

Study on tourist carrying capacity of sustainable tourism---by taking Qingliang Mountain in the south-eastern china as an example

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Abstract. This paper analyzed measurable problems of tourist carrying capacity and then studied the corresponding measures by adopting theories and methods of environment sciences. Tourist carrying capacity of Qingliang Mountain was studied by analyzing the system of tourism environment capacity. The results showed that the level of service was 9726, which was smaller than the ecological carrying capacity of 12894. The facilities and spatial capacity were identified as key factors to limit the tourist carrying capacity in Qingliang Mountain. Some advices and measures including newly built and rebuilt basic facilities, construction of management methods for slack and peak tourist season respectively, construction of new sight spot and touring path were discussed to improve the tourist carrying capacity of Qingliang Mountain and solve the problems of overloading of tourists in the peak season.

1. Introduction

Sustainable tourism means to visit a place as a tourist and try to make a positive impact on the environment, society and economy. Nowadays, the environmental problem is very important for all the countries in the world. The resource shortage, environmental pollution and ecological imbalance have become global hot issues [1]. The contradiction among economic development, resource use and environmental protection has confined economic progress and endangered human's life, which has been widely concerned by the world. Tourism, as an industry with fast growth, high output values as well as a large capacity of employment, has attracted great attention due to its notable economic benefits. Further, it is known as a "Rising Sun Industry" because of its powerful momentum in growth. In the past, people thought that there was no contradiction and conflict between tourism and the environment. Tourism was regarded as an "anthracitic industry" without any pollution [2]. Nevertheless, as tourism develops, recently, environmental problems arise frequently which have influenced sustainable development of tourism. People have to reexamine the relationship between tourism development and environmental protection [3]. Researches concerning sustainable development and environmental protection are launched; influences of tourism development on the environment is studied according to ecological principles; sustainable development of tourism is widely concerned.

Tourism, as an economic activity, has contributed extremely to development of many geographically isolated regions as well as other countries [4]. In the last years, the lacking of organization tourism development of many regions in combination with massiveness of tourism causes



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new problems in the organization of regional space. The main reasons can be summarized as follows: (a) regional inequalities because of excessive concentration of tourism in specific areas; (b) progressive abandonment of other productive activities and specific tourism as the only or main activity in a number of regions; (c) degradation of allocated tourism resources and reduction of tourist attractiveness due to overexploitation of natural and structured environments [5].

Tourist carrying capacity can be regarded as the maximum allowable number of tourists in a scenic area under restrictions of ecological environment and basic facilities such as transport or accommodation [6]. At present, many researchers study this problem from the view of ecological environment protection. Undoubtedly, ecological protection is important to tourism areas. In fact, it is the premise to develop tourism industries [7]. However, the above researches ignored one issue that tourism activities are interaction of tourism areas and tourists. The carrying capacity is related to ecological factors and service quality. Enough facilities such as transport vehicles, restaurants and hotels must be guaranteed to provide good service for tourists. Otherwise, the number of tourists will be decreased and the tourism activities will be vanished.

Tourism is a global socioeconomic phenomenon based on human needs for recreation by getting in contact with nature and acquainting with other places and cultures, which is regarded as an activity of important economic, social, cultural and environmental consequences [8]. The economic or social dimension is stressed, but the environmental dimensions is underestimated or ignored among many studies and developmental programs. The balance between tourism and environment imposes configuration of suitable policies for tourism development of some area and imposition of essential limits. Thus, the tourism will not lead to environmental degradation or tourist disdain of some area in a long term by focusing on its protection or its conservation. In other words, the environment will have an influence on tourism and vice versa [9]. The environment of some region is negatively influenced by the increase of tourism in most of times, whereas the tourism development depends on quality and characteristics of environments. Therefore, a new approach is established to calculate tourist carrying capacity by considering both level of service of tourist and ecological environments. First of all, a level of service model is developed; then, the tourist carrying capacity is derived corresponding to critical values of level of service. Later, compared with ecological carrying capacity, the final tourist carrying capacity is determined. Finally, this paper calculates the tourist carrying capacity and evaluates the tourism management methods by taking Qingliang Mountain Resort as an example.

2. Calculating Model of Level of Service

2.1. Influencing Factors

Level of Service means service quality of provided by tourism areas, which is directly reflected by perception of tourists to their activities in tourism areas. For example, if the tourism area can provide enough and convenient transport vehicles, restaurants, hotels and clean environments, tourists will enjoy their travels. Then level of service is high.

Except for the above mentioned, other factors such as sanitations, route planning, weather condition will also affect level of service. This section will study level of service of established facilities in tourism areas. Nevertheless, only important factors including transport, hotels, and restaurants will be studied in this paper.

