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Research on the Construction of Ecological Protection and Its Environmental Impact Based on Analytic Hierarchy Process

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Abstract: In order to explore the important role of Saihanba in resisting wind and sand, protecting the environment, we select the natural state of the environment, the quality of resources and the environment, and the state of ecological protection as the secondary indicators for evaluation. The analytic hierarchy process is introduced to obtain the corresponding weight of each index to construct a comprehensive evaluation model. We find that it has been increasing year by year, and its environmental conditions have improved significantly after the restoration of Saihanba. Then, in order to explore the impact of the restoration of Saihanba Forest Farm in resisting sand and dust storms in Beijing, we construct a TOPSIS comprehensive evaluation model. Finally, we analyze the Spearman grade correlation between the Saihanba Ecological Environment Quality Evaluation Index and the Beijing Anti-Dandstorm Ability Index, and the restoration of Saihanba Forest Farm played an important role in the fight against sand and dust in Beijing.

1. Introduction

China adheres to the concept that green water and green mountains are golden mountains and silver mountains, adheres to respecting nature, living in harmony with nature, protecting nature, adheres to the priority of conservation, protection and natural recovery, implements the strategy of sustainable development, improves the overall coordination mechanism of ecological civilization, constructs the system of ecological civilization, promotes the transformation of economic and social development to comprehensive green development, and builds a beautiful country. With the help of the Chinese government, Saihanba Forest Farm has regained its vitality from the desert, and has become an ecological and environmental protection green farm with stable sand control function.

2. Ecological Environment Impact Assessment System

2.1 Construction for Saihan Dam

Due to the great differences in ecological environment, economic and social development levels in different regions, it is necessary to analyze and discuss the construction of index system for sustainable forest management in accordance with the actual situation of the region. The established evaluation system for sustainable management of forest farms must reflect the sustainable capacity of forest resources, economic and social development of forest farms, as well as the potential for sustainable development of forest farms (Sun, 2017; sheppard et al, 2005). Based on the research results of forest sustainable development standards and indicators at home and abroad, according to the idea of sustainable management and the particularity of forest management in forest farms, this paper carried out the research on the construction of sustainable development evaluation system in Saihanba Forest Farm.

The methods for selecting indicators include the combination of one or more methods such as frequency analysis, theoretical analysis and expert consultation. Based on the principles of feasibility, representativeness and hierarchy, this paper combines the above three methods to comprehensively screen indicators (Wang et al., 2015). The selected indicators should reflect the ecological, economic and social aspects related to Saihanba Forest Farm.

After consulting the previous literature, the ecological environment evaluation system of Saihanba is finally constructed, and the ecological environment evaluation system of Saihanba is established, which consists of three levels: the overall level, the system level and the variable level. A total of 9 indicators, specifically divided into the following table 1:

Table 1: Indicator system of ecological environment impact assessment of Saihanba

Overall layer	System layer	Variable layer
Comprehensive Index of Ecological Environment Impact of Saihanba	Natural state of environment	percentage of forest cover
		forest wood volume
		Water source oxygen capacity
	resource and environmental quality	carbon sink
		quantity of oxygen release
		biodiversity indices
	Ecological protection status	Surface water quality compliance rate
		Air quality compliance days
		Urban PM2.5 concentration

2.2 Data collection and processing

For the selection of evaluation index, we fully consider the impact of the subsystem for the system, taking into account the data we can find, after investigation and access to relevant information to obtain *the* Saihan dam index data

2.3 Evaluation System Based on Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a systematic analysis method proposed by Professor T LSaaty, a famous American operational researcher. This method decomposes a complex problem layer by layer according to the logical relationship of attributes, and forms a hierarchical structure to analyze it, so as to simplify the difficulty of analyzing the problem. On the basis of layer by layer decomposition, it synthesizes and gives the solution results of complex problems[1].

Since the higher the concentration of PM2.5 in urban areas is, the lower the score of ecological environment evaluation is, the value of PM2.5 is taken as a negative number when establishing the normalization matrix[2]. After the data matrix of Saihanba ecological environment evaluation index is determined, two experts are invited to establish the judgment matrix of the index, and the weight coefficient of each index is obtained by using the calculation method introduced above. The weight coefficient of each index is shown in table 2.

Table 2: Index weight data

Indicator layer	Weight	Sub-index layer	Weight	Total scale
		E_1	0.4028	0.1508
U_1	0.3745	E_2	0.3085	0.1155
		E_3	0.2886	0.1081
		E_4	0.3548	0.0891
U_2	0.251	E_5	0.3548	0.0891
		E_6	0.2905	0.0729
		E_7	0.3745	0.1403
U_3	0.3745	E_8	0.3745	0.1403
		E_9	0.251	0.094

Thus the total weight matrix can be obtained

$$M = [0.1508, 0.1155, 0.1081, 0.0891, 0.0891, 0.0729, 0.1403, 0.1403, 0.094]^T \quad (1)$$

The total score of environmental quality evaluation of each city can be obtained from Equation:

$$F = 100 \cdot G \cdot M = [10.966, 11.1543, 11.2274, 11.3197, 11.4175, 11.4817, 11.5315, 11.5722, 11.5956, 11.6077, 11.5625, 11.3341, 11.4136, 11.5622, 11.7917, 11.7408, 11.7582, 11.8387, 11.8824]^T \quad (2)$$

They correspond to 2002-2020, respectively. According to the data, the ecological environment quality evaluation of Saihanba shows an upward trend year by year.

