Evaluation Technology of Tourism Environmental Capacity of Nature Reserves Based on Big Data

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Abstract: In today's world, tourism has gradually become a rapidly growing and huge industry. The tourism industry plays an increasingly important role in stimulating urban economy, promoting social employment, and improving culture and environment. This paper aimed to study the evaluation technology of tourism environmental capacity of natural reserves based on big data analysis. In this paper, a mathematical model of tourism environmental capacity was proposed. Based on this study, the tourism environmental capacity experiment of Nature Reserve A based on big data analysis was analyzed. The experimental results of this paper showed that the annual tourism space capacity of Nature Reserve A was about 470000 person-times, and through the questionnaire survey, it was found that the tourism psychological capacity of Nature Reserve A was about 1300 people per day. In tourism development, strengthening environmental protection can effectively increase tourism environmental capacity.

1. Introduction

With the progress of society, people's preference for tourism is also increasing. The negative impact of tourism on the ecosystem is in direct proportion to the passenger flow of the tourist destination. In order to protect the ecology, the number of tourists must be controlled. Therefore, in order to achieve sustainable development, it is necessary to carry out scientific planning. With the emergence and development of large-scale tourism activities, the research on tourism environmental carrying capacity has also emerged and developed.

At present, there is still a lack of systematic research on regional tourism development and planning. Based on the investigation of various indicators of ecotourism environmental capacity, this paper calculates them, and evaluates and analyzes the results of the calculation. The process

and results of this study provide a scientific reference for the development direction of tourism.

Vandarakis. D. evaluated the passenger capacity of Rhode Island in order to find various high-level travel projects that can make the tourism industry develop continuously. To reduce the negative effects of tourism, people must carry out various activities, such as hiking, cycling, diving, archaeology, and hiking in excellent natural conditions. In addition, redefining urban planning can reduce the impact on the environment and promote the sustainable development of the island while reducing the concentration of tourism population [1]. The purpose of S Sundriyal was to evaluate the negative impact of the growing tourism industry on the popular mountain resort of Mussoorie, India. Based on the field observation data, the qualitative and quantitative methods were used to evaluate it. The observation showed that the increasingly serious traffic congestion, air pollution, untreated solid waste, water shortage and inadequate infrastructure are at the peak of tourism. Based on the evaluation of human interference caused by tourism to urban natural landscape, the degree of consequential damage caused by tourism to the environment was evaluated [2]. Zhang. M. constructed the theory and key technology of geological environment bearing capacity assessment based on the interdisciplinary research of risk, production-life-ecological function and geological environment. Based on the risk theory, taking the life, property and health risks caused by human activities such as production and life as the starting point and combining point, the concept of allowable bearing capacity and ultimate bearing capacity was proposed, and the status of bearing capacity was divided into three levels, namely safe bearing capacity, allowable overweight and unacceptable overweight [3].

Based on the research and analysis of the tourism environmental capacity of Nature Reserve A based on big data analysis, this paper draws the following conclusions: in the tourism development, scientific tourism development plans should be formulated to maintain the equal importance of tourism development and environmental management.

2. Assessment of Tourism Environmental Capacity of Nature Reserves

2.1. Ecotourism

Ecotourism can be divided into three types: pure ecotourism, quasi-natural ecotourism and pan-ecological tourism. Both pure natural ecotourism and quasi-ecological sightseeing tourism are based on the development of ecological environment protection, while pan-natural ecotourism is based on ecological environment protection, which not only maintains the nature, but also drives the development of the whole tourism industry, and also drives the development of tourism in the whole region [4-5]. Ecotourism is not to destroy the environment at the cost, but to live in harmony with nature. At the same time, it is not allowed to make future generations of tourists lose the same enjoyment opportunities at the expense of the enjoyment of contemporary tourists.

Ecotourism is a new concept. Compared with traditional tourism, it is characterized by paying attention to the protection of local resources and environment, taking the original and harmonious natural ecosystem and customs with local characteristics as the goal of tourism. Guided by the concept of ecology, environmental education, interpretation and management are used to achieve the goal of regional sustainable development [6-7].

2.2. Characteristics of Tourism Environmental Capacity

(1) Systemic

Tourism environmental capacity has systematic characteristics. The environmental system of a tourism region includes four subsystems: tourism ecosystem, tourism economic system, tourism spatial system and tourism social system. They are closely connected with each other, and the

energy information between them is also flowing. Therefore, it is these subsystems that play a decisive role in the development degree and status of a tourism region [8-9].

