Xilinguole	0.1876	0.6829	1.0000	0.6235	4
8	Wulanchabu	0.2161	0.3279	0.5794	0.3745	11
9	Ordos	0.3780	0.4474	0.8074	0.5443	5
10	Bayannaouer	0.1950	0.1353	0.5527	0.2943	12
11	Wuhai	0.0858	0.1885	1.0000	0.4248	10
12	Alashan	0.2787	0.5919	0.5864	0.4857	7
Average value		0.2732	0.4502	0.8472	0.5235	

Note: Due to the statistical data, this paper in the calculation of the index to do the adjustment and replacement of the ecological resources index (T1) by the built-up area green coverage area, energy consumption index (T4) for the area of total energy consumption, waste recovery index (C3) by the total amount of wastewater discharge.

A. The Ecological Efficiency of Tourism Industry in Inner Mongolia Area is in Increasing Trend

Fig. 2 shows that the overall eco efficiency of tourism industry in Inner Mongolia region is in increasing trend and in 2005, 2010 and 2015 annual efficiency value has been changed, in addition Chifeng City, Bayannaouer City and Alashan City, the eco efficiency of tourism industry shows decreasing trend but in the other cities in last 15 years, especially in Hohhot City ,Hulun Buir City, Xilinguole, and Wuhai City, their efficiency is very obvious. However, in the past five years the efficiency of Alashan is relatively low, and it has been declined slightly, while Chifeng and Bayannaouer have experienced a process of first decline and then rise.

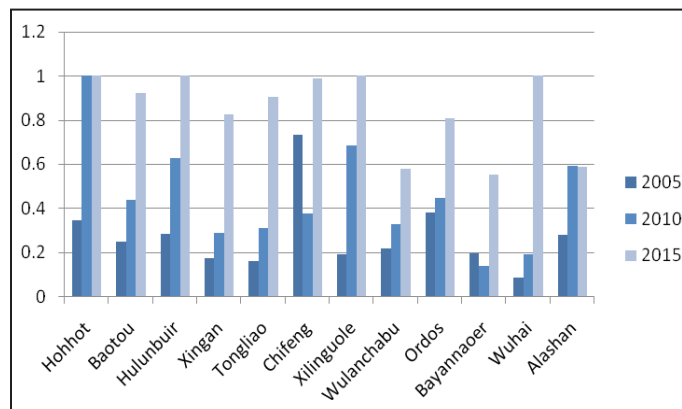


Fig. 2: Changes in the ecological efficiency of tourism industry in the Inner Mongolia Autonomous Region cities

B. The Ecological Efficiency Gap of Tourism Industry in Various Cities of Inner Mongolia is More Obvious

Fig.3 shows that the 12 cities in the Inner Mongolia can be divided into three echelons from the average annual efficiency level:

The 1st echelon belongs to the high level of the region, including Hohhot City, Chifeng City, HulunBuir City and Xilinguole City, the tourism industry ecological efficiency in Hohhot city, Chifeng City, HulunBuir city and Xilinguole city is far higher than the average level of the cities, especially the capital Hohhot, has the most outstanding performance. The average efficiency reached 0.7811, which is higher than the average level of the cities about 50%; Chifeng City, HulunBuir City and Xilinguole City ranked in 2nd to 4th, average efficiency value is above than 0.6, higher than the average level of the cities about 20%.

The 2nd echelon is a middle level area, including in these 3 regions, such as Ordos City, Baotou City and Alashan City. The average value of tourism industry eco efficiency is around 0.5, which is closer to the average level of the cities and is in the middle or upper level of the whole region.

The 3rd echelon is a low-level area, including Tongliao City, Xingan City, Wuhai City, Wulanchabu City and Bayannaer City. The average value of the tourism industry eco efficiency in these 5 regions is significantly lower than the average level of the other cities.

