Sustainable Forestry (2020) Volume 3 Issue 2
doi:10.24294/sf.v3i2.1592

REVIEW ARTICLE

Recreation value evaluation of natural landscape resources based on environmental capacity

Liming Zhang*

Hubei University, Hubei 430062, Wuhan Province, China. E-mail: 374365252@qq.com

ABSTRACT

This paper reviews and comments on the evaluation methods of the recreational value of natural landscape resources, pointing out that the current popular TCM method and CVM method both rely too much on the market prediction conclusion and cannot truly reflect the recreational value, and putting forward the idea, specific operation steps and calculation methods of evaluating the recreational value of natural landscape resources with tourism environmental capacity.

Keywords: Tourism Environmental Capacity; Natural Landscape Resources; Recreation Value

ARTICLE INFO

Received: 11 May 2020
Accepted: 21 June 2020
Available online: 7 July 2020

1. Overview

Natural landscape resources have multiple functions, and there are various directions and ways of development and utilization. Different directions of use lead to different values of landscape. Whether it can reasonably determine its utilization direction and maximize the value of resources is an important issue related to the sustainable utilization of natural landscape resources. In recent decades, recreation has received increasing attention as an important function of natural landscape resources. However, due to the lagging theory and method of recreational value evaluation, people do not have a clear understanding of its value, and there is a phenomenon of excessive or disorderly development, which affects the protection, development and management of natural landscape resources. Therefore, before the development and utilization of natural landscape resources, we should scientifically evaluate their different values under various utilization modes, compare their multi-purpose values, and determine the best utilization direction. This paper believes that recreation is one of the most basic functions of natural landscape, and whether to carry out recreational development will depend on the comparison of recreational development value with production and ecological value. In the comparison of multiple values, it's most suitable for recreational development only when the recreational value is the largest. Therefore, the evaluation of the recreational value of natural landscape resources is the basis for the scientific and rational use of natural landscape resources, as well as the basis for determining the direction and scale of recreational development.

2. Relevant research and progress

Before the 1960s, cost-benefit analysis (CBA), which originated

from the concept of “consumer surplus”, was applied to the recreational value evaluation of natural landscape resources. In the 1960s, John krutilla[2] put forward the “economic value theory of comfort resources”, which believed that for reasons such as scientific research, biodiversity protection and uncertainty, it was necessary to protect some rare and precious comfort resources such as landscape and ecology, and strictly control their use within the renewable limit. In particular, he put forward the “uniqueness”, “authenticity” and “uncertainty” “irreversibility” and other important concepts of comfort resources[1], which laid the foundation for the later monetary value evaluation of tourism resources. In the 1970s, with the development of welfare economics, the value of non-market public goods such as landscape resources and environment gradually attracted people’s attention. From the late 1970s to 1980s, the travel cost method (TCM) was widely used in the monetary value evaluation of natural landscape resources. In the late 1980s, hedonic price approach (HPA) was popularized and applied. Since the 1990s, the contingent valuation method (CVM) has gradually occupied a dominant position in the monetary value evaluation of tourism resources.

In the history of recreational value evaluation for more than 40 years, foreign scholars have made very useful discussions on the recreational value evaluation of individual landscapes, especially forest landscapes, and put forward many methods, including Policy Value Evaluation, production cost method, the market method, opportunity cost method, travel cost method, and continuous value method. It can be roughly divided into two ideas: one is to use shadow price and consumer surplus to evaluate the recreational value, such as travel cost method, opportunity cost method, cost expenditure method, market value method, hedonic pricing method, etc.; the second is to measure the recreational value based on willingness to pay. The commonly used contingent value method (CVM) mainly uses various market research methods to calculate the recreational value through the traveler or the willingness to pay (WTP) for the recreational products. Among these methods, TCM and CVM methods are the most widely used. For example, American scholar Donnelly used TCM and CVM methods to calculate the value of fishing and deer hunting in Edward state in 1985 and 1986[2,3]; British scholars Willis and Benson used TCM to calculate the tourism value of forests of the British Forestry Commission in 1990[4,5]. Domestic scholars have used TCM and CVM methods to conduct tentative researches on the recreational value of forest resources in the past two decades, such as Lu and Wu, *et al.*, used TCM methods to calculate the recreational value of Zhangjiajie National Forest Park[6,7]; Wang used TCM Method to calculate the recreational value of Beijing Xiangshan Park[8]; Ai used TCM Method to evaluate the recreational value of Wuyishan National scenic spot; Li *et al*. used the improved travel cost method to evaluate the recreational value of Jiuzhaigou[9]; Li *et al*. used the method of income capitalization to calculate the recreational value of Wuyi Mountain[10].

