



## **Evaluation and Risk Analysis of Carrying Capacity of Eco-Environment in Scenic Spots**

**MIAO HAN**

*Shangqiu Vocational and Technical College, Shangqiu 476000, China*

*Email: maomaosnopy@126.com*

**Abstract:** In the tourism development process, it needs to implement infrastructure construction vigorously, especially strengthen the construction of super highway and other transportation facilities. Speed up the progress of integration and clustering of tourism in southeast of Guizhou province and improve the levels of hotels, restaurants, entertainments and shopping to meet the requirements of tourist. Construct tourism industry cluster by taking enriching of tourism resources as basis and taking traffic roads as support; strengthen tourism coordination and closely combine the individual interests of tourism enterprises within tourism cluster together and realize economic benefit of tourism scale. Practice has proven that with the increasing participation of tourism enterprises into the cluster, the channels for transporting tourists will attain geometric growth, the more clusters, the stronger control ability for tourist market and the stronger competitiveness of regional tourism industry.

**Keywords:** *Eco-environment scenic spots, risk analysis, Eco-environment evaluation*

### **1. Introduction**

Carrying capacity of tourism environmental, also called as tourism environmental capacity, is an important scale of measuring whether the tourism environment and tourism development is coordinated and is the core theoretical issue of contradiction between tourism development and environment protection [1]. As a basis of judging whether tourism activities have negative influence on environment, carrying capacity of tourism environment has been proposed with the development of tourism and has become the focus of tourism research. Research on carrying capacity of tourism environmental is an important part of our sustainable development strategy and scientific outlook on development, which has important significance on exploitation of tourism resources, protection of tourism environment and adjustment of tourism structure. However, in view of current research situation, this issue is with great research difficulty as it relates to ecology, resources, regional economy, social environment as well as tourism stakeholders etc.

At present, many scenic spots do not have well and deep understanding of the essence and connotation of ecological tourism in the development process of ecological tourism, lack theoretical guidance for how to plan, develop and manage ecological tourism, cause many places no longer ecological and harmonious any more after implementing ecological tourism [2]; tourism activities has greater and greater impact on environment, which threatens the sustainable development scenic spots. Environmental carrying capacity of ecological tourism can measure comprehensively if the population, tourism resources and ecological environment are coordinated and if the

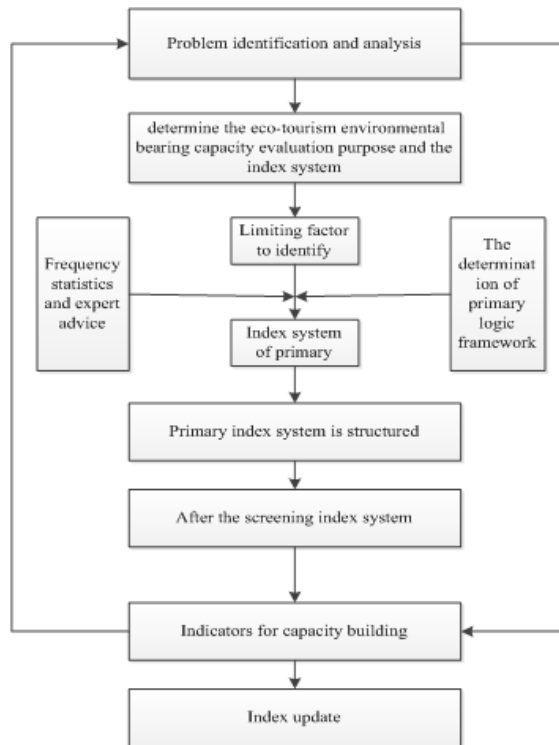
tourism development is sustainable, which is one of the effective tools of coordinating tourism economic development and environmental protection and can guide scenic spots planning and management in a better way.

Miao and Dong autonomous prefectures at the southeast of Guizhou province have been granted as one of the eighteen ecological and cultural protection circles by World Local Culture Protection Foundation with its tourism resources of uniqueness, specialty, exclusiveness, mass participation and originality. Since the implementation of tourism in 1980s, the visitors are increasing rapidly every year. However, the influx of tourists and uncivilized tourism behavior has made great negative influence on the fragile ecological environment in southeast prefectures of Guizhou province [3]. To ensure the coordinated and sustainable development of tourism industry and tourism environment, the prefecture committee and government have proposed strategic slogan of "setting up prefecture with ecology and activating prefecture with tourism", set about ecological tourism planning with each county and scenic spots actively and implemented ecological tourism under the premise of environmental protection. As an important part of ecological tourism planning, evaluation and research on the environmental carrying capacity of ecological tourism are drawing more and more attentions from tourism planning experts and scholars. As an important tool of scenic spots planning and management, carrying capacity of ecological tourism environment is playing a more and more important and outstanding role in the planning, development and management of ecological tourism environment in the southeast part of Guizhou province [4]. It is an

important assurance of implementing ecological tourism smoothly and it is of top priority to strengthen the research on carrying capacity of ecological tourism environment in the southeast part of Guizhou province, analyze the carrying capacity of ecological tourism environment of each scenic spot within this region and estimate the carrying capacity of ecological tourism environment in the southeast part of Guizhou province.

