Analysis of bearing capacity of Kunming Dianchi National Tourism Resort

Yang Zhipeng, Xiong Ying
( Yunnan University of Finance and Economics, Kunming, Yunnan 650221, China)

Abstract: Explaining the practice of social development shows that bearing capacity is a problem that must be faced by regional sustainable development. This paper uses the restrictive factor method to calculate and analyze the bearing capacity of Dianchi Lake Resort. The results show that the bearing capacity of Kunming Dianchi National Tourism Resort is currently in a state of overall coordination and some of the problems are outstanding; and corresponding suggestions are proposed.

1. Introduction
The development practice in recent years has shown that the negative impact of economic and social development on the environment is becoming more and more important. Traffic congestion, serious environmental pollution, and deteriorating quality of life are increasingly highlighted, and bearing capacity issues are receiving more and more attention.

Bearing in mind the comprehensive reference to the “Pareto optimal” aspect of economics, bearing capacity can be considered as the maximum amount of capacity that a region can sustain without causing an unacceptable decline in local environmental quality. Capabilities include the basic contents of resource space carrying capacity, environmental ecological carrying capacity, social psychological carrying capacity, and economic development carrying capacity.

In 1963, Lapage first proposed the concept of tourism capacity, but did not conduct in-depth research. In 2003, Steven Lawson and others used computer simulation models to predict the social carrying capacity of each day of Yakeshi International Park, which was used to guide the daily management and environmental protection of the park. In 2004, Simon et al. estimated the bearing capacity of Hengistbury Head’s tourism industry. This stage has made great progress in quantitative research.

Domestic scholars have also made many researches on this issue. In 1986, Bao Jigang analyzed the current situation of the tourism environment capacity of the Summer Palace and calculated it on the basis of exploring the capacity of tourism environment. In 1995, Cui Fengjun called the capacity of tourism environment capacity as the carrying capacity of tourism environment. He believed that the carrying capacity is composed of the quantity of environmental ecology, the carrying capacity of resources, the amount of psychological carrying capacity, and the carrying capacity of economy. It is objective and scalable, and easy. Denaturation, controllability, existence of the best value and the maximum value. In 2003, based on the discussion of the concept of the carrying capacity of tourism resources, Ma Liping put forward the methods and steps for analyzing the carrying capacity of tourism resources, which provided a basis for the development of regional tourism. In 2014, Sun Caizhi and others used the fuzzy evaluation method to measure and analyze the bearing capacity of the Bohai Sea region.
Experts at home and abroad have carried out a lot of exploration on the concept system and measurement model of bearing capacity, and have achieved gratifying results. It is mainly based on the single factor bearing capacity calculation model, but there is little research on the comprehensive evaluation model, which requires further research and discussion.

In order to protect the ecology and environment of Kunming Dianchi National Tourism Resort, it is urgent to carry out analysis of bearing capacity so as to effectively control the ecology and environment of the resort and to take good measures of the development and protection of the resort in order to better develop tourism and protect the environment. Resort’s ecological environment.

2. Kunming Dianchi National Tourism Resort Overview
Kunming Dianchi National Tourist Resort is one of the 12 national-level tourist resorts approved by the State Council in October 1992 and the only tourist resort in the Inland Province. The climate here is pleasant throughout the year. The annual maximum temperature does not exceed 31°C, the minimum temperature is not less than -6°C, the average temperature is 14.7°C, and air quality is 365 days. The area of the whole area is 47.5 square kilometers, which is composed of two parts: Haishu District and Chenggong Dayu District. Among them, the Haishu District has an area of 22.5 square kilometers, and the large fishing area has an area of 25 square kilometers. It is the ideal place for sightseeing, entertainment, and vacation. It is located in the south of Dianchi Lake in Haishu District, in the north of Kunming City, on the east and in the west of Xishan District, and on the west of the famous Xishan Forest Park. The area has established large-scale projects such as Yunnan Ethnic Village, Yunnan Ethnic Museum, Haishu Park, Caohai Dam, China Civil Aviation Training Center (Dianchi Grand Hotel), Kunming Dianchi Garden Hotel, and Karting Speedway. The Dajian District is located in the southwestern part of Chenggong District, on the east bank of Dianchi Lake in the west, and is connected to the municipal administrative center in the east. It has built golf courses, large fishing parks, and the Liyu River Wetland Park.