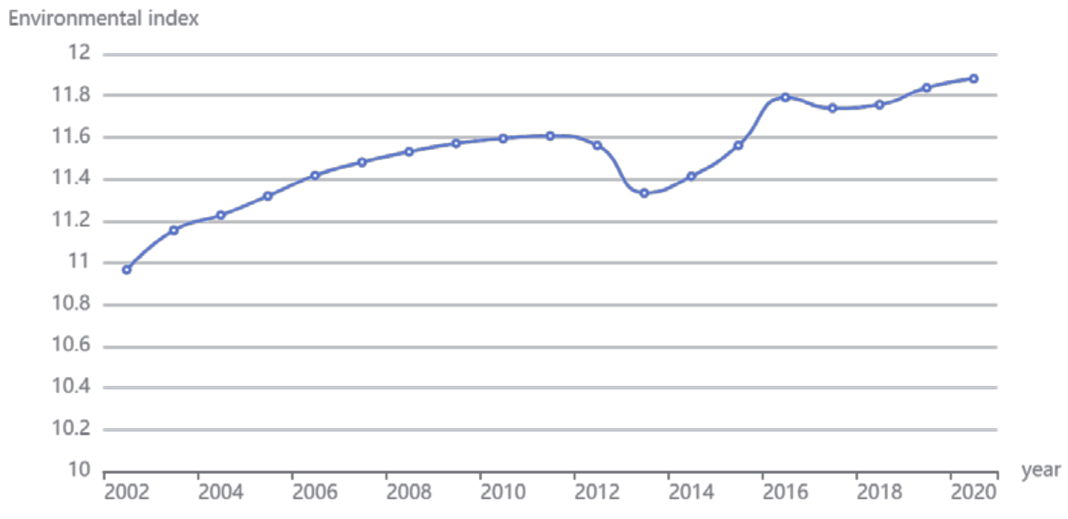

Figure 1: Change trend of ecological environment quality of Saihanba from 2002 to 2020.

2.4 Model Solving and Analysis

From the above model establishment and analysis, with the passage of time, Saihanba on the overall environmental impact on the upward trend, and in recent years there is an accelerated rise, the reason is related to China 's current policy. This conclusion is in line with the current basic situation in China, so the above quantitative analysis conclusion is correct[3].

3. Evaluation System of Beijing's Resistance

3.1 Building the Evaluation System of Beijing's Resistance to Sandstorm

By referring to the literature and combining with the actual situation, it is concluded that the index to measure the ability to resist wind and sediment can be selected as the number of days with strong wind, average wind speed, average pressure, annual average concentration of inhalable particles and annual average concentration of fine particles[3]. In the Beijing Statistical Yearbook, we collected and processed the data of these indicators in Beijing from 2002 to 2020

3.2 Topsis comprehensive evaluation system solution

In the evaluation system of anti-dust ability of Saihanba in Beijing, there are 19 evaluation objects and 5 evaluation indexes. According to the relevant statistical data, the initial evaluation index system $X = \left(x_{ij}\right)_{19\times5}$, x_{ij} is the correlation value of the i evaluation object under the j index.

Step1 Judge the type of decision variables.

The types of decision variables are generally divided into very large, very small, intermediate and interval types. The first step is to determine what type of the five indicators we selected. The number of gale days, average wind speed, annual average concentration of inhalable particulate matter (PM10) (Vic/m3), annual average concentration of fine particulate matter (PM2.5) (μg/m3) belong to very small, the average pressure is interval type, the best interval is [1013, 1024].

Step2 Positiveizing decision variables.

$$M = \max\left\{a - \min\left\{x_i\right\}, \max\left\{x_i\right\} - b\right\}, x_i = \begin{cases} 1 - \dfrac{a-x}{M}, x < a \\ 1 \qquad\quad, a \le x \le b \\ 1 - \dfrac{x-b}{M}, x > b \end{cases} \tag{3}$$

Step3 Standardization of the forwarded matrix.

After normalization, all values have their own dimensions. In order to eliminate the influence of data dimension, we need to standardize the data. The standardization method is as follows:

$$Z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \tag{4}$$

Step4 Scores calculated and normalized.

3.3 Establishment of correlation analysis model

Step 1 data preparation.

According to the ecological environment evaluation index of Saihanba from 2002 to 2020 obtained from the analysis of Question 1, and the evaluation index of wind-blown sand resistance of Beijing from 2002 to 2020 obtained from the second question.

Step 2 computing correlation coefficient.

We select Spearman rank correlation analysis. This test does not need to assume the overall normality, and only needs to determine the level of variables at each point, which has good properties.

Step 3 spearman rank correlation coefficient.

Step 4 analysis of effect

Substituting the data into MATLAB and calling the program package, the Spearman rank correlation coefficient $r=0.7246$, $p<0.01$ was obtained, which rejected the original hypothesis and passed the significant indigenity test, indicating that there was a strong correlation between the ecological environment evaluation index of Saihanba and the evaluation index of Beijing's ability to resist wind and sand. Thus, we can get the conclusion that the restoration of Saihanba forest farm played an important role in Beijing's resistance to sandstorm.

3.4 Analysis of effect

It can be seen from the comprehensive evaluation parameter values of wind-blown sand resistance in Beijing obtained by Topsis comprehensive evaluation that the wind-blown sand resistance in Beijing is on the rise as a whole[4]. Then, the correlation analysis between the ecological environment quality evaluation index of Saihanba and the wind-blown sand resistance index in Beijing is carried out, and the obtained results once again prove that the restoration of Saihanba forest farm plays an important role in resisting sandstorms in Beijing.

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