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CONSTRUCTION OF AN EVALUATION INDEX SYSTEM FOR ECOTOURISM DEVELOPMENT POTENTIAL IN JIANGSU PROVINCE

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Abstract

Ecotourism is an important direction for the development of new tourism as it emphasizes environmental protection and rational use of ecological resources. This model has played a positive and powerful role in promoting the development of regions with rich ecological resources and lagging economic development. Taking Jiangsu Province as an example, this article has evaluated its overall potential in ecotourism development. With a reference to relevant literature and previous research methods, expert scoring method and analytic hierarchy process were adopted to construct the ecotourism evaluation index system, and calculate the weight of each factor index. On this basis, the weighted average method was employed to build an evaluation model to assess the overall ecotourism development potential of Jiangsu Province. The results showed that: 1. Jiangsu Province enjoys superior geographical location and rich natural and human ecotourism resources, so it has high tourism development value, but at the same time, special attention shall be paid to the ecological vulnerability of its northern region. 2. For ecotourism development in specific areas, special consideration should be given to the ecological vulnerability of the northern region. The model and research ideas constructed in this paper have practical significance for more specific research and evaluation in guiding the development of regional ecotourism resources.

Key words: analytic hierarchy process, development potential, ecotourism, tourism development potential evaluation

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1. Introduction

Ecotourism is a new type of tourism development mode in which natural landscape and humanistic landscape are organically integrated, based on a good ecological environment and emphasizing the harmonious coexistence between human and nature, within the ecological environment system. Different from the previous growth mode that only stresses economic growth, ecotourism attempts to find a balance between ecological environment protection and tourism economic growth. On the premise of not destroying the intergenerational equity of tourism resources, it is necessary to fully explore the value of resources and seek a new way to wealth for remote areas that are rich in ecological resources but economically lagging behind. The process of

ecotourism resource development must follow the procedure of "investigation and evaluation- feasibility demonstration of development-determination of tourism development orientation mode and development orientation-ecotourism resource planning and product optimization-operation improvement of ecotourism areas" (Erlinda et al., 2022; Febryano et al., 2022; Mulyadi et al., 2021; Sadad et al., 2022; Shoo and Songorwa, 2013; Wall, 1995). The evaluation of ecotourism development potential is a comprehensive measure of whether the natural resources in a region can be developed protectively and to what extent can be developed, thus promoting the development of economy, society and ecological protection on the basis of considering the carrying capacity of the ecological environment. It has a very positive significance for tourism development

(Erlinda et al., 2022; Güngör et al., 2023; Huang et al., 2022; Ikrimah et al., 2023; Mulyadi et al., 2021; Rahmawati et al., 2023; Sadad et al., 2022; Solekah et al., 2023; Ye and Sun 2021).

After Ceballos-Laskurain (Special Advisor of International Union for Conservation of Nature) proposed ecotourism in 1983, the International Ecotourism Society made a clear definition of ecotourism-tourism activities with dual responsibilities of protecting the natural environment and maintaining the lives of local people. Experts and scholars from relevant disciplines at home and abroad have studied the potential evaluation and impact of ecotourism development (Xiao et al., 2022). Clifton and Benson (2006) established a three-level index system mathematical model for the evaluation of ecotourism resources based on the theory and method of fuzzy mathematics. Wang et al. (2023) Based on the analytic hierarchy process and grey theory, the order of priority for the exploitation of ecotourism resources in Leshan city was determined. Belonozhko et al. (2021) The relevance of the study of calculating the ecotourism potential model is connected with the Arctic region currently being unique in its properties and the development of a methodology for assessing the potential of ecotourism. Wang et al. (2022) the study of coupling and coordination relationship between the tourism economy and ecosystem service value in Southern Jiangsu, China. The result shows that: There are disparities in the levels of a comprehensive tourism economy in different cities, and the overall development level of the tourism economy in southern Jiangsu shows a cyclical fluctuation pattern.

Based on the evaluation system model of tourism resources development, Choi and Murray (2010) adopted the Delphi expert method to build the evaluation system of the tourism development potential of the water conservancy scenic spot, verified the evaluation system of this level by using the AHP analytic hierarchy process, confirmed the weight of indicators at all levels, built the evaluation index system of the development potential, and established the overall evaluation by referring to the national standards and ministerial standards (Choi and Murray, 2010; Dolnicar and Leisch, 2008; Firmansyah et al., 2023). Some scholars used the entropy weight TOPSIS method to select four indicators, namely, landscape resource potential, tourist market potential, environmental protection potential and development condition potential, to conduct model evaluation on Taiwan's green resource potential (Khanra et al., 2021; Lai and Nepal, 2006).

