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Evaluation of Saihanba Environmental Treatment based on Entropy Method

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Abstract

The ecological environment evaluation model was established based on the entropy method, and the six indicators of forest coverage, coverage area, tree accumulation, water conservation, carbon dioxide absorption and oxygen release in Saihanba area were scored. The higher the score Represents the better the governance effect, from which the results of environmental governance in Saihanba area could be obtained through the scoring trend. According to calculations, the ecological environment score of Saihanba in 2021 was 27 times that of 1962 when Saihanba was just started to be harnessed. From this, it could be concluded that the environmental conditions of Saihanba area after restoration were much better than those before the governance.

Keywords

Evaluation Model, Entropy Method, Environmental Governance Effect.

1. Introduction

Since 1962, the forest coverage in Saihanba area has reached 80%[1], can store a large amount of carbon dioxide and provide clean water and oxygen to multiple areas,had become the largest plantation in the world, a green area was formed on the plateau wasteland 400 kilometers north of Beijing[2]. But the goal direction of civilization development, and the new problems encountered on the road of green development, ecological restoration is a higher goal of Saihanba people. Therefore, three major projects of afforestation, natural improvement of artificial forests, and near-naturalization of natural forests have been launched for Saihanba, in an attempt to bring artificial forests closer to natural forests.

2. Model Establishment

2.1 Selection of Indicators

To ensure the universal validity of the evaluation model, the selection of evaluation indicators should follow the principles of representativeness, comparability and measurability [3].

After comprehensive consideration, this paper selects six evaluation indicators, namely, forest coverage, coverage area, forest accumulation, water conservation, carbon dioxide absorption, and oxygen release. The first three indicators can represent the number of trees planted in Saihanba area, and the latter three indicators can represent the important role of Saihanba in maintaining ecological balance and stability.

2.2 Data Preprocessing

In order to establish an evaluation model of Saihanba's impact on the ecological environment, we collected a large amount of data related to Saihanba, selected six indicators that can affect the

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ecological environment, and segmented the data from 1962 to 2018 To provide data support for establishing an evaluation model.

2.3 Establishment and Solution of Entropy Weight Method Model

The entropy method is to assign the weight coefficients in the comprehensive evaluation, which can effectively reflect the change law of the system, and can more objectively reflect the evaluation effect[4]. This question uses the entropy method to calculate the comprehensive score calculation of the six index data of Saihanba since 1962, including the forest coverage rate and the coverage area. The higher the score, the better the governance effect. From this, the trend comparison of scores is used to get the results of environmental governance in Saihanba area. The specific steps are as follows[5-7]:

2.3.1First Enter the Indicator Data Selected in the Attachment, and Normalize the Data

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & & x_{2m} \\ \vdots & & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \tag{1}$$

Suppose the standardized matrix is z, and the elements in z are denoted as Z_{ij}:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x^2{}_{ij}}} \tag{2}$$

Normalize X according to the following formula so that Z_{ij} is in the interval [0,1] without negative numbers:

$$z_{ij} = \frac{x_{ij} - min\{x_{1j}, x_{2j}, \dots, x_{nj}\}}{max\{x_{1j}, x_{2j}, \dots, x_{nj}\} - min\{x_{1j}, x_{2j}, \dots, x_{nj}\}} \tag{3}$$

2.3.2Calculate the Proportion of the J-Th Factor in the I-Th Sample as the Probability of Relative Entropy Calculation

The non-negative matrix obtained after step (1) is:

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & & z_{2m} \\ \vdots & & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix} \tag{4}$$

Calculate the probability matrix P, the calculation formula for each element p_{ij} in P is as follows:

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}} \tag{5}$$

In this case, you need to ensure that the sum of each column adds to 1, that is, the sum of the probabilities corresponding to each indicator is equal to 1.

