Applying fuzzy statistics to evaluate and allocate resources in seven star grotto national park area

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Abstract. The purpose of this study is to use an objective function algorithm to establish the fuzzy number parameters of the fuzzy semantic scale, and then find the way to improve and the development and management of tourist attractions. This paper divides the development of the Seven Star Grotto National Park into three periods: 2001-2005, 2006-2010 and 2011-2015. Using expert scoring and field interviews, combined with the Seven Star Grotto National Park resource profile and Zhaoqing development profile, we quantitatively measured the overall resource level, resource value, scenic conditions and regional conditions of different time period.

1. Introduction

Seven Star Grotto National Park is located in Zhaoqing City, Guangdong Province, a national historical and cultural city. Seven Star Grotto National Park has a history of thousands of years and is famous both at home and abroad for its beautiful landscapes with southern characteristics. It was listed as the first batch of national key scenic spots by the State Council in 1982 [1], which was also the only key scenic spot in Guangdong at that time. Over the past 30 years, the scenic spots in various regions have become hot, and Guangzhou Zhu hai Changlong, Shenzhen World Window, Jinxiu Zhonghua, Kaiping Diaolou, Shaoguan Danxia Mountain and other scenic spots in the surrounding areas have achieved great success, while the Seven Star Grotto National Park is tepid. The dynamic evaluation of the value of its tourism resources is an important aspect of exploring the reasons why the Seven Star Grotto National Park is tepid.

Tourism resource evaluation refers to the process of comprehensive evaluation and appraisal of the value of tourism resources in a certain area and its external development conditions from the perspective of rational use and protection of tourism resources and maximum social and economic benefits [2]. The key difficulty in tourism research and development is to effectively evaluate the resources of the scenic spot. The dynamic evaluation is an evaluation model, where in order to accurately analyze the investment and make decisions, it is necessary to convert the cash flow generated at different moments into equivalent values, and then compare and evaluate the relationship between funds and time on the same basis. Since the 1970s, there have been scholars in China to evaluate the development of tourism resources [3]. The quantitative research on tourism resources evaluation in China is rich in content but the comprehensive dynamic research is lacking.

On the basis of comprehensive understanding of the types, quantity, quality, characteristics, scale, formation reasons and development potential of the resources in the Seven Star Grotto National Park,
systematically and dynamically grasping the progress status, existing problems and development trends of the protection and utilization of tourism resources can provide a reliable basis for determining the direction, timing and focus of tourism resources development [4].

2. Seven star grotto national park tourism resources overview
Tourism resources refer to the part of the geographical environment that has tourism value, that is, the environmental factors that tourists are interested in and the material conditions that can be utilized during the tourism process [5]. According to the reasons for its formation, it can be divided into two parts: natural and artificial. Natural, that is, natural tourism resources, refer to the part of natural scenery that is beneficial to human health, growth, and appreciation, and exists naturally. Artificial, that is, humanistic tourism resources, which are the cultural achievements or artistic shapes created by human beings in various historical periods, including historical sites, contemporary architecture, modern culture and art, customs and folk cultural activities, shopping tasting events, sports competitions, etc. and have obvious historical, national and local characteristics [6]. Tourism resources can be visible to the naked eye, or can be invisible to the naked eye and only be felt, the former such as daylight, beach, the latter such as the city's personality characteristics and personalized atmosphere [7].

2.1. Unique natural tourism resources
Seven Star Grotto National Park is unique in geography. It leans on the mountains in the north and surrounded by water on three sides in the east, south and west. The water area is about 4 million square meters. The lake water is divided into five parts by the lake banks. The embankment is more than 20 kilometers long, and the roads are covered by the trees and the silvery lake and green hills are complemented by each other. The scenery is excellent. Because it consists of seven rocks, and their arrangement is like the Big Dipper, hence it was named as such. The seven rocks are named in order from east to west as Langfeng, Yuping, Shishi, Tianzhu, Chanchu, Xianzhang, and Apo. Since the Tang Dynasty, the reputation of “the first wonder of Lingnan” has been fascinating. The natural tourism resources of Seven Star Grotto National Park are mainly divided into three sub-categories: geography landscape, water scenery, and biological landscape.

2.2. Rich in humanities and tourism resources
There are many cultural relics in the Seven Star Grotto National Park. The main buildings include Shidong Ancient Temple, Yuhuang Temple, Sanxian Temple, Xukong Pavilion, Shuangqing Pavilion, Nanhua Pavilion, Shiyou Pavilion, Qixing Bridge, Juxing Bridge, and Lansheng Memorial Archway, etc. After 1949, a large number of pavilions and hotels were built to make the Seven Star Grotto National Park more beautiful. The scenic spots of the Seven Star Grotto National Park are famous, and tourists are constantly visiting.