To sum up, through comprehensive reference and integration of the research results of scholars at home and abroad, many researches have been devoted to the study on comprehensive information of ecotourism evaluation indicators and systems, including definitions, principles, sustainability, environmental impact and management, which provide a theoretical basis and practical guidance for the evaluation of the development potential of

ecotourism resources. However, further research is needed to enhance the evaluation system for ecotourism resources, improving its scientific accuracy and practical applicability. This will help achieve sustainable development and maximize the benefits of ecotourism. At the same time, it is also necessary to strengthen ecotourism planning and management, enhance cooperation with local communities, and promote the organic combination of ecotourism, environmental protection and social development for win-win growth of ecotourism.

The innovation of this article lies in: 1. Adopting expert scoring and Analytic Hierarchy Process to screen the indicator system of ecotourism development potential, in order to more scientifically and effectively evaluate the comprehensive benefits of ecotourism development potential. 2. Based on the actual situation in Jiangsu Province, an evaluation system was constructed that includes three parts: resource environment, economy and society, and market demand, and a detailed analysis was conducted on the ecotourism situation in Jiangsu Province.

2. Comprehensive evaluation of ecotourism development potential

2.1. Evaluation criteria and methods

The evaluation principles and standards of ecotourism development in this paper are mainly based on the classification system of tourism resources in the *Classification, Investigation and Evaluation of Tourism Resources* (GB/T18792-2003). The development of tourism resources is based on the principle of "highlighting the comprehensive benefits of ecotourism, combining current status analysis with dynamic development, combining single factor analysis with comprehensive system evaluation, and combining qualitative analysis with quantitative analysis". The evaluation indexes are selected and evaluated from both qualitative and quantitative aspects.

In this paper, expert grading method and Analytic Hierarchy Process (AHP) method are used to evaluate the development potential of ecotourism resources in Jiangsu Province, and then the AHP method is used to build a judgment matrix to calculate and analyze the weight of each evaluation element (Weaver and Lawton, 2007).

2.2. Construction of evaluation index system

2.2.1. Construction of the hierarchy analysis evaluation system for ecotourism development potential

On the basis of referring to relevant literature research and ecotourism evaluation standards and criteria, this paper adopts the three component evaluation model of resource environment, economic society and market reaction to build the evaluation index system of ecotourism development potential. Ecotourism resources and environment are the core

elements to be considered in tourism development. In general, natural and cultural landscape, species diversity and other factors play a decisive role in the development of a tourism project, while the environmental factors of tourism development run through a series of links of tourism development and operation, which are basic conditions. The following aspects such as ecological environment carrying capacity, infrastructure construction around the scenic spot, and the attitude of local original residents towards foreign tourists should be considered. The economic society measures the development potential from the financial and human resources that support the development of ecotourism. The market response is judged from the perspective of whether or how much market feedback can be obtained after the development of a regional ecotourism scenic spot (Cobbinah, 2015; Ryan et al., 2000).

Delphi method is a kind of expert consultation technology, which aims to obtain the consensus and opinions of expert groups. It is usually used to predict the trends, formulate policies, solve problems or evaluate the impact of decisions. Its process is to define problems, select experts, send questionnaires to experts, collect and analyze data, and make feedback and convergence. The key of Delphi method is the anonymity of experts and feedback mechanism, which helps to reduce personal prejudice and influence, and promote the communication and understanding among experts. The data sources in this paper are scored by experts and analyzed by machine learning method.

After screening the evaluation indicators with the Delphi method, the five grades of "very unimportant", "unimportant", "general", "relatively important" and "very important" correspond to the scores of 1, 3, 5, 7 and 9 respectively.

In order to avoid the situation that the scoring method of experts may be too subjective, we should observe the following aspects in the index evaluation system: Firstly, diversify the evaluation criteria and use multiple dimensions and indicators for evaluation, rather than relying solely on the subjective score of an expert. The influence of subjectivity can be reduced by comprehensively considering multiple opinions and different perspectives.