## 2. Characteristics of Environmental Carrying Capacity of Ecological Tourism

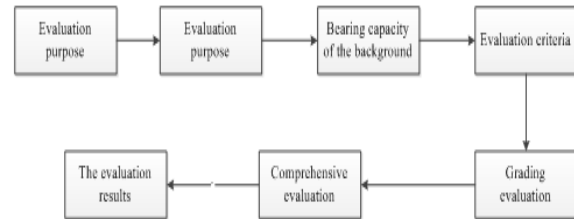
### (1) Characteristics of temporal and spatial variation



**Figure 1:** Flow chart of the total construction of index system

In view of time distribution, tourism activity is seasonal. The natural environmental factors, social economic factors, psychological factors of local residents and suitability of management etc in scenic spots are changing regularly with the passing of time, therefore, the resources space carrying capacity, economic carrying capacity, social and psychological carrying capacity and management service carrying capacity determined by these influencing factors also change with the passing of time, which has finally determined the “sum” of above carrying capacity components, that is the environmental carrying capacity of ecological tourism, has characteristics of time distribution. In view of spatial distribution, as the basis of carrying capacity of tourism environment, spatial differences exist in characteristics of ecological resilience and sensitivity etc of natural ecological environment; regional differences also exist in social economic environment and social

psychology, therefore the carrying capacity of ecological tourism environment is with spatial variation characteristics.



**Figure 2:** Evaluation program flow chart

### (2) Static and dynamic characteristics

Static characteristic is mainly determined by the residence time of visitors when making one visiting activity. In this process, no changes will happen to environmental carrying capacity, so there is an instantaneous environmental carrying capacity. Dynamic characteristic is determined by the relationship between limited residence time and unlimited opening time of scenic spots and this characteristic determines that the environmental carrying capacity of eco-tourism can reach certain quantity within certain time [6].

### (3) Coexistence of controllable factors and uncontrollable factors

The factors of carrying capacity of eco-tourism environment can be divided into controllable factors and uncontrollable factors based on the control ability of human activities to factors influencing the environmental carrying capacity of eco-tourism. Generally speaking, in the carrying capacity of eco-tourism environment, carrying capacity of resource space and social and psychological carrying capacity are big in rigidity and small in flexibility; while economic carrying capacity and management and service carrying capacity is big in flexibility and easy to control. Therefore, the bottleneck for the increase of carrying capacity of eco-tourism environment is the carrying capacity of resource spatial environment and social and psychological carrying capacity.

### (4) Comprehensive and complicated

Tourism is a comprehensive industry and the eco-tourism environmental system formed during its development is a composite system combined with social, natural and economic factors etc. Both qualitative elaboration and quantitative analysis involve in various factors, especially during the quantification of the environmental carrying capacity of eco-tourism [8], it needs more disciplines and more fields crossed with each other to make comprehensive research. This is the complexity of research on the environmental carrying capacity of eco-tourism.

## 3. Establishment of Index System of Carrying Capacity

### 3.1 General process of index system construction for environmental bearing capacity of eco-tourism

The general process of index system construction for environmental bearing capacity of eco-tourism has been confirmed based on above general idea as well as the construction method and theory of index and index system, in addition to refer other construction methods of index system, as shown in picture 1.

The construction of index system for environmental carrying capacity of eco-tourism will be accomplished by several processes. First, analyze and identify the research problems, confirm evaluation object, evaluation objective and index system and then confirm the restricting factors for the environmental carrying capacity of eco-tourism in the southeast of

Guizhou province by analyzing local characteristics, confirm the index system of environmental carrying capacity of eco-tourism in this area, enable it with certain common factors with existing index system in structure and then make it convenient for the following evaluation work. In addition, there is possibility for the overlapping information carried by index, so during the selection of specific evaluation index, it needs to select the primary index with quantitative correlation analysis method on the basis of qualitative analysis. The selected index will be examined based on comments of experts as well as results and comments of related local technical departments on experimental application and finally specific index system will be formed for following overall evaluation.