The inscriptions on precipices in the Seven Star Grotto National Park are worth mentioning here as part of the human resources. The inscriptions on precipices of the Seven Star Grotto National Park are a cluster of a large number of inscriptions on precipices preserved in the south of China. There are more than 500 walls of poems of the poets in Tang, Song, Yuan, Ming, Qing Dynasty and contemporary poets, such as Li Shen, Li Yong, Yu Dayou, Zhu De, Chen Gongyin and Ye Jianying, etc. The celebrity poems add a lot of humanistic atmosphere to the scenic spot and have unique effects and pioneering value in academic research and tourists' viewing.

3. Evaluation methods and data sources

3.1. Indicator system
The selection and construction of indicators is the core of dynamic evaluation. Due to the characteristics of tourism resources, such as stage and variability, the evaluation of tourism resources should also be adapted. This paper follows the principle of combining systemativeness and scientificity,
combining dynamic and relative stability, combining comparability and operability, and refers to the relevant works of literature, and divides the study of the Seven Star Grotto National Park into three stages: 2001-2005, 2006-2010, 2011-2015, and the dynamic evaluation indicator system of tourism resources was constructed from the target layer, the comprehensive layer, and the element layer. The evaluation of tourism resources value is the evaluation of the quality and the excellence of tourism resources, including seven main indicators: 1. Aesthetics, 2. History and culture, 3. Science, 4. Peculiarity, 5. Scale and composition status, 6. Tourism function, 7. Tourism environment capacity [8]. This paper divides the resource value evaluation into four values: culture, recreation, science and observation according to the actual situation. The scenic condition evaluation includes three aspects: scenic spot combination, scenic tourist facilities, and scenic spot management. The regional conditions consist of four parts: regional economic development level, central city size, traffic accessibility and inter-regional combination of tourism. Each factor was subdivided into a total of 19 indicator factors to evaluate the development of tourism resources in the Seven Star Grotto National Park. The value of appreciation needs to be measured in terms of both peculiarity and enjoyment. Cultural value is measured from three aspects: historical and cultural value, religious sacrificial culture value and folk custom value. Scientific value is measured from two aspects: scientific research value and science popularization education value. Recreation value is measured from three aspects: tourism resource portfolio integrity, travel period and environmental capacity. The combination of attractions mainly refers to the combination of resources. The tourism facilities are measured from the two aspects: infrastructure and project facilities. The scenic spot management includes the period of travel and environmental capacity, etc. [9]. As shown in Figure 1.

![Figure 1. Seven Star Grotto National Park tourism resources dynamic evaluation indicator system](A)

### 3.2. Data sources

The data and information in this paper are mainly from field trips, looking up relevant yearbooks, works of literature and searching network resources. In addition, due to the particularity of tourism resources, the standards for evaluation of resource value, scenic conditions and regional conditions are different. This paper designs different scoring reference standards according to the collected data, and obtains indicator scores in different ways: resource value scores are mainly taken from the scores given by 10 senior experts, professors and teachers; the scenic condition scores are mainly taken from
the scores given by the administrative staffs in different positions of the Seven Star Grotto National Park, Zhaqing Tourism Bureau, Xinghu Scenic Spots Authority and senior tour guides of travel agencies; the regional condition scores are scored automatically mainly through the concrete data in Zhaqing Yearbooks.

3.3. Method model
In this paper, through assigning weights and scores to each integrated layer weight, 10 points were assigned to each indicator factor, then the total scores of resource value were 100 points, and the scenic conditions and regional conditions are respectively 50 points, of which the traffic accessibility is given 20 points, because traffic is crucial to the development of the scenic spot, according to which the weights are given as 0.5, 0.25, 0.25, and the comprehensive index of the Seven Star Grotto National Park tourism resources was calculated by time period using the following formula [10-12].

\[ B_i = \sum f_i w_i \]  
\[ A = B_1 + B_2 + B_3 \]

where \( A \) is the total value of tourism resources development; \( i \) is the ordinal number of indicators; \( f_i \) is the weight of each comprehensive layer; \( w \) is the average score of the assignment of individual indicators; \( B_1, B_2, B_3 \) represent the resource value, scenic conditions, and regional conditions respectively [13-14].