Secondly, adopt the opinions of multiple evaluators and conduct statistical analysis to reach a consensus. This method can collect the opinions of multiple evaluators through expert groups and questionnaires, and draw evaluation conclusions based on statistical analysis. Thirdly, build the evaluation model based on data and statistical methods to avoid too much subjective judgment. Also, this method can build a model through machine learning and evaluate it according to the analysis results of the data. It should be noted that subjective problems inevitably have some subjectivity, and it may be difficult to completely eliminate subjectivity. Therefore, in the evaluation process, due attention shall be paid to multi-dimensional and multi-

source evaluation, and it's imperative to carry out comprehensive evaluation by combining expert opinions, data-driven model and transparency principle. The coordinated development degree model is mainly used to evaluate the coordination of the development of a region or a system, which can effectively reflect the coordinated relationship between various elements, so as to provide reasonable decision-making basis for policy makers. The model can effectively measure the imbalance between the development of different elements, effectively evaluate the region or system, scientifically predict the long-term development trend, and analyze the serious disharmony of the development of key elements in the development process, so as to take targeted countermeasures against these problems.

The arithmetic mean value of the scores of each evaluation index is called "opinion concentration C_j", and the variance of the scores of each evaluation index is named as "opinion coordination V_j"; and the calculation formula of C_J and V_j are as expressed by Eq. (1).

$$C_j = \frac{\sum_{i=1}^{n} X_{ij}}{n}, \quad V_J = \frac{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(X_{ij} - C_J\right)}}{C_j} \quad (j=1, 2, 3, …, m)$$
(1)

In Eq. (1), X_{ij} is the score of the i_{th} expert on the j_{th} indicator, n is the number of experts participating in the evaluation, and m is the number of indicators. The larger C_j is, the more important the indicator is in this element level. The smaller V_j is, the less controversial about the importance of the indicator among the experts involved in the evaluation is, and the more representative it is. The calculation results are shown in Table 1.

2.2.2 Determination of index weights

(1) Building judgment matrix. After sorting out the selected indicator system, experts will be invited to conduct another scoring and evaluation to determine the weight of each indicator. The judgment matrix is constructed according to the indicator system Jiangsu ecotourism development. When comparing the relative importance of factors i and j at a certain level, a_{ij} is adopted. The value of a_{ij} "1, 3, 5, 7, 9" and its reciprocal are used to measure the relative importance of two elements, indicating "equally important, slightly important, obviously important, strongly important, and extremely important|" respectively. "2, 4, 6, and 8" are the median values of the above two adjacent judgments.

For example, $a_{ij}=1$ means element i is as important as element j, and $a_{ij}=3$ means that i is slightly more important than j, and so on; On the contrary, the importance of the relative value of element j and element i meets $a_{ij}=1/a_{ij}$. If the number of elements in the hierarchy is n, the judgment matrix is as given by Eq. (2).

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1m} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{mn} \end{pmatrix} \tag{2}$$

Table 1. Table of opinion concentration and coordination of indicator system

Destination layer A	Criterion layer B	Element layer C
Evaluation index system of ecotourism development potential	Resources environment	Resource endowment
		Environment impact factors
	Economic society	Economic index
		Social factor
	Market reaction	Customer source status
		Market status
Index level D	**Degree of opinion concentration**	**Degree of opinion coordination**
1. Forest coverage	8.35	0.14
2. Biodiversity	8.22	0.20
3. Abundance of natural landscape	7.51	0.23
4. Scale of natural landscape	7.40	0.34
5. Abundance of cultural landscape	6.86	0.28
6. Scale of cultural landscape	6.12	0.33
7. Number of national tourism resources	7.41	0.15
8. Ecological environmental carrying capacity	8.16	0.16
9. Environmental quality of air and surface water in the scenic area	6.83	0.22
10. Completeness of basic service facilities	7.61	0.16
11. Proportion of construction land in the scenic area	7.53	0.26
12. Ecological and environmental awareness of indigenous residents	7.34	0.20
13. Acceptance of tourists by indigenous residents	6.85	0.24
14. Average annual growth rate of local GDP	7.06	0.28
15. Habitat GDP	7.9	0.21
16. Annual average growth rate of financial revenue	7.00	0.31
17. Investment in tourism construction	8.24	0.13
18. Average annual growth rate of total revenue of tourism industry	7.60	0.17
19. Proportion of tourism industry in the tertiary industry	7.78	0.20
20. Years of education per capita	6.80	0.18
21. Natural population growth rate	7.30	0.21
22. Unemployment rate in tourist development area	6.53	0.23
23. Proportion of social security expenses in GDP	7.03	0.19
24. Number of large and medium-sized cities in surrounding provinces and cities	7.49	0.22
25. Distance from the east developed area	8.11	0.14
26. Market radiation	7.20	0.24
27. Tourism brand awareness	6.55	0.16
28. Growth rate of tourists	7.48	0.20
29. Growth rate of tourism revenue	7.66	0.21