(2) Ecology

The natural environment is the material basis for people to carry out tourism activities. Among them, the most important is the pure natural ecology and the culture with the most national characteristics, and the most important is the artificial tourism resources created by history and modern mankind [10-11]. First of all, people are more inclined to get close to and understand nature, and more people are more inclined to get close to and understand nature. It is not difficult to see that in almost all scenic spots, even those simple cultural scenic spots, there are necessary water, air, soil, biology, etc., which are not only the most important elements in the tourism landscape, but also an inevitable factor that affects and restricts the development of tourism.

(3) Comprehensive

Tourism environmental carrying capacity is a series of complex elements, and there is a relationship of mutual influence and restriction between them. From another perspective, it also reflects the systematic characteristics of tourism environmental carrying capacity [12-13].

2.3. Mathematical Model of Tourism Environmental Capacity Based on Big Data Evaluation

The determination of tourism environmental carrying capacity is an optimal choice of ecology and economy, and a comprehensive function of environment, society and ecology [14-15]. Tourism environmental capacity refers to the maximum number of tourists T that can be accommodated under the conditions of meeting the space capacity T1, facility capacity T2, ecological environment capacity T3, socio-economic capacity T4 and psychological capacity T5, which is expressed in a simple formula: $T = \min(T_1, T_2, T_3, T_4, T_5)$. Whether the unit is line or area, different turnover rates K_i should be determined according to different situations.

$$K_i = \frac{t_i}{t_{i0}} \tag{1}$$

Among them, t_i is the one-day opening time of the scenic spot, and t_{i0} is the time required to visit the whole area.

(1) Mathematical model of spatial environmental capacity of areal tourist attractions

It is known as the space measurement model of tourist spots, or the area method and area calculation method. It is also calculated by the average tourist area of each tourist.

$$T_{mi} = \frac{S_i}{S_{i0}} * K_i \tag{2}$$

Among them, T_{mi} is the tourism space capacity of the ith areal tourist attraction; S_i is the area of the ith tourist attraction; S_{i0} is the reasonable area for tourists to visit.

(2) Mathematical model of spatial environmental capacity of tourist attractions

It is also known as line measurement mode, linear measurement mode and line method. It is based on the length of the corridor occupied by each visitor.

$$T_{xi} = \frac{L_i}{L_{i0}} * K_i \tag{3}$$

Among them, T_{xi} is the space capacity of the ith tourist line in the scenic spot; L_i is the total length of the tourist path; L_{i0} is the reasonable length of the tourist path.

3. Experimental Evaluation on Tourism Environmental Capacity of Nature Reserve a Based on Big Data

3.1. Current Situation of Environmental Evaluation of Nature Reserve A

(1) Characteristics of tourism resources

Unique primeval forest: Nature Reserve A is mainly composed of Siberian taiga forest, and together with Siberian subspecies, it forms the only complete ecological landscape in the Siberian Taiga forest region of China, forming a primeval forest. It is a rare "paradise" with high economic value, scientific research value and ecological environment value.

Amazing waters and lakes: towering and spectacular alpine glaciers, mysterious alpine lakes and crisscrossing rivers are all natural advantages here. There are more than 300 lakes with different shapes, which were formed during the fourth Great Ice Age more than 4000 years ago, with a maximum depth of 188 meters.

Charming grassland scenery: in the Nature Reserve A, in the middle mountain area, the scenery is beautiful. There is a big river that cuts the grassland into pieces. There are lush hillside forests, tall and straight pines, and valuable trees such as spruce, fir, and korean pine. It forms a surrounded forest sea, with a variety of wild animals breeding in the forest. In the gentle slope zone, it is a piece of green. On this piece of green, there are also flowers of various colors, just like being in a sea of flowers and grass.

(2) Analysis of atmospheric environment quality

By comparing and analyzing the monitoring data of the atmospheric environment quality in April 2019 (the closing period of the scenic spot) and August 2019 (the opening period of the scenic spot), it can be found that during the closing period of the scenic spot, the atmospheric environment quality is relatively stable without human activities. After the opening of the scenic spots, with the increase of human activities, the concentrations of various air pollutants produced have also shown a rising trend, which indicates that the impact of human activities is the most important reason for the change of environmental quality in the development of tourist attractions. As shown in Figure 1, the comparison of the atmospheric environment quality of each tourist attraction during the closing and opening periods is shown, in which Figure 1 (a) shows the monitoring results of SO2 in each tourist attraction during the closing and opening periods, and Figure 1 (b) shows the monitoring results of NOx in each tourist attraction during the closing and opening periods.