**Table 1:** The index system of ecological tourism environment bearing capacity

The target layer	Primary index and weight	Secondary indexes and weights	
The index system of ecological tourism environment bearing capacity	The natural environment bearing capacity index	The ecological environmental bearing capacity	The water quality indicators
			Atmospheric quality indicators
			The noise level
			Solid waste disposal rates
		The ecological carrying capacity	Tourism carrying capacity
			Biodiversity index
			Biological species ecological status indicators
		Natural disasters restrictions on tourist area	The vegetation coverage
			Self-purification capacity of the scenic spot
			Ability to resist wind and snow
			Flood control ability
	Social environment bearing capacity index	Physiological capacity	Tourism scenic area damage strength index
			Group populated
			Tourists social and economic background
			Have a class satisfaction
			Tourist area populated
			Tourism economy cognitive level
			The cognitive level of tourism environment
			The impact of the tourism activities of culture
			Tourism activities on the lifestyle change
			Historical sites
	The bearing capacity of social culture	The bearing capacity of tourism management	Large engineering facilities
			General manager of ability
			Employee creativity
			Business knowledge and skills
			Management skills
	Bearing capacity of facilities		Training ability
			Human resource planning ability
			Quality standard
			Operating standards
			Management mode

**Table 2:** The weight coefficient of index factors

Weights	Bala River-Little Peony	Wuyang River	Yang Asha Lake	Li Township
$a_{ij}$	$A_{i1}$	$A_{i2}$	$A_{i3}$	$A_{i4}$
$a_{1j}$	0.142	0.362	0.302	0.201
$a_{2j}$	0.163	0.146	0.136	0.123

a3j	0.205	0.059	0.092	0.142
a4j	0.251	0.102	0.114	0.217

**Table 3:** The bearing capacity of environmental quality comprehensive correlation degree and the evaluation results

Evaluation of tourist area	Tourism environment carrying level quality				The evaluation results
	I	II	III	IV	
Bala river - little peony	-0.2012	0.1472	-0.0925	-20178	II
Wuyang river	0.1235	-0.2054	-0.4212	-0.5201	I
Yang asha lake	0.0064	-0.3021	-0.5214	-0.5425	I
Li township	-0.1854	0.2458	-0.4201	-0.5032	IV

The construction of index system is not finished at this stage and in the end, it also needs to strengthen the construction of index acquisition ability and make continuous dynamic update for index. The construction of index acquisition ability mainly includes the construction of index monitoring ability, sometimes will include the construction of management ability for index system etc.

### 3.2 Index System of Environmental Carrying Capacity of Eco-Tourism

The index system for the research on environmental carrying capacity of tourism is totally different for different types of scenic spots. Even for the same type of scenic spot, the index system of research is not completely the same, while having different focuses based on summarizing own specific situations. The construction of index system adopted in this paper adopts the former index selection method. The environmental carrying capacity of eco-tourism can be divided into carrying capacity of natural environment of tourism, carrying capacity of social environment and carrying capacity of economic environment. Select some representative and key indexes based on the specific situation in the southeast of Guizhou province, which mainly include 4 layers of indexes (as shown in table 1). The specific meaning of index system is as following.

### 4. Evaluation Procedure of Environmental Carrying Capacity of Eco-tourism

Evaluation procedure is as shown in picture 2 and the specific contents are as following:

- (1) Investigations of current situation within this region, which include investigation of current situation of tourism resource environment, investigation of current social situation and investigation of current economic situation. The adopted methods include ground investigation, remote sensing, collection of historical data, making statistics and summarize historical materials etc.
- (2) Evaluation of carrying capacity situation; make correct evaluation for carrying capacity of each level based on understanding of the current situation and background of carrying capacity

and with adoption of matter element analysis and evaluation method.

- (3) Comprehensive evaluation analysis; make comprehensive analysis and rating for the environmental carrying capacity of eco-tourism in scenic spots located in the southeast of Guizhou province based on evaluation results of first grade, second grade, third grade and four grade.

#### 4.1 Evaluation Model

Attain the index values for above n single evaluation indexes through testing and make cluster analysis for m cluster objects (students) through constructing whitening weight function and then confirm the belonging category of grey of cluster objects in No. t grey. Record m cluster objects as  $A_1, A_2, A_3, \dots, A_m$ , cluster indexes as  $B_1, B_2, B_3, \dots, B_n$ , and grey as  $C_1, C_2, C_3, \dots, C_t$ .

Now assume the sample matrix of all cluster objects for all indexes is d, and then:

$$d = \begin{bmatrix} d_{11} & d_{12} & \vdots & d_{1n} \\ d_{21} & d_{22} & \vdots & d_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ d_{m1} & d_{m2} & \vdots & d_{mn} \end{bmatrix}$$

In which  $d_{ij}$  is the sample value of No. i cluster object on No. j cluster index  $B_j$ ,  $1 \leq i \leq m, 1 \leq j \leq n$ ; construct whitening weight function  $f_{ik}, 1 \leq j \leq n, 1 \leq k \leq t$ ,  $f_{ik}$  is the whitening weight function of No. j index  $B_j$ , belonging to No. k grey.