| Table 1. Annual average scores of the dynamic evaluation indicators of the Seven Star Grotto National Park tourism resources (retain two decimal places) |
| --- |
| Target layer (A) | Comprehensive layer (B) | Elemental layer (C) | Indicator layer (D) | Annual average scores |
| Dynamic evaluation of the Seven Star Grotto National Park tourism resources (A) | Resource value (B1) | Ornamental value | Peculiarity | 7.38 | 6.88 | 6.70 |
| | | Enjoyment | 7.13 | 6.75 | 7.25 |
| | | Cultural Value | Historical and cultural value | 7.25 | 7.25 | 8.38 |
| | | | Religious sacrificial culture value | 7.00 | 6.38 | 7.13 |
| | | | Folk value | 6.75 | 6.25 | 6.25 |
| | Scientific value | Scientific research value | 8.00 | 8.00 | 7.13 |
| | | Science popularization education value | 7.25 | 7.00 | 7.88 |
| | Recreational value | Tourism resource portfolio integrity | 7.25 | 8.00 | 7.63 |
| | | Period suitable for tourism | 7.75 | 7.88 | 7.63 |
| | | Environmental capacity | 8.50 | 8.50 | 7.75 |
| | Scenic conditions (B2) | Attraction combination | Resource combination | 6.20 | 6.60 | 8.00 |
| | | Tourist facilities | Infrastructure | 6.20 | 6.40 | 8.20 |
| | | | Project facilities | 5.80 | 6.40 | 8.00 |
| | | Scenic spot management | Institutional setup and staffing | 6.00 | 6.60 | 7.40 |
| | | | Environmental | 6.40 | 7.20 | 9.00 |
3.4. Dynamic evaluation of the development of tourism resources in the seven star grotto national park

Based on the calculated data, this paper will dynamically evaluate it from four respects of the Seven Star Grotto National Park tourism resources: overall development scale, resource value, scenic conditions and regional conditions.

3.4.1. The overall development level of resources has improved, and the conditions of scenic spots are development guarantees.

The assessment shows (see Table 1) that over time, the overall level of tourism resources in the Seven Star Grotto National Park has improved, but at a slower rate. The total value of the three phases of evaluation increased from 51.525 in 2005 to 53.238 in 2010 and 56.75 in 2015. Among them, the increase in resource value is the smallest, even negative growth, and it can be said that it is basically stable at a certain level, which is related to the nature of the Seven Star Grotto National Park itself [15]. Referring to Table 2, the rock itself will not change much, and the time periods researched in this paper are also shorter. The data shows that the increase in regional conditions is the largest overall, which is attributed to Zhaoqing Municipal Government vigorously developing this region and the benefit to the scenic spot. Although the increase of scenic conditions of the Seven Star Grotto National Park is ordinary, the increased margin has an increasing trend, indicating that all parties pay more and more attention to the construction of the scenic spot [16-17].

Table 2. Dynamic evaluation table of the Seven Star Grotto National Park tourism resources

|                       | Scores     | Growth rate (%)  |
|-----------------------|------------|------------------|
|                       | In 2005    | In 2010          | In 2015    | In 2005-2010 | In 2010-2015 | In 2005-2015 |
| Resource value (B1)   | 37.13      | 36.44            | 36.85      | 1.85         | 1.13         | -0.74        |
| Scenic conditions (B2)| 7.65       | 8.30             | 10.15      | 2.55         | 22.29        | 32.68        |
| Regional conditions (B3) | 6.75     | 8.50             | 9.75       | 25.93        | 14.71        | 44.44        |
| Total scores (A)      | 51.53      | 53.24            | 56.75      | 3.32         | 6.60         | 10.14        |

3.4.2. The value level of tourism resources has declined, and the peculiarity level has decreased year by year.

Referring to Table 3, the assessment shows that the overall development trend of the tourism resources value of the Seven Star Grotto National Park is not clear, and in some time periods the negative growth has occurred. During the five years from 2005 to 2010, the resource conservation and scenic area construction of the Seven Star Grotto National Park is not enough. There is even a suspicion that excessive development has caused its devaluation [18]. Although the situation has been reversed since 2011, due to insufficient strength, the ornamental value, scientific value and recreational value of the tourism resources value of the Seven Star Grotto National Park have shown negative growth during the fifteen years of the research period [19-20].
### Table 3. Table of the Seven Star Grotto National Park tourism resources value scores (percentage system)

|                   | Scores |                   | Growth rate (%) |                   |                   |                   |
|-------------------|--------|-------------------|-----------------|-------------------|-------------------|-------------------|
|                   | In 2005| In 2010 | In 2015 | In 2005-2010 | In 2010-2015 | In 2005-2015 |
| Ornamental value   | 72.50  | 68.13  | 69.75  | -6.03 | 2.39 | -3.79 |
| Cultural value     | 70.00  | 66.25  | 72.50  | -5.36 | 9.43 | 3.57 |
| Scientific value   | 76.25  | 75.00  | 75.00  | -1.64 | 0.00 | -1.64 |
| Recreational value | 78.33  | 81.25  | 76.67  | 3.72  | -5.64 | -2.13 |

3.4.3. The scenic conditions have been greatly improved, and the improvement in scenic spot management has been the largest.