In fact, TCM, CVM and other methods are using the concept of consumer surplus or willingness to pay to evaluate the recreational value by measuring the number of tourists and per capita consumption. There are two deficiencies in this assessment. One is whether the predicted number of tourists is accurate? Second, is this tourist volume the best reception volume of the tourist destination? Due to the limitation of prediction methods, the accuracy of tourist volume will be affected; and the way of recreation development and activity design will also affect the number of tourists. Only the recreation development based on the sustainable utilization of natural resources can truly reflect the best number of tourists. Therefore, whether it is a developed tourist destination or a tourist destination to be developed, the application of existing evaluation methods will be affected by the accuracy of the predicted value of tourist volume. This paper attempts to use tourism environmental capacity to replace the number of tourists to evaluate the recreational value, which will have two obvious advantages: (1) tourism environmental capacity is the largest number of tourists that a tourist destination may receive under the state of sustainable development; (2) there are relatively mature technical

methods for the evaluation of tourism environmental capacity.

3. Recreational value evaluation method based on tourism environmental capacity

According to the above analysis, the limitations of the existing methods are mainly reflected in the calculation of tourist volume, because the accuracy of the calculation of tourist volume is not only limited by the market prediction methods, but also affected by the development of tourist destinations. The same natural landscape resources have different recreational utilization directions and development modes, so the number of tourists is different. If the existing recreation satisfaction is high or the tourist destination is in a state of sustainable development, the number of tourists is authentic and consistent with the actual situation, and the recreation value calculated based on the number of tourists will reflect the real situation; otherwise, overestimating or underestimating the recreational value will affect the rational utilization, effective development, scientific protection and management of natural landscape resources. In view of the fact that the above-mentioned evaluation methods are too dependent on the dynamic tourist market and the selected survey means, and do not truly reflect the recreational value, this paper proposes to use the method of combining environmental capacity and willingness to pay to calculate the recreational value. Tourism environmental capacity refers to the maximum amount of recreational activities that a tourist destination can bear in a certain period of time. According to the concept of sustainable development, it refers to the maximum amount of recreational activities that a tourist destination can bear in terms of environment, ecology, society, economy, culture, as well as the psychology of residents and tourists without affecting the sustainable utilization of natural landscape resources. Obviously, it is more accurate and scientific to calculate the recreational value based on the tourism environmental capacity than using the number of tourists.

3.1 Basic assumptions

No matter what method is used to evaluate the recreational value, the assessed tourist destination should meet the following assumptions: (1) recreational development is the most suitable direction for the use of the assessed natural landscape, that is, in the three major uses of natural landscape production, recreation and ecology, recreational use is the most suitable; (2) in the process of recreation development, the natural landscape has been most effectively and fully utilized, that is, the selection of recreation function of natural landscape is consistent with the suitability of recreation development, the selection of development mode is reasonable, and recreation is fully utilized; (3) the intensity of recreation development is controlled within the recreational environment capacity of natural landscape, that is, recreation development activities are based on the sustainable utilization of regional recreation industry or natural resources. On the premise of meeting the three assumptions, the assessed recreational value will be the largest and most realistic.

3.2 Evaluation process

Since the evaluation of recreation value is based on certain assumptions, the actual evaluation should strictly follow the corresponding evaluation procedures to ensure that the above assumptions are met. The specific process design is shown in **Figure 1**.

(1) Determine the scope of the assessment. The evaluation of recreation value is carried out for a specific landscape area rather than a single landscape element, and the environmental capacity is also directly affected by the spatial scope. Before the evaluation, the evaluation scope should be accurately defined, and the definition of this scope is generally the application area.