3. Calculation of Carrying Capacity of Kunming Dianchi National Tourist Resort
Through previous literature review and data compilation, this paper used the restrictive factor method, which is often referred to as the “barrel principle” research method, to calculate the carrying capacity of Kunming Dianchi National Tourism Resort. In terms of psychological carrying capacity, questionnaire surveys were used. In this way, questionnaire surveys were conducted on residents and tourists in tourist destinations and conclusions were reached. This method is simple, easy to collect data, using formulas to calculate more scientific and more practical. Considering the tourist destination as a system, its bearing capacity depends on the smallest one of the values of each bearing capacity. The bearing component includes the ecological environment, resource space, economy, and psychology. It calculates, draws and analyzes the results, and proposes corresponding countermeasures and suggestions. According to the above-mentioned index system of carrying capacity, the bearing capacity of Kunming Dianchi Tourism Resort was estimated by collecting relevant data.

3.1 Sources Of Data
The data on the carrying capacity of the ecological environment, the carrying capacity of the resources, and the economic carrying capacity in this paper comes from the Environmental Protection Bureau of the Kunming Dianchi National Tourism Resort, while the data on the psychological carrying capacity comes from questionnaires on the ground. The residents' psychological carrying capacity. In this survey, 250 questionnaires were distributed to residents and 233 questionnaires were returned. The recovery rate was 93.2%, of which 222 were valid questionnaires, and the effective rate was 88.8%.

3.2 Measurement Methods
(1) Eco-environmental carrying capacity EEBC_b formula is:

\[ EEBC_b = \text{Min}(AEBC_b, SWBC_b, WEBC_b) \]  

The formula for estimating each component of ecological environment carrying capacity is:
AEBC_b = \frac{\text{Regional environmental atmospheric capacity per capita emission}}{\text{Daily solid waste handling capacity}} \quad \text{Unit: (person/day)} \quad (1-2)

SWBC_b = \frac{\text{Daily solid waste handling capacity}}{\text{daily solid waste production per capita}} \quad \text{Unit: (person/day)} \quad (1-3)

WEBCb = \frac{\text{daily solid waste production per capita}}{\text{Solid waste handling capacity}} \quad \text{Unit: (person/day)} \quad (1-4)

In the formula, EEBC (Ecology Environment Bearing Capacity): Ecological environment carrying capacity (person/day); AEBC (Air Environment Bearing Capacity): Atmospheric environment carrying capacity (person/day); SWBC (Solid Waste Bearing Capacity): Solid waste carrying capacity (person/day); WEBC (Water Environment Bearing Capacity): amount of water environmental load (person/day).

(2) Calculation of psychological carrying capacity: Dianchi Tourism Resort is a large area where local residents and tourists are interviewed and questionnaire surveys are conducted to understand their attitude towards tourism activities to infer the psychological carrying capacity of local residents, according to the questionnaire survey. The proportion and actual interview results infer the psychological carrying capacity of tourists.

(3) The formula for estimating the carrying capacity of resource space is:

\[ C_{REC} = \frac{\text{total size of resource space}}{\text{per capita basic space standard}} \quad (3-1) \]

(1) Resource space capacity calculated by the per capita area of the scenic spot:

\[ D_m = \frac{S}{d} \quad (3-2) \]

\[ D_a = D_m \times T_a / t \quad (3-3) \]

\[ D_{an} = D_a \times T_{an} \quad (3-4) \]

S is the tourist attraction area (m²); d is the tourist minimum per capita space standard (m²); \( D_m \) is the instantaneous passenger flow capacity; \( D_a \) is the daily passenger flow capacity; \( D_{an} \) is the annual passenger flow capacity; t is the tourist tour once The average required time (h); \( T_a \) is the effective tour time (h); \( T_{an} \) is the annual effective tour time (d).

(2) Tourist capacity calculated based on the per capita length of tour route:

\[ D_m = L/l \quad (3-5) \]

\[ D_a = V \times T_a / l = D_m \times T_a / t \quad (3-6) \]

\[ D_{an} = D_a \times T_{an} \quad (3-7) \]

Among them, L is the total length of the tour route (m); z is the reasonable distance (m) for tourists on the tour route; V is the average visitor speed; \( D_m \), \( D_a \), \( D_{an} \), \( T_a \), t and \( T_{an} \) have the same meaning as before.

(3) The air purification capacity is the calculation formula for atmospheric environmental bearing capacity:

\[ R_s = \frac{Sf}{S_k} \quad (3-8) \]

Among them, \( R_s \) is the bearing capacity of the atmospheric environment; S is the actual tourist area of the scenic spot; \( S_k \) is the per capita green area; f is the green coverage rate of the scenic area. According to Hu Zhongxing’s study, each person must have an average of 30m² to 40m² of forest green space in order to maintain the normal proportion of SO2 and NO2 in the air and keep the air fresh. Therefore, the average per capita green space area in the study was 40m².

