The Relation Between Ecological Economy and Sustainable Tourism Development

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Abstract—Tourism is usually regarded as a green ecological economy, but in reality, tourism development will also have negative impacts on the local ecological environment. However, this does not mean that tourism development and ecological environmental protection are antagonistic. Taking the World Natural Heritage Site in Chongqing as an example, this study evaluated the impact of tourism development on the environment based on tourism ecological footprint model. The results show that tourism development does have some negative impacts on environmental protection, but at the same time, it also provides more realistic possibilities for heritage protection. It is practical and feasible to realize ecological development through tourism development. By limiting the speed of tourism development and strengthening the ecological compensation of tourist destinations, the ecological protection and tourism development of World Heritage Sites can be unified for a long time. To be specific, the ecological protection and sustainable development of tourism can be realized by limiting the level of tourism development and the number of tourists, guiding tourists to change their consumption, reducing the ecological footprint of tourism, transferring the ecological footprint of tourism, and improving the ecological carrying capacity.

Keywords- world natural heritage; sustainable tourism; ecological footprint model

1 INTRODUCTION

Known as a "smokeless industry" and a "sunrise industry", tourism has gradually developed into one of the world's largest and most powerful industry. While the rapid development of tourism drives the economy, it also brings a lot of negative effects, such as a series of problems caused by the blind and excessive development of tourism resources, extensive management of tourism scenic spots, and idle tourism infrastructure. The world natural heritage has the comprehensive value of tourism value, scientific value, artistic value and so on. Therefore, some people believe that tourism development and the realization of ecological economy is difficult to coexist. However, does the negative impact of tourism development really mean that ecological economy is difficult to achieve? Is it possible to develop tourism while giving priority to environmental protection and ecology?

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As we all know, natural heritage protection is the inevitable requirement of preserving the earth's landform and biodiversity, but the work of heritage protection faces challenges from politics, economy, environment, social culture and other aspects. The development of heritage resources must be carried out on the premise of not damaging the authenticity and integrity of heritage resources. However, the predatory exploitation of heritage resources in world heritage sites makes the world heritage sites face unprecedented high consumption and pressure. It is urgent to explore a sustainable development path to effectively protect the world's natural heritage. At present, the world natural heritage sites are generally developed and protected by tourism. But what is the impact of tourism development on heritage sites? Whether it is an effective way remains to be further explored. This paper takes Wulong karst world natural heritage site as an example, evaluates the sustainability of its tourism development and the effectiveness of its protection with the tourism ecological footprint model, then puts forward strategies for the protection of world natural heritage site and sustainable tourism development, in order to synchronously realize the sustainable development of ecological economy and tourism.

2 THEORETICAL BASIS AND CALCULATION MODEL

The tourism ecological footprint originates from the concept of ecological footprint and analysis of ecological footprint (EFA). Ecological footprint can be seen as "the footprint left on the earth by a giant foot on a city and factory created by human beings" [1], and then gradually developed into ecological footprint analyses (EFA) [2] and ecological footprint model [3]. As to tourism research, Wackernagel (2000) was the first to make a preliminary analysis on the ecological footprint of international tourism. Colin Hunter (2002) firstly proposed the concept and classification of tourists' ecological footprint and the application of this method in the sustainable development of tourism, and calculated the ecological footprint of tourists and individual tourism products throughout the life cycle of tourism products [4]. In short, tourism ecological footprint is the bioproductive land area needed by a region to support the consumption of various resources and the absorption of wastes related to tourism activities. In the area of tourism activities usually includes tourists and local residents, only tourists' tourism activities of the biological productive land area can be called "tourism ecological footprint", which corresponds to the survival and development of biological productive land area known as the "regional local ecological footprint", local ecological footprint of tourism ecological footprint with area "superposition" effect to influence the sustainable development of regional tourism.