(3) Analysis of water environment quality in scenic spots

According to the scenic area development plan, within the scope of the tourist area, taking Lake A, Lake B and Lake C as the main body, it is an important part of the environmental protection work to ensure that the water quality is not polluted and maintain the Class I water function of the lake in the development of the tourist area. At present, in the development of scenic spots, the impact on the surface water experience is mainly caused by some water entertainment projects, such as fishing, yacht tourism, rafting, etc. These projects would produce a small amount of oil and debris, which enter the water body, and then have a certain impact on the water quality. Therefore, people can take reasonable measures to develop tourism projects, strictly manage them, and control the number of yachts, so as to effectively protect the water environment quality in the scenic area. Table 1 shows the water quality monitoring results of each lake.
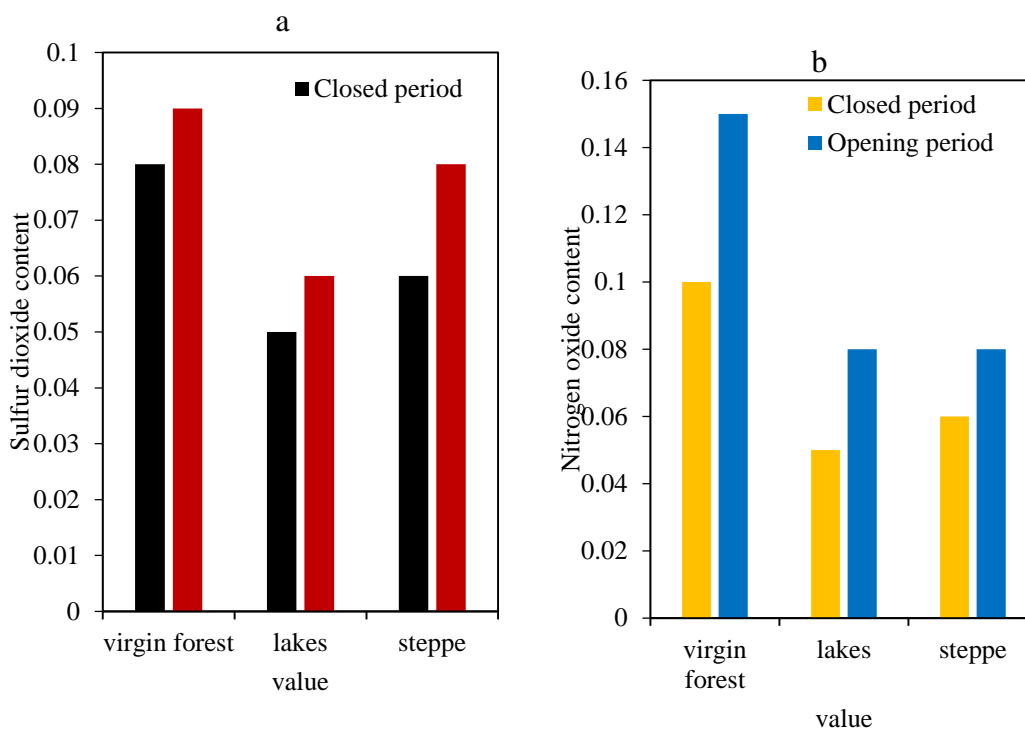
a

b

Figure 1. Comparison of atmospheric environment quality of tourist attractions during the closing and opening periods

Table 1. Water quality monitoring results of lakes

Monitoring results	PH	Permanganate index	Cyanide	Mercury
Lake A	8.40	1.27	0.003	0.0001
Lake B	7.71	1.36	0.003	0.0001
Lake C	8.16	1.40	0.003	0.0001