(4) Calculation formula for economic carrying capacity: Economic conditions, that is, factors that satisfy the basic living conditions of tourists such as clothing, food, housing, transportation, and entertainment. According to research results at home and abroad, economic carrying capacity is mostly measured through four factors: local hotel beds, water supply capacity, power supply capacity, and transportation capacity. For example, main and non-staple food supplies are not included in the restrictive economy due to their greater flexibility. The factor, the specific formula is:

\[ \text{DEBC}_b = \text{Min} (\text{DEBC}_{b1}, \text{DEBC}_{b2}, \ldots \text{DEBC}_{bi}) \quad (3-9) \]
where \( \text{DEBC}_b \) is the economic carrying capacity (person/d); \( \text{DEBC}_{bi} \) is the economic carrying component formed by the ith factor supply, \( \text{DEBC}_{bi} = \frac{S_{bi}}{D_{bi}} \). \( S_{bi} \) is the ith factor supply (amount/d); \( D_{bi} \) is the daily demand per person of the ith factor (amount/person•d).

### 3.3 Measurement Results

After the calculation, four major factors and various small factors after the four major factors are obtained, which more intuitively reflect the specific situation of the carrying capacity of the Dianchi Lake Resort.

The atmospheric environmental carrying capacity of the ecological environment is a non-limiting factor. The original carrying capacity of the solid waste carrying capacity \( \text{SWBC}_b = 100000 \), the remaining carrying capacity \( \text{SWBC}_b = -21325 \), and the water environment carrying capacity is a non-limiting factor;

In terms of psychological carrying capacity, the results of an effective questionnaire analysis: In general, residents’ greatest support for tourism is mainly economic benefits. For example, an increase of local residents’ employment opportunities has a support of nearly 70%. Nearly 70% of the participants in the right to participate in the distribution of tourism development benefits are also in favor, and local residents are still willing to develop tourism. This proves that the local residents’ psychological carrying capacity is relatively large. Calculation of the psychological carrying capacity of tourists. 280 tourist questionnaires were distributed and 267 questionnaires were returned. The recovery rate was 95.4%, of which 231 were valid questionnaires, and the effective rate was 82.5%. The analysis of effective questionnaires is as follows: In terms of tourists, tourists’ satisfaction with the local people is less than 60%, which proves that the local conflicts with local residents in the development of tourism are still very serious. This actually affects tourism development of. The scenic spots scored low in entertainment facilities, scenic spot management, services, public facilities, and the environment. Satisfaction was 61.6%, 53%, 46.5%, 29.7%, and 50.5%, respectively, and overall tourists' satisfaction was not high. Visitors to the trip mainly because of attractions (59.3%), landscape (66.3%) attractive. It is proved that the local tourism administration department has a limited role in the scenic spot and mainly depends on the natural scenery to attract tourists.

The carrying capacity of resources and space is calculated based on per capita floor space, and the original carrying capacity is 33,333, the remaining carrying capacity is 4194, and the original carrying capacity of per capita green land is 32,754, and the remaining carrying capacity is 3615.

The carrying capacity of accommodation facilities in terms of economic carrying capacity: original carrying capacity \( \text{DEBC}_{b1} = 8731 \), remaining carrying capacity \( \text{DEBC}_{b1} = -2121 \), original carrying capacity of water supply carrying capacity \( \text{DEBC}_{b2} = 93750 \), remaining carrying capacity \( \text{DEBC}_{b2} = 1563 \), carrying capacity of power supply facilities and transportation The carrying capacity of the original bearing capacity is temporarily not limited.

The magnitude of the bearing capacity ultimately depends on the carrying capacity of the numerical minimum factor, which is the limiting factor of the entire evaluation area factor. Therefore, according to the results shown in the table above, it can be known that the final minimum capacity of the Dianchi Lake Tourism Resort is equal to the minimum value of the ecological environment carrying capacity, the spatial carrying capacity of resources, psychological carrying capacity, and economic carrying capacity. The original carrying capacity:

\[
\text{TEBC}_b = \text{Min}(\text{EEBC}_b, \text{REBC}_b, \text{PEBC}_b, \text{DEBC}_b)
\]

\[
= \text{Min}(100000, 32754, > \text{PEBC}_b, 6610)
\]

\[
= 6610 \text{(person/day)}
\]

The remaining bearing capacity is

\[
\text{TEBC}_b = \text{Min}(\text{EEBC}_b, \text{REBC}_b, \text{PEBC}_b, \text{DEBC}_b)
\]

\[
= \text{Min}(-21325, 3615, > \text{PEBC}_b, -2121)
\]

\[
= -21325 \text{(person/day)}
\]
It can be seen that, among the original capacity of Dianchi Lake, the accommodation in the carrying capacity of resources and resources is a limiting factor; and in the remaining carrying capacity, the solid waste in the carrying capacity of ecological environment is a limiting factor. At present, the resort industry as a whole has broad prospects for tourism development. In the past 2014, the number of tourist attractions in the scenic spot has exceeded 10 million, and it is expected to reach 15 million in 2015. Taken together, the tourism service industry in Dianchi Lake Tourism Resort in 2015 Total revenue is expected to reach 27.7 billion yuan, an increase of 23% compared with 2010. However, in the course of development, it can be seen that the scenic commodity chain is single, the ecological destruction of the scenic spot and environmental pollution still exist, and the overall environment still has room for further improvement.