(2) The product of elements in each row of the judgment matrix is figured out, i.e., $M_i = \prod_{j=1}^{n} a_{ij}(i, j = 1, 2, 3\ldots)$, and then it is extracted to get $V_I = \sqrt[n]{M_i}$. After normalization, $W = \dfrac{V_i}{\sum V_i}$ is obtained and $W=(w_1, w_2, \ldots, w_n)$, among which w_1, w_2, …, w_n is the weight of each index.

(3) After the weight of each indicator is calculated through the judgment matrix, the consistency of each indicator element needs to be checked, which is measured with the consistency degree indicator CI. The formula is given by Eq. (3).

$$CI = \frac{\lambda_{\max}(A) - n}{n - 1} \tag{3}$$

where: $CI=0$ shows that there is complete consistency. The smaller the value of CI is, the weaker the inconsistency is. The larger the value of CI is, the stronger the inconsistency is. Generally, when $CI \leq 0.10$, it is considered that the consistency of judgment matrix A is acceptable, otherwise we comparison needs to be conducted among the matrices again.

2.2.3. Establishment of evaluation model

After determining the weight level of each

element, it is necessary to adopt a unified assignment method to quantify each indicator. Each indicator is agreed to be divided into five grades A, B, C, D and E according to different standards, and each grade is assigned 10, 8, 6, 4 and 2 respectively.

Then, the method of multi-linear weighted average is used to comprehensively evaluate the sustainable development of ecotourism in a region (Eq. 4).

$$I = \sum_{i=1}^{n} X_i D_i \sum \sum \quad (I \in [0,10]) \qquad (4)$$

where, *I* is the comprehensive score; X_i is the specific score of this tourism resource on the index of the i_{th} indicator layer, D_i is the overall weight level of this indicator, and *n* is the number of indicators of all indicator layers.

2.2.4. Quantification of ecotourism development potential

According to the characteristics of ecotourism resources, the weighted average is used to obtain the overall score. The development potential of ecotourism resources in the region is quantified as the five corresponding score ranges of A, B, C, D and E, namely [10,8], [8,6], [6,4], [4,2], and [2,0], representing five development potential evaluations, namely, excellent, good, medium, low and poor, which are shown in Table 2.

According to the above steps, after analyzing and calculating the data, the weight of each evaluation element indicator can be obtained, and the consistency is gradually checked one by one. It is found that each indicator has passed the inspection requirements. In order to further improve the accuracy and reliability of the Delphi method results and reduce experts' personal prejudice and influence, it is necessary to eliminate the extreme scores in experts' opinions. Therefore, the indicators with opinion concentration less than 7.4 and opinion coordination degree greater than 0.22 should be eliminated. The results are listed and the weight details are summarized as shown in Fig. 1.

2.2.5. Results

Through multiple rounds of expert evaluation and scoring, combining with the actual situation of ecotourism resources in Jiangsu Province, the comprehensive evaluation index I=7.87 is figured, suggesting fairly high development potential. It means that Jiangsu Province is "an excellent region with rich ecotourism resources, certain market influence, and certain development potential, and can obtain fairly high economic and social benefits on the premise of

meeting the ecological environment sustainability". From the overall scope of Jiangsu Province, there are national ecotourism demonstration areas in the southern and northern regions, but the distribution distance is far, and the northern region is relatively weak. According to the above ecotourism development potential index system, the comprehensive evaluation of cities in Jiangsu shows that the development potential from high to low is represented by Suzhou, Nanjing, Wuxi, Nantong, Changzhou, Xuzhou, Yangzhou, Yancheng, Taizhou, Zhenjiang, Huai'an, Lianyungang, and Suqian.

On the whole, the original residents' awareness of ecological and environmental protection, the completeness of infrastructure services, the number of national tourism resources, the number of large and medium-sized cities in surrounding provinces and cities, and the growth rate of tourists are scored lower. Combined with the actual situation, the weak points of ecotourism in Jiangsu Province are as follows:

1. The awareness of ecological protection is weak. The ecological environment in some areas of Jiangsu Province has been damaged to a certain extent. The lack of awareness of ecological environment protection leads to the improper use of ecotourism resources, which has brought certain hidden dangers to ecotourism.