(2) Basic investigation and analysis of tourism development conditions. Carry out the investigation of ecological elements, recreational resources, surrounding economic and social environment, development policies and constraints in the landscape area, so as to lay the foundation for suitability analysis.

(3) Analysis on the suitability of the direction of recreation utilization. Natural landscape resources have multiple functions and may also be suitable for a variety

of recreational uses. For example, the forest can develop a variety of recreational activities such as hunting, hiking, forest rehabilitation, camping, forest education, and the water landscape can develop a series of recreational activities such as swimming, fishing, water sports, boating, etc. Different recreational uses have different environmental impacts and economic and social benefits, and the aim of suitability analysis is to find out the most suitable recreational utilization direction of the assessed landscape resources, so as to maximize the benefits of the recreational land on the premise of ecologically sustainable development. For the developed tourist destinations, it is important to analyze the suitability of existing products and recreational activities and the rationality of the development mode, and put forward appropriate utilization ways.

(4) Measurement of recreational environment capacity and willingness to pay. On the premise of meeting several assumptions of recreational value evaluation, the recreational environmental capacity is calculated. At the same time, according to the analysis of the target market positioning of recreational products, a recreational consumption willingness survey is carried out for specific tourist groups (i.e., market segments) rather than ordinary residents, and the willingness to pay is calculated according to the survey data. The design of the willingness to pay questionnaire, the selection of survey objects and methods, and the selection of survey time will affect the accuracy of the measurement of willingness to pay.

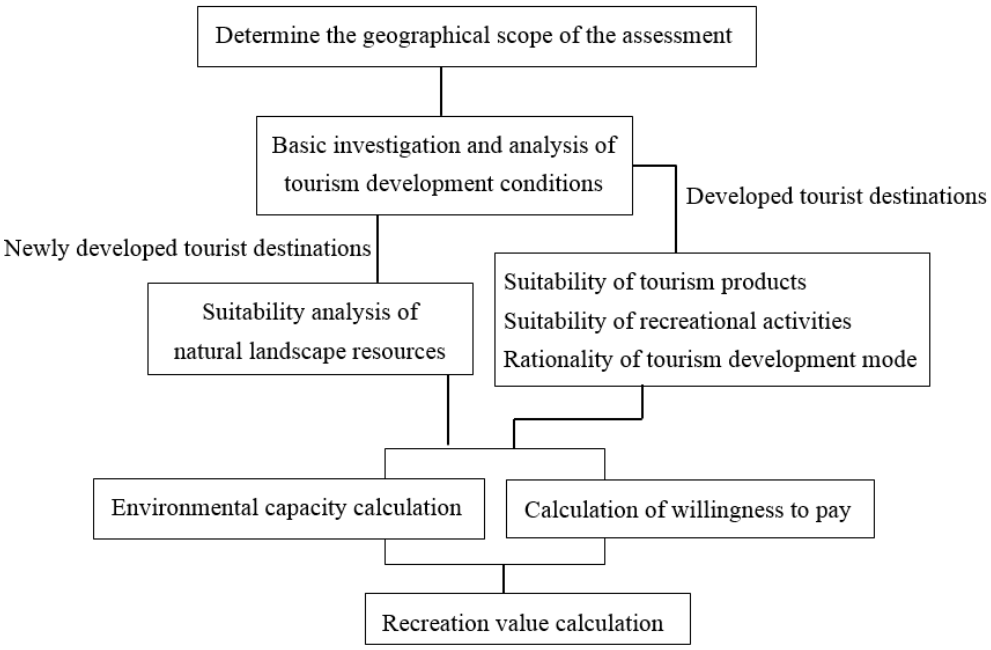

Figure 1. Process of value evaluation system of nature based on environmental capacity.