2.3.3Calculate the Information Entropy of Each Indicator and Calculate the Effective Value of the Information, and Normalize the Entropy Weight of Each Indicator

The calculation formula of information entropy is as follows:

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$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{n} p_{ij}\ln(p_{ij}), (j = 1,2,\dots,m) \tag{6}$$

After calculating the information entropy, calculate the effective value of the information, the calculation formula is as follows:

$$d_j = 1 - e_j \tag{7}$$

Finally, the effective value is normalized, and the entropy weight of each formula is calculated according to the following formula:

$$\omega_j = \frac{d_j}{\sum_{j=1}^{m} d_j}, (j = 1,2,3,\dots,m) \tag{8}$$

After calculating according to the above method, the entropy weight corresponding to each factor in the factor set is obtained as:

ω_1=[0.0561 0.0561 0.2189 0.2309 0.2189 0.2189]

Finally, use the original data to calculate the comprehensive score (see Appendix 1 for details):

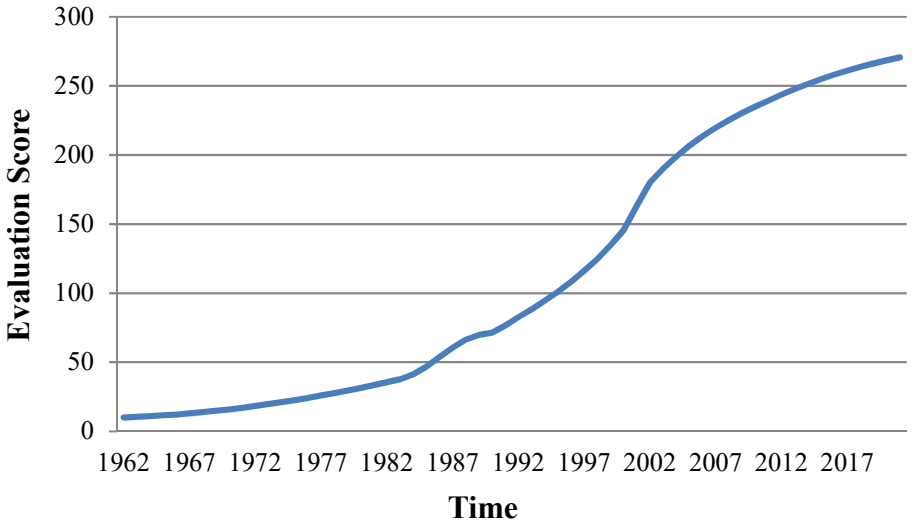

Figure 1. Comprehensive evaluation score of entropy method

3. Conclusion

It can be seen from the above data, when the Saihanba area was first treated in 1962, the evaluation score is only 10.09, until 2021, evaluation score reached 270.67. score increased by 26 times during governance, As a result, the environmental conditions in the Saihanba area after restoration are much better than those before the treatment.

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References

[1] Liu Yi. Carry forward the spirit of Saihanba and promote the construction of ecological civilization[N]. People's Daily,2021-11-16(006).

[2] Gao Hainan. Research on Saihanba Forest Farm (1962-2017) [D]. Hebei Normal University,2019.

[3] Li Xue. Road traffic safety evaluation method and its preliminary application research [D]. Nanjing: Hohai University, 2006.

[4] Si Hanshan. Research on the Comprehensive Evaluation of the Development of 4 Provinces in the Middle Reaches of the Yellow River Based on the Entropy Weight-TOPSIS Model[J]. Science and Technology and Industry, 2021, 21(11): 203-207.

[5] Li Shuai,Wei Hong,Ni Xilu,Gu Yanwen,Li Changxiao. Evaluation of urban human settlement environment quality in Ningxia based on analytic hierarchy process and entropy method[J]. Chinese Journal of Applied Ecology,2014,25(09):2700-2708.

[6] Yang Li,Liu Chengcheng,Song Li,Sheng Wu.Evaluation of Coal Mine Emergency Rescue Capability Based on Entropy Method[J].China SoftScience,2013(11):185-192.

[7] Fu Lei. Research on the Tourism Highway Landscape Evaluation System Based on Entropy Method [D]. Chongqing Jiaotong University, 2014.