2. Incomplete infrastructure, inconvenient transportation, and lack of perfect hotel, catering, health and other service facilities affect the development of ecotourism and tourist satisfaction. 3. The innovation of tourism products is insufficient. Most scenic spots are dominated by traditional natural landscapes, lacking of characteristics, personality and creativity, making it difficult to attract more tourists.

3. Discussions

Through analysis of the ecotourism development potential in Jiangsu Province, the innovation of this paper is to build a more scientific and effective evaluation index system of ecotourism development potential, which can more accurately evaluate the comprehensive benefits of ecotourism development potential.

This is of great significance for formulating environmental protection and tourism development policies and improving the management level of ecotourism. In addition, we have made a further assessment on the development of ecotourism in Jiangsu Province. Based on the field survey and data analysis of ecotourism projects in Jiangsu, we've evaluated the environmental status, tourist satisfaction and economic benefits of each project.

Table 2. Grading standard of ecological tourism development potential

Comprehensive evaluation index I	*<2*	*2~4*	*4~6*	*6~8*	*>8*
Order of evaluation	Extremely low development potential	Small development potential	Medium development potential	Fairly high development potential	Extremely high development potential

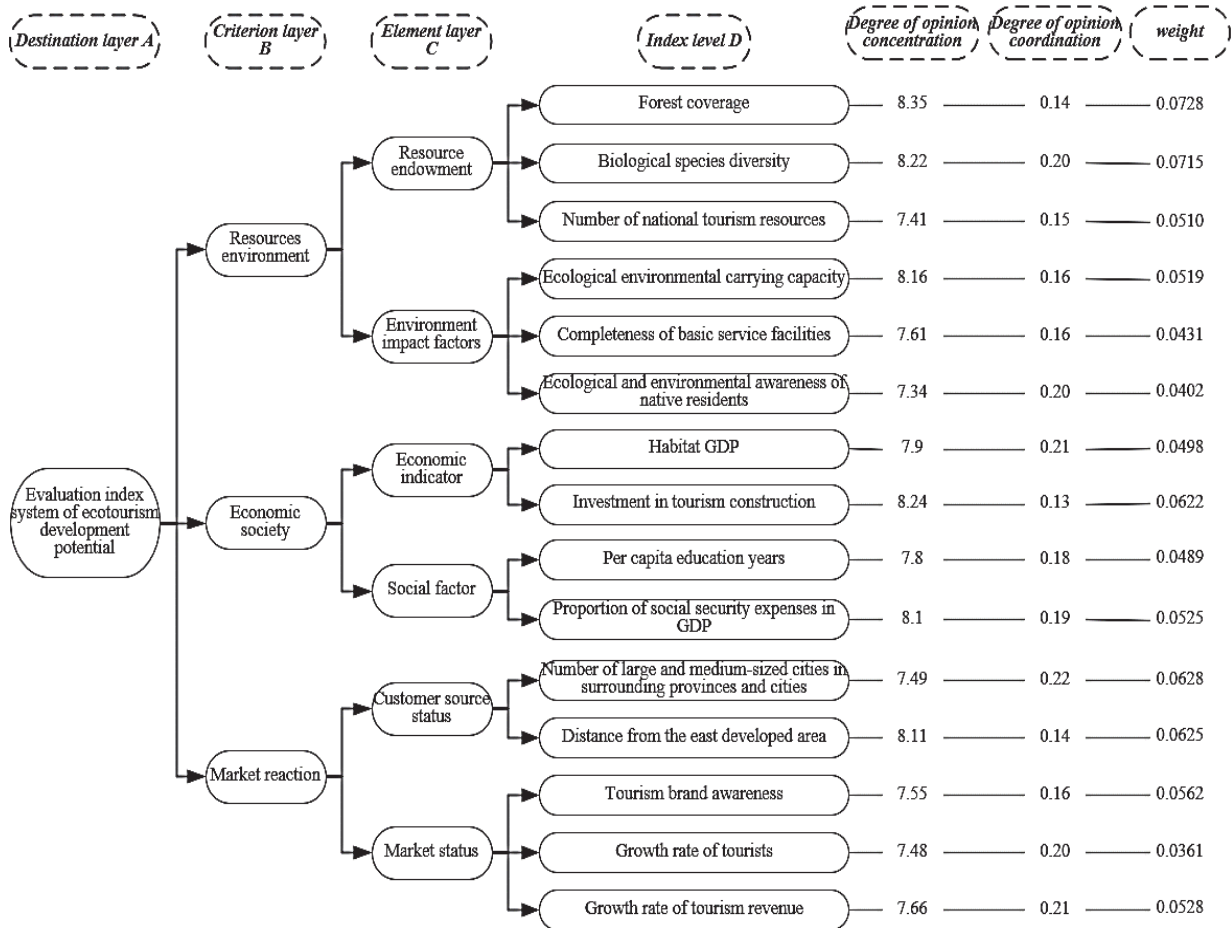| Destination layer A	Criterion layer B	Element layer C	Index level D	Degree of opinion concentration	Degree of opinion coordination	weight
		Resource endowment	Forest coverage	8.35	0.14	0.0728
			Biological species diversity	8.22	0.20	0.0715
	Resources environment		Number of national tourism resources	7.41	0.15	0.0510
		Environment impact factors	Ecological environmental carrying capacity	8.16	0.16	0.0519
			Completeness of basic service facilities	7.61	0.16	0.0431
			Ecological and environmental awareness of native residents	7.34	0.20	0.0402
Evaluation index system of ecotourism development potential	Economic society	Economic indicator	Habitat GDP	7.9	0.21	0.0498
			Investment in tourism construction	8.24	0.13	0.0622
		Social factor	Per capita education years	7.8	0.18	0.0489
			Proportion of social security expenses in GDP	8.1	0.19	0.0525
	Market reaction	Customer source status	Number of large and medium-sized cities in surrounding provinces and cities	7.49	0.22	0.0628
			Distance from the east developed area	8.11	0.14	0.0625
		Market status	Tourism brand awareness	7.55	0.16	0.0562
			Growth rate of tourists	7.48	0.20	0.0361
			Growth rate of tourism revenue	7.66	0.21	0.0528