2.1 Tourism ecological footprint model

The tourism ecological footprint model [5] is the specific application of the ecological footprint model in tourism research. According to the characteristics of tourism consumption, tourism ecological footprint model includes seven parts: tourism food, tourism accommodation, tourism transport, visiting, tourism shopping, tourism entertainment and tourism solid waste, which is shown in the equation (1):

$$TEF = TEFfood + TEFaccommodation + TEFtransport + TEFvisiting + TEFshopping + TEFentertainment + TEFwaste \quad (1)$$

The tourism food ecological footprint (TEF_{food}) is mainly composed of three parts. According to the actual situation of tourism catering consumption and composition, which is shown in the equation (2).The tourism accommodation ecological footprint ($TEF_{accommodation}$) is mainly determined by the area of construction land occupied by high-end, medium and low-end hotels, guesthouses, farmhouses and the other tourism accommodation facilities that provide accommodation for tourists, and the area of fossil energy land converted by energy consumption of hotels and guesthouses that provide services for tourists, including energy consumption of air conditioning, lighting and washing. According to the difference in the built-up area requirements of different grades and types of accommodation facilities and the energy consumption of providing corresponding services, which is shown in the equation (3). The tourism transport ecological footprint ($TEF_{transport}$) mainly consists of the construction land area of tourism transport facilities and the fossil energy area transformed from transportation energy consumption related to tourism activities which is shown in the equation (4).Tourism visiting ecological footprint ($TEF_{visiting}$) mainly consists of scenic sightseeing facilities construction land area and transformation in the scenic area energy consumption of fossil energy land area, which is shown in the equation (5); Tourism shopping ecological footprint ($TEF_{shopping}$) is composed of the construction land , ecological productive land area corresponding to tourism commodity consumption and the area of fossil energy transformed from energy consumption in the production, transportation and sales of tourist commodities is shown in the equation (6). Tourism entertainment ecological footprint ($TEF_{entertainment}$) mainly consists of facilities of construction land occupied area and offers visitors leisure entertainment is converted to energy consumption of the fossil energy land area of two parts, which is shown in the equation (7); The tourism solid waste ecological footprint(TEF_{waste}) is shown in the equation (8), composed of the ecological productive land area occupied by solid waste landfill and the forest land area needed to absorb solid waste and produce waste gas through bacterial action.

$$TEF_{food} = [\ \Sigma Si + \Sigma(N \times D \times Ci / Pi) + \Sigma(N \times D \times ei / ri)\ ] \times Fe \quad (2)$$

$$TEF_{accommodation} = [\ \Sigma(Si \times Ni) + \Sigma(365 \times Ni` \times Ki \times ei/r)\ ] \times Fe \quad (3)$$

$$TEF_{transport} = [\Sigma(Si \times Ki) + \Sigma(Ni \times Di \times ei/r)] \times Fe \quad (4)$$

$$TEF_{visiting} = Si \times Fe \quad (5)$$

$$TEF_{shopping} = \{\Sigma Si + \Sigma[(Ri/pi)/gi]\} \times Fe \quad (6)$$

$$TEF_{entertainment}=\Sigma Si\times Fe \quad (7)$$

$$TEF_{waste} =\{[(Q\times q^{DOC})/Pa]\times W+\Sigma Sj\} \times Fe \quad (8)$$