3.2. Calculation and Evaluation of Ecological Environment Capacity of Nature Reserve A

(1) Water pollution load calculation

The domestic water capacity of Nature Reserve A is 4000m3/d, with 9000 residents available for drinking. Based on 140L/d per person, the total amount of water in the whole ecotourism zone is 7 million liters/day. There are only a few simple living environments in tourist attractions, and the domestic sewage discharge of residents is less. In the comprehensive service area, the leachate tank can be used for comprehensive treatment. The solid waste left by tourists is cleaned by special cleaners, and the slope of the whole scenic spot is very flat, which is convenient for garbage collection and disposal. As shown in Figure 2, Figure 2 (a) shows the maximum allowable emission concentration of biochemical oxygen demand (BOD5), ammonia nitrogen (NH3-N), PH and total phosphorus of each pollutant, and Figure 2 (b) shows the actual pollution load of Nature Reserve A.
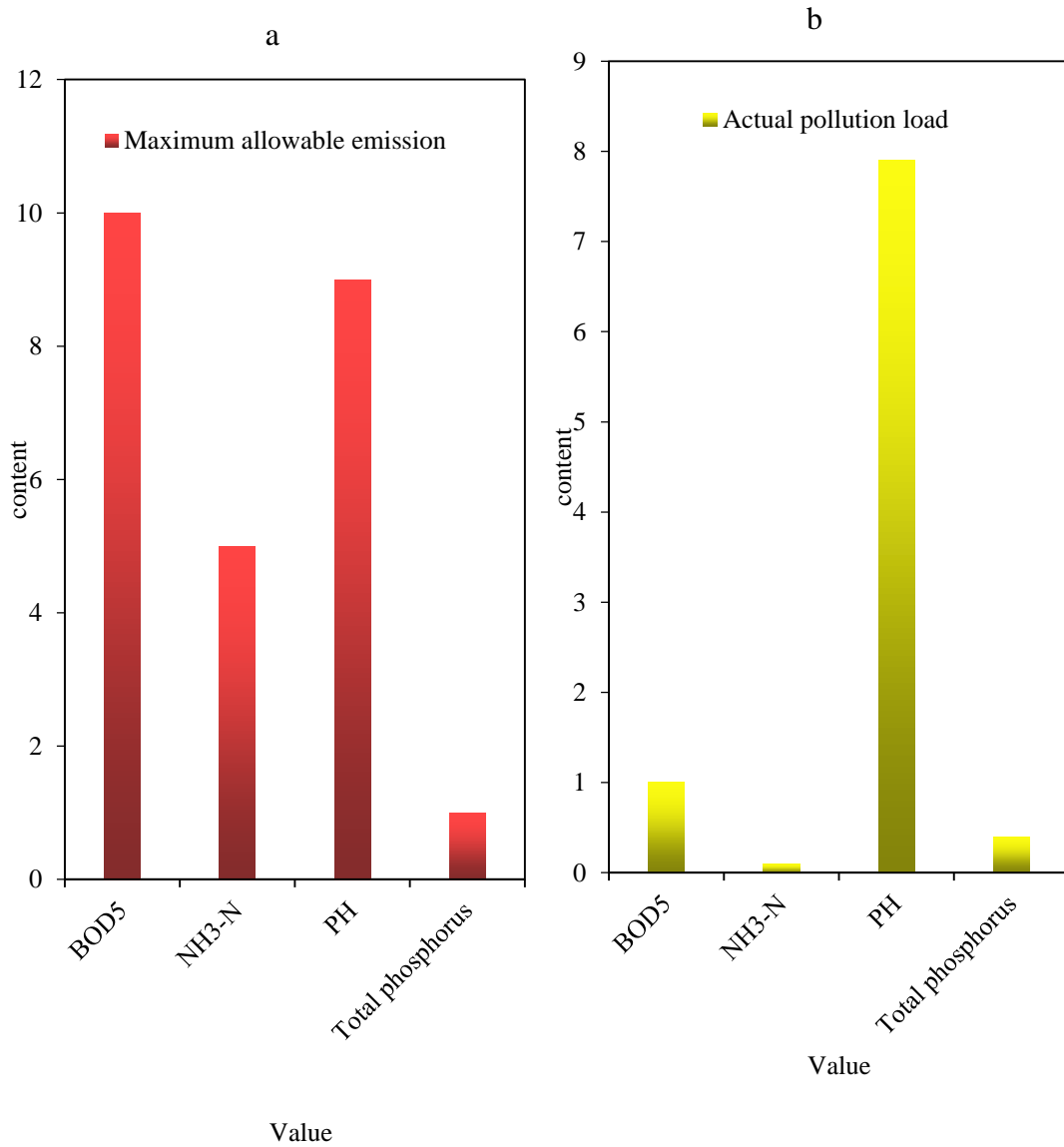
Figure 2. Comparison between the maximum allowable emission concentration of pollutants and the actual pollution load