The assessment shows that from 2000 to the present, the scenic conditions of the Seven Star Grotto National Park have always been okay. In the beginning, it is close to the passing score of 60 points. The starting point is relatively high. The space that can be improved is actually slightly less, but in the past ten years, the growth rate of scenic conditions of the Seven Star Grotto National Park is 30%, of which the development of scenic spot management is the largest. Overall, the growth rate in the later period is obviously faster than that in the previous period, indicating that the management of the scenic spot attaches great importance to it and pays more and more attention to it. It can be improved from where it can be improved and from where it is easy to improve.

### Table 4. Table of the Seven Star Grotto National Park condition scores (percentage system)

|                   | Scores |                   | Growth rate (%) |                   |                   |                   |
|-------------------|--------|-------------------|-----------------|-------------------|-------------------|-------------------|
|                   | In 2005| In 2010 | In 2015 | In 2005-2010 | In 2010-2015 | In 2005-2015 |
| Attraction combination | 62.00  | 66.00  | 80.00  | 6.45  | 21.21 | 29.03 |
| Tourist facilities  | 62.00  | 64.00  | 82.00  | 3.23  | 28.13 | 32.26 |
| Scenic spot management | 58.00  | 64.00  | 80.00  | 10.34 | 25.00 | 37.93 |

4. Seven star grotto national park is located in the northern suburb of Zhaoqing city

Guangdong Province. Zhaoqing City is an inland city in Guangdong Province. Its geographical location is not superior, nor has it been favored by the provincial and municipal governments. There is no policy support, and all aspects of development are lacking, but fortunately located around the developed Pearl River Delta, then the economy and transportation have been developed interactively.

Table 4 shows that Zhaoqing's traffic accessibility and the growth rate of the regional economic level are the largest. In recent years, Zhaoqing has been strengthening traffic construction and improving public transportation and passenger transportation networks. The high-speed railway station of Zhaoqing East Station was also built and put into use a few years ago, which greatly facilitated the surrounding areas and the Guizhou area and the Guangxi area, and strengthened communication, exchanges, and cooperation within and outside the province. And the newly built light rail has greatly facilitated the transportation within the province, making Seven Star Grotto National Park a popular attraction for many tourists on these transportation lines. At the same time, the development of the regional economy has also provided strong support for tourists to go to the Seven Star Grotto National Park.

In Table 5, the economic development has further improved the eating, living, transportation, sightseeing, shopping and entertainment related to the tour, which is an extension of the scenic spot, allows visitors not only to be attracted by the Seven Star Grotto National Park but also to be attracted by other things. However, the weak inter-regional combination will drag the hind legs of the Seven Star Grotto National Park. Even if the Seven Star Grotto National Park is extended in other aspects, it will not last long if there is no good and fixed scenic spot to attract tourists as a combination.

### Table 5. Table of Seven Star Grotto National Park regional condition scores (percentage system)

|                   | Scores |                   | Growth rate (%) |                   |                   |                   |
|-------------------|--------|-------------------|-----------------|-------------------|-------------------|-------------------|
|                   | In 2005| In 2010 | In 2016 | In 2005-2010 | In 2010-2015 | In 2005-2015 |
| Ornamental value   | 72.50  | 68.13  | 69.75  | -6.03 | 2.39 | -3.79 |
| Cultural value     | 70.00  | 66.25  | 72.50  | -5.36 | 9.43 | 3.57 |
| Scientific value   | 76.25  | 75.00  | 75.00  | -1.64 | 0.00 | -1.64 |
| Recreational value | 78.33  | 81.25  | 76.67  | 3.72  | -5.64 | -2.13 |
5. Conclusion
The research shows that during 2005-2015, the overall development of tourism resources in the Seven Star Grotto National Park was very slow. Seven Star Grotto National Park, as the first batch of key scenic spots in the country, performed poorly in the booming tourism development booms around the country, and the change is little fifteen years ago and fifteen years later, which is worth introspection and discussion. The core product of tourism should be the culture and landscape that people can experience. The value of the tourism resources of Seven Star Grotto National Park is mainly reflected in the value of the natural landscape of the seven rocks and the value of culture, myths, stories, festivals and other cultural landscapes associated with them. The data shows that between 2005 and 2015, the protective development of natural resources landscape of the Seven Star Grotto National Park was relatively slow, and the mountain caves, lake water, animal and plant protection were not in place, and were over-exploited; the human resources were not paid enough attention, and cultural connotation was not excavated and extended with the development of the tourism market, and the cultural value depreciated.

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