2.2. Level of Service Model of Single Factors

2.2.1. Level of Service of Transport The spatial accessibility of transport network is important to traveler. If the transport network can cover every spot, the tourists can reach their destinations conveniently. Besides, the crowd degree inside the vehicle carriage is another important factor that will affect tourist's perception. A crowded carriage will reduce service quality. Therefore, the level of service model of transport is established by considering the above two mentioned factors.

2.2.2. Level of Service of Accommodation Tourists will spend more than one day in many famous tourism areas such as HuangShan. Thus, tourists have to stay one night or more at hotels in some areas. Two factors including the number of beds and price of accommodation will affect LOS of accommodation. Tourists will choose hotels based on redundant beds and reasonable price.

Tourists who come from different regions with different economic levels will have discrepant expectations on the price of accommodation. If the accommodation cost in scenic areas exceeds their expectation or affordability, tourists will cancel trips. The accommodation cost can be divided into K (k=6) levels with each level corresponding to one economic level of tourists. The datas are shown in Figure 1.

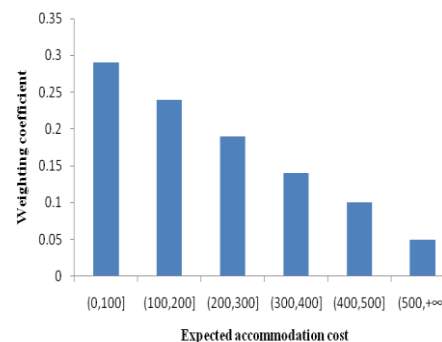


Figure 1. Six levels of the cost of accommodations

A_i Denotes the number of tourists that need accommodation corresponding to level i in tourism areas and E_i denotes the number of beds in economic level i . Generally, the lower of accommodation cost, the more demands of the hotel. Therefore, the lower cost of beds has more important effect on level of service of accommodation.

2.2.3. Level of Service of Restaurants Dining is another important thing for tourists. Like accommodation, the number of seats for dining and the price are two critical factors that affect level of service of restaurants. Therefore, the dining cost is divided into Q (Q=5) levels according to economic levels (as shown in Figure 2).

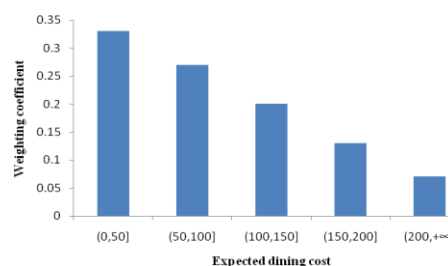


Figure 2. Five levels of dining cost

2.3. Integrated Level of Service Model

Three level of service models of single factors are established in section B, but they cannot reflect the integrated level of service of tourism areas. Thus, an integrated level of service model is established based on three single models.

2.3.1. Determination of weighting factors of single factors as discussed above, three factors have an influence on level of service of tourism areas but with different levels. The degree of influence of each factor shall be determined by using weighting coefficients.

Generally, the transport is more important than accommodations and restaurants, because a large number of tourists have to take vehicles to spots in many tourism areas. The transport factors are closely related to tourist activities, while hotels and restaurants are extra factors of tourism. This paper determines weighting coefficients of transport, accommodation and restaurant factors as 0.4, 0.3 and 0.3 respectively.

2.3.2. Development of Integrated Level of Service Model From equation (1), (2) and (3), it can be found that with the increasing number of tourists, PI is increased, which indicates deteriorated level of service. The values of PI_t , PI_z and PI_c are larger than 0 but without upper bound. In most cases, we need a value between 0 and 1 that can directly show the degree of LOS. Thus, we conduct a normalization process to three single level of service models.

2.3.3. Tourist Carrying Capacity Based on Level of Service Model The value of PI is between 0 and 1 now. The more tourists come into the tourism area, the larger of the value will be, which indicates worse level of service. When PI increases to a certain value, the level of service will deteriorate badly and tourists feel severely comfortless. In this case, the number of tourists of the tourism area is equal to its tourist carrying capacity. In this paper, we define the critical value of PI as 0.90 with its corresponding number of tourist's equivalent to tourist carrying capacity T_{LOS} .

3. Final Calculating Model of Tourist Carrying Capacity

3.1. Calculating Model Based on Ecological Environments

Many researchers studied this problem from the view of ecological environment. This paper uses the model established in references 8 directly.

3.2. Final Model of Tourist Carrying Capacity

The T_{CC} is used as the tourist carrying capacity, whose determination should consider both level of service of service facilities and ecological environments.

When $T_{EE} > T_{LOS}$, if the number of tourist is larger than T_{LOS} and smaller than T_{EE} , though the ecological environment can be protected, tourists who come into the tourism area will have a bad level of service and cannot get a glad trip. Otherwise, when T_{EE} is smaller than T_{LOS} , if the number of tourists is larger than T_{EE} but smaller than T_{LOS} , then the ecology will be damaged. Thus, it can be concluded from the analysis that the two factors must be considered when determining tourist carrying capacity.