4. The Results Of Analysis

4.1 After calculation, at present, the carrying capacity of the entire resort is indefinitely large in terms of atmospheric carrying capacity, and the sewage treatment is temporarily unrestricted. However, the remaining amount of solid waste is less than 8,000 people/day, while the average tourist in the same period is The daily load is 29149 person/day, so the solid waste carrying capacity is currently the minimum of the ecological carrying capacity of the resort. In the tourism reception area, the requirements and management standards for the physical environment represented by infrastructure must be higher than those in other areas. Its capacity in water supply systems, solid waste treatment systems, and sewerage systems must be able to ensure peak usage during the tourist season.

4.2 In terms of social psychology, according to the questionnaires and interviews with local residents and tourists, local residents have a very high attitude towards the economic benefits of tourism development. Overall, the psychological carrying capacity of tourists and residents is also Not a limiting factor. The scenic area should also develop tourism at multiple levels and extend the industrial chain of the scenic spots to form a complete tourism industry chain, which will in turn stimulate local residents to participate in the tourism industry.

4.3 In terms of resource space, the calculations are based on per capita area, per capita possession of tour route length, and per capita possession of green space. It is known that the per capita area of the current scenic spot has a large carrying capacity and a large margin. For the further development of the resort area; per capita tour length, the current total is 33,333 people / day, the current average number of tourists has reached 29,149, the remaining amount has been small, it is expected that there will be congestion during the peak period; per capita possession of green area and Per capita possession of tour length is similar. The scenic spot should coordinate the supply relationship of tourist attractions; appropriately take diversion measures, such as opening up new tourist attractions, implementing rest and recuperation in the off-season, and taking turns to open the scenic spots.

4.4 In terms of economic carrying capacity, in general, due to the rapid economic and social development in Kunming, visitors are basically not short-circuited in terms of reception, especially transportation, water supply, and power supply. They are also very flexible and can adapt to different quantities. Tourist visits.

5. Conclusion

The life cycle theory of the development of tourism destinations shows that the bearing capacity crisis is often accompanied by the evolution of the destination life cycle stage. From a long-term perspective, the development work must focus on the expectations of the future situation. Taking the bearing capacity as an early-warning mechanism, different tourism carrying indices represent different tourist carrying conditions, so as to make a judgment whether to issue an alarm. If an alarm is issued, the causes are analyzed, and the control measures are implemented through the corresponding forecasting
measures. Bearing capacity as a management tool. In short, when we use environmental resources to obtain benefits, we must have a profound understanding of environmental carrying, we must effectively control the environmental capacity, and grasp the strength of development. Controlling the environmental carrying capacity can do a good job in the tourism industry.

References:
[1] Cui Fengjun, Liu Jiaming. A study of the theor yand application of tourism environmental Bearing capacity [J].Progress in Geography, 1998, 17(1):86 -90.
[2] Liu Yan. Tourism Psychological Carrying Capacity: Determinants and Measurement Models [J]. Shanghai Economic Research, 2003, (2): 60-64.
[3] Li Qinglong. Discussion on Ecological Carrying Capacity[J].Forestry Economic Issues, 2006(3):170-172.
[4] Wang Hui, Jiang Bin. Calculation of tourist environmental Capacity with ecological footprint model[J].Journal of Liaoning Normal University(Natural Science Edition), 2005, 28(3):358 -360.
[5] Lu Ying,He Daming, Liu Jiang, etal.Ecological footprintand ecological capacity dynamic analysis of Yunnan province[J].China Population, Resources and Environment, 2006, 16(3):93 -97.
[6] Xie Hongxia, Ren Zhiyuan, Mo Hongwei. Analysis of Urban Ecological Footprint——Taking Xi’an as an Example[J]. AridLand Geography, 2005, 28(2):215 -218.
[7] Croes R R and Vanegas M. Sr. An econometric study of tourist arrivals in Aruba and its implications[J]. Tourism Management 2005, 26 (6): 879 -890.
[8] Dritsakis N. Cointegration analysis of German and British tour-ism demand for Greece[J]. Tourism Management 2004, 25(1): 111 -119.
[9] Jenks G F. The data model concept in statistical mapping. International Yearbook of artography,1967, 7: 186–190.
[10] Xiong Ying, Dong Chenseng. The Characteristics of the Ecotourism Visitor Flow Activities to the Wulingyuan Scenic[J]. Economic Georaphy 2014 , (11):173-178.