(2) Solid waste forecast

According to the field survey, the scenic spot has relevant garbage disposal equipment, which is sufficient to clean and dispose the solid waste in the demonstration area. Therefore, the solid waste would not restrict the ecological environment capacity of the scenic spot temporarily. As shown in Figure 3, Figure 3 (a) shows the amount of garbage generated by urban residents, accommodation passengers and individual passengers per day, and Figure 3 (b) shows the amount of garbage generated by urban residents, accommodation passengers and individual passengers per day. A nature reserve would produce 3994 kg of garbage every day.
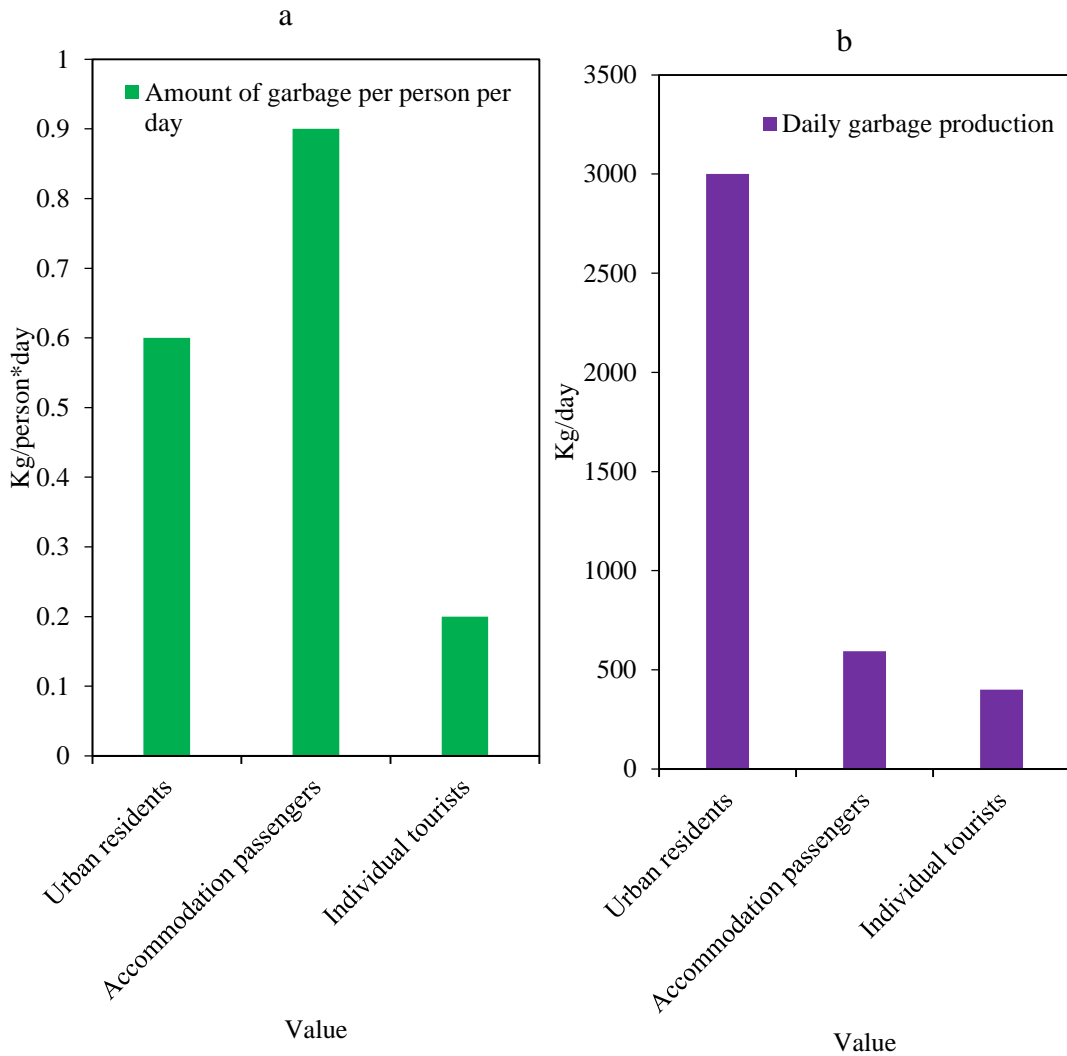
Figure 3. Daily garbage generated by urban residents, accommodation passengers and individual passengers