4. Example Analysis

In this section, we take Qingliang Mountain scenic resort as an example to explain the model established in this paper. Qingliang Mountain, located in Anhui Province, is a national forest and geology park.

4.1. Data collection

In August 2015, when the resort was in peak season, the investigated data were shown in Figure 3 and 4.

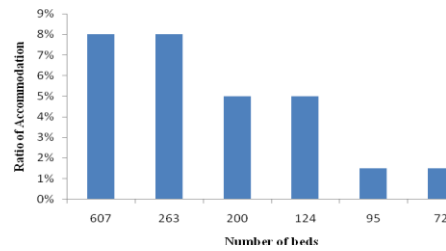


Figure 3. Statistical data about accommodation

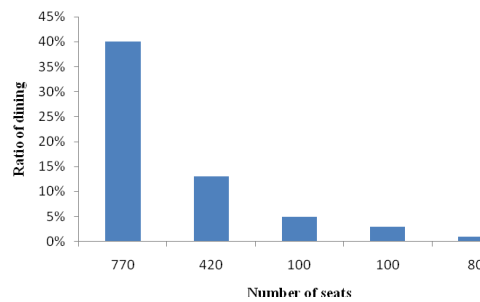


Figure 4. Statistical data about dining

Besides, 20 YuTong buses are available in the tourism area to pick up tourists in each spot for free. Each bus can carry 40 tourists.

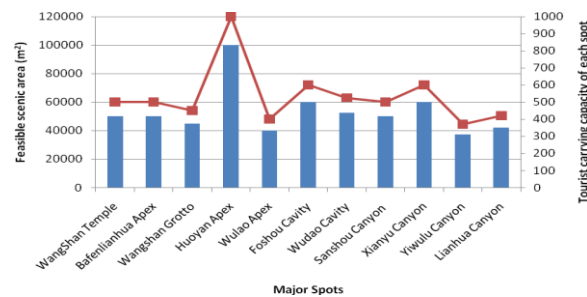


Figure 5. Statistical data about spots

The Qingliang Mountain is quite large, tourists usually spend over 5 hours on traveling every day. Therefore, we determine the turnover frequency^a as 2.0.

In Figure 5 the feasible tourism area does not refer to the size of each spot but the size that can accommodate tourists for sight-seeing. For example, the actual size of Huoyan Apex is more than 1000000m², but only the space around the Apex can be used by tourists, the size is 100000m², which is 10% of the actual size.

4.2. Calculation of Tourist Carrying Capacity

The dates in Figure 3, 4, 5 are used and then substituted into equation 11 and 12, we can get $T_{LOS} = 9726$, $T_{EE} = 6447 \times 2 = 12894$. The final tourist carrying capacity equals to:

$$T_{CC} = \min(9726, 12894) = 9726$$

Therefore, the tourist carrying capacity of Qingliang Mountain is 9726 tourists every day.

It can be found from the above mentioned results that the ecological carrying capacity T_{EE} is larger than level of service carrying capacity T_{LOS} , which indicates the development of basic facilities (transport, accommodation and restaurant) cannot afford enough tourists. If the tourism area can allow 12894 tourists, though the ecological environment will not be damaged but tourists will get a low level of service. Thus, a further investment on these facilities shall be continued to promote the level of service.

5. Conclusions

There have been conflicts between tourism exploitation and environmental protection. The conflicts lead to obviously worsening environmental quality. The worsened water quality has especially restricted sustainable development of tourism there. However, the tourism development in the new century poses higher demands on Qingliang Mountain. On one hand, the number of tourists needs to be settled. On the other hand, while reducing polluted drainage and solving pollution, the self-purification ability of environment shall be particularly stressed. This paper establishes a new tourist carrying capacity model by considering both ecological environments and basic facilities such as transport, accommodation and restaurant. Then the Qingliang Mountain Resort is taken as an example for further validation. The results show the ecological carrying capacity is 12894 and the carrying capacity of basic facilities is 9726. Thus, the tourist carrying capacity is determined as 9726. The resort can increase its capacity of basic facilities aiming to provide better service to tourists.

We should advocate environment-friendly travels. According to environment conditions and pollution characteristics in Qingliang Mountain, the environment-friendly products should be advocated and detergents should be reduced. The use of detergents with phosphorus is prohibited. The environment behaviors of tourists lead to sustainable development of environments and tourism. The tourism industry in Qingliang Mountain shall achieve its sustainable development by combining pollution prevention with strict pollution administration so as to have a glorious future. The area possesses necessary resources (natural and cultural) for a powerful, balanced and long-term tourism development. Undoubtedly, the sustainable development model shall be reinforced; the local factors are required along with modernization of the existing tourism products; the additional services and products as well as modernization of the existing infrastructures and services shall also be improved.

Acknowledgment

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