Fig. 1. Index system of ecotourism development potential

This provides a scientific basis for the development of ecotourism in Jiangsu Province, which can be finely managed and developed according to the problems and advantages of different regions. In addition, it's found that the ecological vulnerability of Northern Jiangsu needs further analysis. Through comparative analysis of the ecological environment indicators and socio-economic indicators in the northern region, major problems in the ecological vulnerability of the region have been observed, requiring to strengthen the protection and management measures. At the same time, further research on the ecological vulnerability of the northern region is suggested to better guide the development and protection of ecotourism in the region. This is of great significance to the sustainable development of ecotourism in Jiangsu Province as a whole.

4. Conclusions

In this paper, indicators are selected through expert scoring and analytic hierarchy process, and an indicator evaluation system of ecotourism development potential is established. The model calculation and analysis results show that the overall ecotourism development potential of Jiangsu Province belongs to the level of "possessing high development potential". The rich natural and cultural tourism resources, the investment of tourism funds increasing

year by year, and the special geographical traffic location in the central region make the potential of eco-tourism development in Jiangsu Province huge. However, based on the overall situation of the province, this paper evaluates the potential of eco-tourism development. The rather fragile ecological environment also brings great challenges to the tourism development of Jiangsu Province. Due to the great pressure of ecological degradation, the eco-tourism development in local areas needs to pay special attention to the protection of the ecological environment.

From the perspective of indicator system, a three component evaluation system containing resources and environment, economy and society, and market response are constructed. Through the data analysis and screening using the expert scoring method, 15 element indicators, such as deep forest coverage and biological species diversity have been analyzed downward. The influence of these indicators in the whole indicator system, namely, the weight, is quite different.

The most important factors are biodiversity, forest coverage and the number of national tourist attractions under the resource endowment. The reason is that the development of ecotourism must rely on certain qualified ecotourism resources in some quantity, and the resource environment endowment is the premise and foundation of ecotourism

development. It is difficult to replace the effect of naturally formed attractions with some man-made landscapes in the later stage.

To sum up, the development of ecotourism in Jiangsu province needs to be improved in the following aspects: Firstly, it is necessary to promote the formation of distinctive tourism landscape clusters in the region, with a considerable degree of combination, which can meet the comprehensive development of tourism products; Secondly, the quality of tourism resources in Jiangsu Province should keep the high ground, and maintain certain competitiveness in the tourism market within its range.

The higher taste for the resources, the stronger the market competitiveness, and the higher the value of tourism development in Jiangsu Province; Finally, the tourism ecological development in Jiangsu needs obvious characteristics, which are conducive to the formation of resource complementarity with surrounding tourism resources, the establishment of good regional cooperation, and the joint promotion of tourism resources and market development.

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