Calculate grey vector:

Call mapping  $F_{ik} \rightarrow \sigma_{ik}$  as grey cluster, in which:

$$\sigma_{ik} = \sum_{j=1}^n f_{jk} (d_{ij}) \eta_{jk}$$

$$\eta_{jk} = \frac{\lambda_{jk}}{\sum_{j=1}^n \lambda_{jk}}$$

#### 4.2 Confirmation of Weight Coefficient of Index Factors

Confirm the weight coefficient of the fourth layer evaluation factor corresponding to environmental



carrying capacity of each scenic spot in southeast of Guizhou province, as shown in table 2.

Make use of correlation function formula to calculate the comprehensive correlation of environmental carrying capacity in each scenic spot of southeast Guizhou province and judge the rating of tourism carrying capacity of environmental quality according to the rating level of correlation (table 3).

It can be learnt from the calculation results of table 3 that the carrying capacity of environmental quality in Bala river-small Danjiang scenic spot is at 11 grade level, which is mainly because this area takes unique folk customs as the main tourism products. As the tourist distributing center in the southeast of Guizhou province, Kaili is also in this scenic spot. There are many ethnic villages in this scenic spot but the range (scenic spots) is too small; population here is extensively concentrated, moreover, the development and protection measures is poor, which have caused the backwardness of environmental-protection facilities as well as the poor environmental quality. In the following tourism development and planning, it needs to strengthen the environmental protection. The carrying capacity of environmental quality in national scenic tourist area Wuyang river and Yangasha lake tourist area are at I grade level, which is mainly because that the areas of these two scenic spots are big with various tourism resources and focusing on waterscape. Moreover, with the great support of government, the environmental carry capacity of this area is big. Wuyang river scenic spot is the top ecological tourism area in the southeast of Guizhou province and tourists here has strong ecological consciousness and produce small damage to the environment, however, with the establishment of Sanbanxi power station, Yangasha lake tourist area has created scenic spot of smooth lake rising from high valleys, Jianhe hot spring resort tourism area has gained more popularity for Yangasha lake. The tourism here develops prosperously. Therefore, Wuyang lake and Yangasha lake are focusing on ecological tourism at the moment and in the following tourism planning, it needs to pay special attention to the protection of tourism resources and environment. The environmental carrying capacity of Licongrong Dong minority is at n level, which is mainly because that as the biggest Dong customs display area in the southeast of Guizhou province, the scenic spots are mainly ethnic villages, such as Qisha, Zhaoxing, Xiaohuang, Zhanli, Chejiang Gurong Group. Many scenic spots in this tourism area did not make scientific tourism planning, the facilities for tourism and environmental protection are lagging behind, population is relatively concentrated and the environmental quality of tourism is worse than Wuyang River and other ecological tourism regions. The local government should make scientific tourism planning, rectify scenic environment in an unified way and improve the dirty, mess and bad tourism

environment completely and improve the interest of tourists in this scenic spot.

## 5. Problems Faced by Tourism Industry in Southeast of Guizhou Province and Countermeasures

(1) Protection of environment and resources is the basic premise for the sustainable development of tourism industry

Tourism resource is the basic condition of tourism development and the reasonable exploitation and utilization as well as protection of tourism resource is the assurance for the sustainable development of tourism industry. Therefore, in the single factor of carrying capacity, tourism resource will be the first factor restricting the development of tourism industry. So in the future development, the positioning, development direction and development scale must be made based on tourism resource.

(2) Set up reasonable management and guarantee system

Under marketing economic system, economic regulation and control method is an important way to protect ecological environment and improve carrying capacity of tourism. For example, in scenic spots with partition management, implementing high entrance fee for fragile areas to restrict most of tourists at the surrounding area of core area and then ensuring good tourists acceptance in this area without producing great impact on environment.

(3) Make full use of social conditions to improve the environmental carrying capacity of tourism

In the tourism development process, it needs to implement infrastructure construction vigorously, especially strengthen the construction of super highway and other transportation facilities. Speed up the progress of integration and clustering of tourism in southeast of Guizhou province and improve the levels of hotels, restaurants, entertainments and shopping to meet the requirements of tourist. Construct tourism industry cluster by taking enriching of tourism resources as basis and taking traffic roads as support; strengthen tourism coordination and closely combine the individual interests of tourism enterprises within tourism cluster together and realize economic benefit of tourism scale.

Practice has proven that with the increasing participation of tourism enterprises into the cluster, the channels for transporting tourists will attain geometric growth, the more clusters, the stronger control ability for tourist market and the stronger competitiveness of regional tourism industry.

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