3.3 Calculation of environmental capacity

Since the 1960s, the environmental problems of tourist destinations have attracted the attention of scholars at home and abroad to the study of tourism environmental capacity. In the early 1970s, the research mainly focused on the natural ecological environment of tourist destinations, especially the bearing capacity of biological factors. Wall and Wright put forward the concept of tourism capacity in their book *The Environmental Impact of Outdoor Recreation* in 1977, they believe that tourism capacity refers to the level of tourism activities that a region can achieve without unacceptable damage to its resources and environment. In the late 1970s, people gradually realized the importance of the social psychological endurance of tourists or residents of tourist destinations in the study of environmental capacity, which made the study of environmental capacity transition from a single natural ecological capacity to a comprehensive capacity containing social psychological capacity, Shelby and Heberlein systematically expounded and demonstrated social psychological capacity in their "*Carrying Capacity in Recreational Settings*"[11], which played an im-

portant role in the promotion of the concept of social psychological capacity. Since the 1980s, many domestic scholars have made a lot of empirical researches based on the research results of foreign tourism environmental capacity and combined with domestic case areas. Especially the involvement of environmental and ecological scholars is promoting the in-depth research of environmental capacity. In fact, tourism environmental capacity includes ecological capacity, social capacity, tourist psychological capacity, etc., which is usually expressed by tourist capacity (see **Figure 2**).

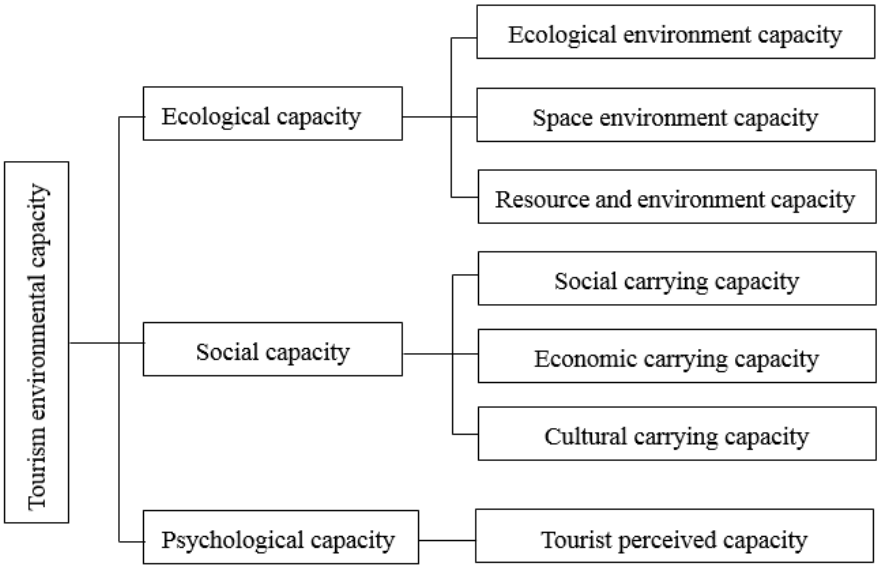

Figure 2. Conceptual system diagram of tourism environmental capacity.

Each capacity can be measured from many aspects, such as ecological capacity is determined by ecological carrying capacity, spatial carrying capacity and resource carrying capacity; social capacity is determined by the minimum of social carrying capacity, economic carrying capacity and cultural carrying capacity; psychological capacity refers to the perceived capacity of tourists. The calculation of tourism environmental capacity should follow the "barrel principle", that is, it should be determined by the minimum capacity of each individual capacity. Its conceptual model is:

$$C = \min (C_1, C_2, C_3, \dots \dots C_7) \quad (1)$$

In formula (1), C is the environmental capacity, C_1~C_7 are the ecological environmental capacity, spatial environmental capacity and other six monomer capacities in addition to the economic capacity. The economic capacity can be changed according to the needs of tourism development, which only affects the current tourist capacity and cannot reflect the best tourist capacity in the future, as shown in the factors in column 3 of **Figure 2**. Since the tourist destination is composed of multiple scenic spots, places of interest or tourist spots, the environmental capacity of scenic spots (spots) with different functions and environments is different. The environmental capacity of tourist destinations should be calculated for different landscapes (points) or scenic areas. In the specific calculation, it is necessary to calculate the six capacities listed in **Figure 2** except the economic capacity one by one, and take the minimum capacity as the tourism environmental capacity of the scenic area, that is:

$$C_i = \sum_{j=1}^{n} C_j \times N_j \quad (2)$$

Where, C_i refers to the environmental capacity values in C_1~C_7, Cj refers to the environmental capacity of the j^{th} landscape area, N_j refers to the daily tour turnover times of the j^{th} landscape area, and N refers to the number of landscape areas of the assessed tourist destination.