In equations (1) to (8), “Si” respectively represents the construction land area of type I catering, accommodation, transportation, sightseeing, shopping, leisure and entertainment facilities; “N” represents the number of tourists; “D” represents the average number of days of travel for tourists; “Ci” represents the per capita daily consumption of food type I for tourists; “Pi” represents the average annual productivity of ecologically productive land corresponding to food type I; “Ri” represents the average calorific value per unit of fossil fuel productive land area of type I energy; “Ei” respectively represents the daily energy consumption corresponding to type I catering facilities, transportation means and accommodation facilities; “Fe (e=1,2,3,4,5,6)” represents the equilibrium factor of six types of ecological productive land; “Ni” represents the number of beds in category I accommodation facilities; (Ni` = Ni (1+ti)/2, where it is the room double opening rate of type I accommodation facilities); “Ki” represents the average annual room occupancy rate of type I accommodation facilities; “R” represents the average calorific value per unit of ecological productive land area of fossil fuels in the world; “Ki” represents the tourist utilization rate of type I traffic facilities; “Nj” represents the number of tourists of the JTH mode of transportation; “Dj” represents the average travel distance of tourists of type j vehicle; “Ri” refers to the consumption expenditure of tourists for the i-type tourist commodities; “PI” represents the local average selling price of the ith tourist commodity; “Gi” represents the average annual productivity of the local bio-productive land corresponding to unit I of tourist commodities; “Pa” represents the amount of CO_2 that can be absorbed per hectare of woodland on average (the global average of 5.2tCO_2 per hectare of woodland per year [6]); “Q” stands for waste production; “q^{DOC}” refers to the proportion of organic carbon per unit of waste; “W” is the CO_2 equivalent coefficient of organic carbon (about 30% organic carbon is contained in 1 ton of waste in China [7], “W” is 2.89); “Sj” represents the area of farmland occupied by landfill.

2.2 Tourism ecological carrying capacity and ecological surplus calculation model

Tourism ecological carrying capacity calculation model is shown in the equation (9) and the equation (10). Among the equation, “TEC” represents the total tourism ecological carrying capacity; “N” is the population; “tec” stands for per capita ecological carrying capacity; “a_j” represents per capita ecological land area; “r_j” is the equilibrium factor and the “y_j” is the yield factor. TES stands for tourism ecological surplus; TED is the tourism ecological deficit; TEC represents the total ecological capacity of tourism; TEF stands for tourism ecological footprint. Tourism ecological footprint and tourism ecological carrying capacity are compared with each other. When TEF<TEC, it is ecological surplus (TES). And it reflects that the tourism ecological footprint of a place is less than the carrying capacity of the tourism ecological, resulting in the tourism ecological surplus, indicating that the ecological capacity of the place is enough to support its human load, and its tourism development mode is in a relatively sustainable state.

$$TEC = N \cdot tec = N \sum_{i=1}^{6} (a_j \cdot r_j / y_j) \quad (9)$$

$$TES/TED=TEC-TEF \quad (10)$$

3 RESULTS

3.1 Tourism ecological carrying capacity and surplus of Wulong karst world natural heritage site

Wulong karst world natural heritage site belongs to Wulong county, and its average forest coverage rate is as high as 47%. The research scope is the core area and buffer zone of the world natural heritage site, and the forest coverage rate is higher, which means the ecological productive land within the scope of this study can be regarded as all forest land. The following is the calculation of tourism ecological carrying capacity and per capita tourism ecological carrying capacity as shown in figure1.

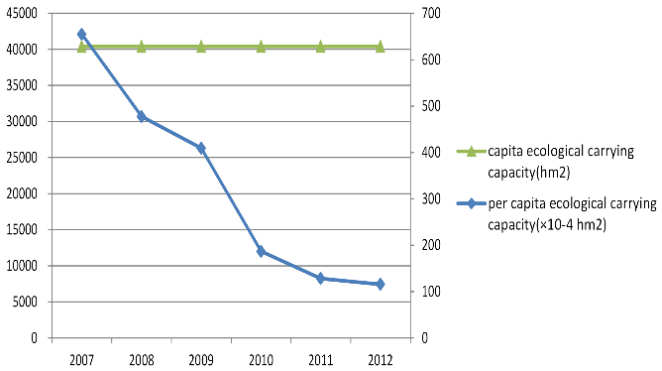

Fig. 1 Tourism ecological carrying capacity of Wulong karst world natural heritage site

According to the above calculation results and relevant charts, the comprehensive analysis of the change trend of tourism ecological carrying capacity shows that the tourism ecological carrying capacity basically remains unchanged. The core area and buffer zone of the world heritage site are protected strongly, the land use situation has not changed much in recent years. In fact, there will be some changes in the ecological carrying capacity within the research scope, but considering the integrity and subjectivity of the research, the hypothesis in this paper is reasonable.