3.3. Calculation of Tourism Environmental Capacity

(1) Space tourism capacity

The carrying capacity of tourism space is the number of tourists it can carry in a specific period on the basis of its reasonable use. The estimation result of travel length per capita (or basic land per capita) has a great impact on the estimation of tourism environmental capacity. Theoretically, it should be based on the impact of tourism activities on the ecological environment of tourism destinations, through field investigation and research, and in the specific calculation, analogy, empirical method and other methods can be used. According to the relevant information of the scenic spots in the Nature Reserve A, as shown in Figure 4, in the calculation of the tourist environment capacity of the scenic spot, based on 4 m/person and 8 m2/person, the relevant information of each scenic spot was obtained through field investigation. Then according to the 10 hours of open time per day and the average effective visit time of 250 days per year, the annual

number of tourists that can be received in the Nature Reserve A was calculated to be only 510000.
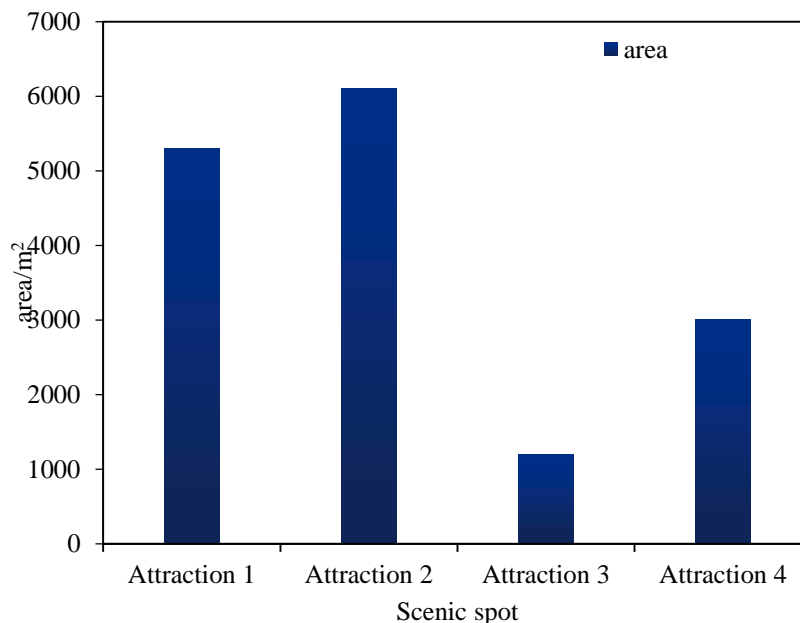

Figure 4. Visiting area of scenic spots in Nature Reserve A

(2) Analysis of tourism psychological capacity

Tourism psychological capacity refers to the maximum number of tourism activities that a tourism destination can bear without affecting the quality of tourism activities, which is also called tourism perception ability. On this basis, different tourist areas are divided into different types, as shown in Table 2. In addition, a questionnaire was also used to conduct a survey of different tourism enthusiasts and predict their tourism psychological capacity. The results show that when the average daily capacity is 1300 people, the satisfaction of tourists woould be higher.

Table 2. Basic requirements for different types of tourists

Types of tourists	Types of tourists	Basic Requirements
1	Wilderness lovers	Expect a quiet, fresh and isolated atmosphere
2	Sports lovers	Expect good sports conditions and a quiet environment
3	Camper	Seeking a natural atmosphere requires a large space for activities
4	Natural scenery viewer	Hope to fully experience the natural beauty

3.4. Countermeasures for Environmental Protection in Tourism Development

(1) Formulating scientific tourism development plan

In the process of ecotourism development of the original ecological natural environment, it would have a direct impact on each component of the tourism ecological environment capacity. Therefore, in the process of tourism development, it is necessary to establish correct tourism development thinking, and pay full attention to the protection of the tourism ecological environment. People should not only focus on the local economic development, but also neglect the environmental protection in the process of tourism development.

(2) Paying equal attention to tourism development and environmental management

In the process of development, construction and operation of tourist attractions, the local government and various management departments have focused on development and management, but failed to do a good job in the environmental protection of tourist attractions while pursuing the maximization of tourism profits, resulting in disorderly development and bringing negative impact on the environment of tourist attractions. Some tourism development and construction projects have not strictly followed the environmental impact assessment and "three simultaneities" system, and a large number of illegal construction projects have caused serious damage to the natural environment of the scenic spot. Therefore, people should pay attention to both the development of tourism and the governance of the environment.

4. Conclusion

Based on the construction of the tourism environmental capacity measurement system of the nature reserve, and based on its actual situation and research objectives, this paper measured and studied the tourism environmental capacity of the nature reserve, and analyzed it. At the same time, it also analyzed the use status of the tourism environmental capacity and the time and space changes of the use status. At the same time, in view of the existing problems of the tourism environmental capacity in the scenic area, the paper put forward the environmental protection measures that should be taken in the tourism development to formulate a scientific tourism development plan, with equal emphasis on tourism development and environmental management.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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