During the calculation process, the following problems will be faced: (1) because landscape resources have a variety of recreational functions, the

recreational development and utilization methods of landscape resources are different, that is, recreational activities are different, and recreational sites will have different environmental capacity. Before calculating environmental capacity, the development direction of landscape resources should be clear. (2) Recreational social capacity usually refers to the degree of influence that residents and recreational people in the recreational community can bear. There are obvious differences in the affordability of tourists and residents of different ages, different cultural levels, different preferences, different economic backgrounds, etc. Before calculating the social psychological capacity, it is necessary to analyze the sociological and psychological characteristics of local residents and recreational people. (3) Due to the influence of several factors such as tourists' environmental awareness, ethics, environmental induction and so on, tourists from different tourist sources have different degrees of negative impact on landscape resources, resulting in different ecological capacity of recreation places because of tourist sources. For those reasons, before calculating the ecological capacity, we should analyze the target tourist market and determine the segment market according to the characteristics and suitable development direction of this kind of landscape resources. Therefore, the evaluation steps proposed in this paper should be strictly followed.

3.4 Calculation of willingness to pay

Willingness to pay (WTP) refers to the monetary resources that consumers are willing to pay for a commodity, an opportunity or an enjoyment. It has been widely used in the economic value evaluation of environmental resources in western countries. In the evaluation of recreational value, the willingness to pay is obtained from the perspective of tourists, based on a series of assumptions, through market research. The calculation formula of tourists' average willingness to pay is:

$$\overline{WTP} = \sum_{i=1}^{n} WTP_i / \sum_{i=1}^{n} Q \tag{3}$$

In formula (3), $\overline{WTP}$ is the average willingness to pay of tourists, $\sum_{i=1}^{n} WTP_i$ is the total willingness to pay obtained through market research, $\sum_{i=1}^{n} Q$ is the total number of tourists surveyed. $\overline{WTP}$ refers to all the expenses that tourists are willing to pay for visiting the assessed scenic area and completing a tourism activity, including the sum of transportation, sightseeing, accommodation, catering, shopping, entertainment and other expenses, that is, $WTP_i = \sum_{i=1}^{n} Cn$, where Cn indicates the cost of various tourism elements such as transportation, sightseeing and shopping. Since the willingness to pay of each tourist is obtained in the form of sampling survey, the value of willingness to pay may deviate. In order to avoid deviations, scientific arrangements should be made for the design of investigation items and the selection of samples, and to ensure that the respondents can obtain sufficient information. At the same time, when using the consumption intention survey, the evaluated tourist destination must meet two assumptions: one is that recreational development is the most suitable direction for the utilization of the natural landscape resources; the other is that the destination has selected the most reasonable development mode and provided the most suitable supporting service facilities and services.

3.5 Recreation value evaluation

The recreational value of a natural landscape resource is usually expressed in terms of total recreational value (TRV), which is the multiplication product of environmental carry capacity of recreation (ECCR), annual suitable travel days (T) and the average willingness to pay (WTP), namely:

$$V_t = C_e \times T \times P \tag{4}$$

This is a simplified conceptual formula, in which V_t is the annual recreational value, C_e is the daily recreational environmental capacity of the tourist destination, t is the number of days suitable for tourism in a year, and P is the average willingness of tourists to pay. In the actual assessment, because the environmental capacity of different scenic spots or service areas in the tourist area and the time required for tourism are different, it is necessary to adopt the method of zoning calculation. At the same

time, the willingness to pay per capita of tourists in different regions is also different, which makes the evaluation of recreational value more complex, namely:

$$C_t = \sum_{i=1}^{n} C_{ei} * T_i * P_i \quad (5)$$

In formula (5), n refers to the number of partitions divided according to the environmental capacity of different spaces. C_t is the annual recreational value, C_{ei} is the daily environmental capacity of the i^{th} region in the tourist area, T_i is the annual number of days suitable for tourism in the i^{th} region, and P_i is the average willingness to pay of tourists in the i^{th} region. Therefore, in the actual calculation, we should calculate the environmental capacity of different zones in the tourism area, and calculate the average willingness to pay after investigating the willingness to pay of tourists in different zones.