3.2 Evaluation of sustainable development of tourism

According to the above calculation results, the tourism ecological footprint of Wulong world natural heritage site is compared with the tourism ecological carrying capacity, and the tourism ecological deficit (or surplus) can be obtained. By comparing the per capita ecological footprint of tourists in Wulong world natural heritage site with the per capita ecological carrying capacity

of tourists, it can be concluded that the per capita ecological deficit (or surplus) of tourists is sorted into figure 2.

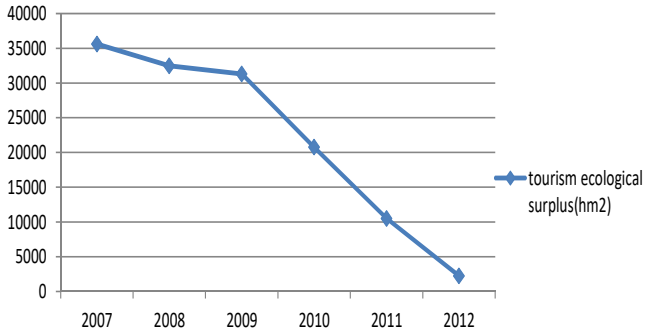

Fig. 2 Tourism ecological surplus of Wulong karst world natural heritage site

The tourism ecological footprint does not exceed the carrying capacity of tourism ecological, which shows as the surplus of tourism ecological. The per capita tourism ecological footprint does not exceed the per capita tourism ecological carrying capacity, which is shown as per capita tourism ecological surplus. Tourism ecological surplus and per capita ecological surplus showed a rapid decline trend. The main reason is that the ecological carrying capacity of the heritage site remains basically unchanged, while the rapid increase of tourist reception and the change of tourists' consumption patterns increase the ecological footprint of tourism by a large margin, resulting in a substantial decrease in the tourism ecological surplus and per capita tourism ecological surplus.

4 CONCLUSION

Since Wulong karst world natural heritage site was successfully applied for the world heritage site, tourism industry has developed rapidly, but it is accompanied by the rapid increase of the ecological footprint of tourism and the substantial decline of the ecological surplus of tourism. The key to solve the problem lies in limiting the degree of tourism development and increasing the intensity of ecological compensation. In order to realize sustainable development, it's necessary to take measures to reduce tourism ecological footprint or improve carrying capacity of local tourism ecology.

Firstly, the destination should try to reduce tourism ecological footprint, including guide tourists, especially overnight tourists, to enjoy a low-carbon and environment-friendly lifestyle and avoid unnecessary waste of consumer goods to reduce the ecological footprint of solid waste in tourism. Secondly, it should try to transfer tourism ecological footprint, which can realize the trade flow of ecological footprint between regions; Finally, the destination may try to improve the ecological carrying capacity of tourism. Improvement of regional tourism ecological carrying capacity can be realized by changing the proportion of ecological productive land.

Through the study on the tourism ecological footprint of Wulong karst world natural heritage site, we found that tourism development does challenge heritage protection, while at the same time, tourism development provides realistic possibility for heritage protection in terms of funds and social consensus. Tourism protection and development are not opposites, they are more likely to be unified in the long run. The key lies in limiting the development speed of tourism and improving the ecological supplement of heritage sites while protecting heritage sites. Although most scholars believe that tourism development is the means to achieve heritage protection, heritage protection is the ultimate goal. However, heritage protection is often regarded as a means of tourism development rather than the ultimate goal in reality. In the development and protection of world heritage sites, the government, tourism enterprises, local residents, tourists and other stakeholders need to further study how to coordinate the interests of all parties so as to better realize the sustainable development of heritage protection and tourism development.

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