Fig. 3 shows that there is also a bigger gap between the cities' tourism industry development status from the new level of efficiency in 2015, among them, Hohhot City, Hulun Buir City, Chifeng City, Xilin Gol city and Wuhai City. The efficiency value is equal to 1, indicates that the comprehensive efficiency reached a relatively optimal level, which belongs to the highest level of ecological efficiency of tourism industry in the Inner Mongolia Region; Xingan City, Baotou City, Tongliao City and Erdos City are close to or higher than the average level of the other cities, which belong to the average level of ecological efficiency of tourism industry; Wulanchabu City, Bayannaer City and Alashan City are far below the average level, belonging to the lowest level of ecological efficiency of tourism industry in the Inner Mongolia Autonomous Region.

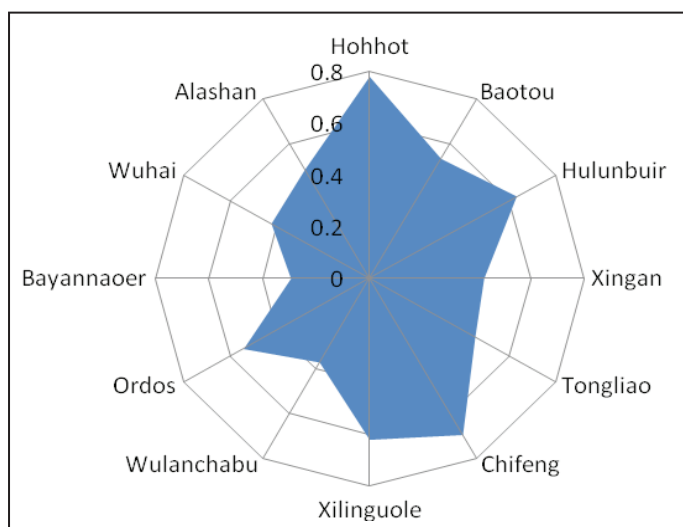


Fig. 3: The Radar Map of the Ecological Efficiency of the Tourism Industry in the Inner Mongolia Autonomous Region, 2015

V. Conclusion

From the perspective of ecological economics and industrial ecology, result shows that the eco efficiency of tourism industry is constantly in increasing trend and its essential to ensure that the

path of sustainable development of regional tourism industry, the Inner Mongolia Autonomous Region is an important ecological barrier in North China, and the green development path is the inevitable choice of regional tourism industry development and policy regulation. Therefore, evaluation of the ecological efficiency of the regional tourism industry in Inner Mongolia Region is based on the DEA method, conducive to the region more scientifically and accurately understanding the sustainable development level of tourism industry, especially for the tourism industry management departments to grasp the tourism industry in the macro green and sustainable development, to take beleaguered measures to make up for the lack of narrow gap, to constantly improve the development and utilization of regional tourism resources efficiency. This paper only talks about the evaluation of the comprehensive eco efficiency of the regional tourism industry, and also discusses the factors affecting the efficiency, the relationship between the system and the specific development path.

In Inner Mongolia region, from the last 15 years, the ecological efficiency of tourism industry has been improved rapidly, but the regional imbalance is more prominent. Moreover, the original ecological environment is better, the scale of the tourism industry is larger and lower energy consumption, higher levels of the national cultural heritage area, the tourism industry eco efficiency is also better, such as Hohhot City, HulunBuir City, XilinGol City, Chifeng City and other places, the level of development of ecological tourism industry has reached a relatively best state; and the higher the proportion of the industrial economy of Baotou City, Erdos City Tongliao City and other places in the development of efficiency is not ideal, poor description of typical industrial city in the production of tourism resources investment and tourism benefits corresponding relationship, there are many places need to be improved in the aspects of tourism investment and operational efficiency etc.. In short, the ecological efficiency of the regional tourism industry in Inner Mongolia showed a lot of non-equilibrium, so the development of tourism industry in various regions need to be for structural adjustment from the perspective of the tourism industry, especially the steps should be taken from the tourism industry of green production, ecological tourism construction and national culture inheritance, and continuously improve the regional tourism attraction to expand the scale of the tourism industry, so as to improve the overall eco efficiency of tourism industry, promote the sustainable development of regional tourism.

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