4. Conclusion and discussion

The current evaluation method of recreation value of natural landscape resources has some obvious shortcomings, mainly because the two basic indicators used for the calculation of recreation value—the number of tourists and per capita consumption (willingness) are excessively dependent on the accuracy of market prediction, and have obvious subjectivity. Due to different market survey methods, sampling objects, and tourism development modes, the assessed recreational value may be quite different, which cannot truly reflect the recreational value of natural landscape resources, and is not conducive to the effective utilization and scientific management of natural resources. This paper proposes to measure the recreational value based on the environmental capacity, through the calculation of the maximum tourist capacity that may be received under the sustainable development state of the tourist destination, and assists the investigation of the average tourist consumption intention effectively solving the shortcomings of the above methods, which is of great significance for the protection, development and management of natural landscape resources, especially for the transfer of tourism management rights of natural landscape resources, and the promotion of the marketization and standardization of the tourism industry. Of course, the calculation of recreational value based on environmental capacity will also face many new problems. For example, the concept of environmental capacity itself is very complex, and the workload of comparing and calculating various types of environmental capacity in the same landscape area is very huge; in addition, the method proposed in this paper still needs the help of market research to determine the average consumption intention of tourists, and its accuracy will be affected by the market research itself. At the same time, the method proposed in this paper has completed empirical analysis in some areas, but due to the limited space of the paper, the paper only reveals the evaluation ideas and conceptual models in detail, and fails to elaborate the cases. It also needs to carry out empirical research in more types of landscape areas to improve this idea and evaluation method.

Conflict of interest

The author declared that there is no conflict of interest.

References

1. Krutilla JV. Conservation reconsidered. In: Smith VK (editor). Environmental resources and applied welfare economics: Essays in Honor of John V. Krutilla. Washington: Routledge; 1988. p. 263–273.
2. Krutilla JV. Conservation reconsidered. The American Economic Review 1967; 57(4): 777–786.
3. Smith VK. Environmental resources and applied welfare economics: Essays in Honor of John V. Krutilla. Washington: Routledge; 1988.
4. Donnelly DM, Loomis JB, Sorg CF, *et al*. Net economic value of recreational steelhead fishing in Idaho. USDA Forest Service Resource Bulletin: RM–9; 1985.
5. Donnelly DM, Nelson LJ, Rocky Mountain Forest and Range Experiment Station (Fort Collins, Colo.). Net economic value of deer hunting in Idaho. USDA Forest Service -Resource Bulletin: RM–13; 1986.
6. Willis KG, Benson JF. Recreational values of forests. Forestry: An International Journal of Forest Research 1989; 62(2): 93–110.
7. Willis KG, Garrod GD. Amenity value of forests in Great Britain and its impact on the internal rate of return from forestry. Forestry: An International Journal of Forest Research 1992; 65(3): 331–346.
8. Lu D, Wu Z, Zhang Q, *et al*. Benefits of Zhangjiajie

National Forest Park. Journal of Central-South Forestry University 1985; 5(2): 160–170.
9. Wu C, Deng J, Li S. Evaluation for recreational benefits of Zhangjiajie National Forest Park. Scientia Silvae Sinicae 1992; 28(5): 423–430.
10. Wang L, Shang X. Xiangshan gongyuan senlin youqi jiazhi de jingji pingjia (Chinese) [Economic evaluation for forest recreation benefits of Xiangshan Park. Forestry Economics 1993; (3): 66–71.
11. Li W, Li W. Using a modified travel cost method to evaluate the recreational benefits of Jiuzhaigou Nature Reserve. Acta Scientiarum Naturalium Universitatis Pekinensis 2003 39(4): 548–555.
12. Li J, Zhang J. Evaluating the tourism value of national-level scenery area of Wuyi Mountain. Fujian Environment 2003; 20(3): 46–48.
13. Shelby B, Heberlein TA. Carrying capacity in recreational settings. Corvalis: Oregon State University Press; 1986.