Environmental Evaluation Model Based on Sekhangba

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Abstract: China's Seyhanba forest has recovered from the desert and is now an environmentally friendly green farm with stable sand control function. Therefore, it is important to study the ecological environment before and after the ecological restoration of Seyhanba for ecological restoration and environmental protection. In this paper, an environmental model of the Seyhanba is developed and can be extended to other provinces.

Keywords: Comprehensive Evaluation of Topsis; Grey Relational Analysis; Grey Comprehensive Evaluation

1. Introduction

In this paper， we collected relevant data, build an evaluation model, use the entropy weight method and TOPSIS comprehensive evaluation, then quantitative analysis of evaluation results for comparison.We collected data on the social and natural environmental indicators of each province in the country in 2020, followed by the establishment of a linear weighted grey comprehensive evaluation model based on linear weighting to quantify the environmental scores of each province and determine the provinces that need to establish ecological reserves based on their scores. Finally, we analyze a specific province.Finally,we summarize the models used and present our recommendations for building ecological reserves.

2. Symbol Description

Table 1. Symbol description

Symbol	Definition
i	Year
j	Number of indicators
x_{ij}	Data for indicator j in year i
P	Proportion
w	Entropy weight
e	Information entropy
d	Information utility values
z	Standardized Matrix
D	Distance of data from the evaluation object
S_i	Un-normalized score

3. Models

We collected some data and identified relevant indicators, first using the entropy weight method to determine the

weights of each indicator, then using the comprehensive evaluation of TOPSIS to rank the evaluation indicators. Finally, the environmental changes before and after the environmental transformation of Saihanba can be quantified.We have collected six environmental indicators for 1962-2021 years for the Saihanba,.Please see the following chart for details： Froest coverage,Are of coverage,forest stockpile,Volume of water culmination,CO2absorption,Oxygeb release.

3.1 Entropy method model

Define: Entropy is a measure of the degree of disorder in a system. For a certain indicator, the entropy value can be used to determine the dispersion degree of an indicator, the smaller the entropy value of information, the greater the dispersion degree of the indicator, the greater the influence (weight) of the indicator on the comprehensive evaluation.Therefore, we use the entropy weighting method to objectively determine the weights of the selected indicators.

Using the entropy weighting method, we calculated the weights of each indicator: Forest coverage 0.0387; Area of coverage 0.0387; Forest stockpile 0.2363; Volume of water culmination 0.2136; CO_2 absorption 0.2363; Oxygen release 0.2363.

3.2 TOPSIS

Define: The TOPSIS method is a method of ranking a limited number of evaluation objects according to their proximity to an idealized target, and is a method of evaluating the relative merits of the existing objects.

Therefore, we applied TOPSIS to determine the annual environmental scores of Saihanba from 1962 to 2021, and evaluated the ecological impact of the environmental transformation of Saihanba based on the scores.

Through the information we collected, we calculated and ranked the combined evaluation value of each scenario to accurately reflect the changes between the environmental conditions at each stage of the Saihanba. 2021 0.0565; 2020 0.0502; 2019 0.0442; 2018 0.0397; 2017 0.0375.

From the above analysis process, we can know that 2020 has the highest environmental score, which means that the environmental quality condition of Saihanba in 2020 is in the best condition, with a normalized score of 0.0565. And the normalized score of 1962 is 0, which means that 1962 is the worst one among all the years. It shows that the ecological transformation of the Saihanba can promote the improvement of the ecological environment.

In addition, dust storms have a significant impact on the environment we selected three indicators that cause dust storms in Beijing, and four environmental indicators in Saihanba and performed a grey correlation analysis to find the Grey Correlation of the environmental indicators in Sanhanba to the dust storm indicators, and thus quantify the impact of the Saihanba on Beijing.

Three indicators of sandstorm: High temperature, Percentage of sunny weather, Percentage of severe weather.

Environmental indicators after renovation:Forese area, Volume of water content, Oxygen realease, CO_2 absorption.

3.3 The model of Grey Correlation Analysis

Define: Gray Correlation Analysis is a typical method of systematic analysis, and there is no discrepancy between its quantitative results and the qualitative analysis results.

Therefore, we used Grey Correlation Analysis to determine the correlation coefficients of the environmental indicators of Saihanba on the impact of sand and dust storms, and the result is as following:

Table 2: Results of Grey Correlation Analysis

storm / Environment	Percentage of High temperature	Percentage of sunny weather	Percentage of severe weather

Forest area	0.9227	0.9277	0.7581
Volume of water content	0.9049	0.9092	0.7654
CO2 absorption	0.9226	0.9276	0.7580
Oxygen release	0.9226	0.9276	0.7580

As we can see from the above table, the forest area, water content, carbon dioxide absorption and oxygen release of Saihanba have an influence on all factors that cause dust storms, in which the forest area has the greatest influence on the factors that cause dust storms, with the percentage of reaching 0.9277.

Finally, we hope to determine which Provinces in China needed to establish ecological reserves. So we collected indicator data on the environmental status of each province in China in 2020, established an environmental assessment model based on a comprehensive gray evaluation, identified the provinces in China that need to establish ecological reserves through the evaluation scores, and finally we choose QingHai to analyse.

3.4 The model of Grey Integrated Assessment method

We used the Grey Integrated Assessment to score environment in all provinces, After the analysis, through matlab calculation, we get the five provinces that need to build ecological protected areas most are Sichuan, Tibet, Henan, Inner Mongolia, Qinghai.

Next, we selected the social and natural conditions of cities and prefectures in Qinghai province for specific analysis. We collected the population and forest area of six cities and prefectures in Qinghai Province, established a grey comprehensive evaluation model, and obtained the indexes of ecological protection areas that cities and prefectures need to establish: HaiNan State 0.137; HaiBei State 0.130; HaiXi State 0.1299; YuShu State 0.126; GuoLuo State 0.125; XiNing City 0.118; HuangNan State 0.116; HaiDong State 0.11.

3.5 Summary of the model

In the previous four problems, we used entropy weight method, TOPSIS comprehensive evaluation, gray correlation analysis, and gray comprehensive evaluation to solve various problems.

The entropy weight method can objectively assign weight values to the indicators we selected, which is helpful to reflect the results we solved and to conduct a correct analysis. At the same time, the entropy weight method has a wide range of application and no requirement for data. Therefore, the entropy method can be used in any evaluation model, including but not limited to environmental assessment, product quality assessment, etc.

The TOPSIS comprehensive evaluation model can rank the scores of the objects we want to evaluate, and at the same time, it can quantitatively reflect the gap between the objects and the optimal solution, which is beneficial to analyze the gap between different evaluation objects. In the first problem, we analyzed the gap between environmental scores of different years from 1962 to 2021, thus quantifying the difference in environmental conditions before and after the transformation of the Saihanba.

The construction of a gray correlation analysis model then reflects the impact of the Saihanba on Beijing's environment through gray correlation. Its advantage over regression analysis is that this method does not require a large amount of data, it is still possible to use gray correlation analysis with a small amount of data, and its qualitative analysis results do not differ significantly from the quantitative analysis results. In the case of few selected indicators, we construct a gray correlation analysis model for comprehensive evaluation, and the gray correlation analysis still has the idea of entropy method, which

can assign objective weight to the indicators.

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