

Study on the impact of Saihan Dam ecosystem on Beijing ecology

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Abstract. In order to study the impact of Saihan Dam ecology on Beijing ecology, this paper establishes TOPSIS model based on entropy method. The model establishes the evaluation index system of ecological environment sand damage degree, analyzes the factors causing sand damage. Finally, through the given data, the differences before and after the restoration of the ecological environment of Saihan Dam are compared, as well as the impact on the climate and ecological environment of Beijing.

Keywords: TOPSIS model; entropy method; environment of Beijing.

1. Introduction

Saihan Dam ecosystem is the largest artificial forest ecosystem in the world, with a forest coverage rate of 80%. It transports 137 million cubic meters of purified water and releases 550000 tons of oxygen to Beijing and Tianjin every year, building an indestructible ecological barrier [1,2].

Saihan Dam ecosystem plays an important role in resisting wind and sand, protecting the environment and maintaining ecological balance and stability [3]. In order to study the impact of Saihan Dam ecosystem on environmental protection, TOPSIS Model Based on entropy method is developed to establish the ecological and environmental impact assessment model of Saihan Dam. The ecological environment before and after the restoration of Saihan Dam is quantitatively compared and analyzed.

2. Establishment of TOPSIS Model Based on entropy method

2.1 Modeling steps

To obtain all the differences of various ecological indicators data before and after the establishment of ecological protection measures in Saihan Dam for forwarding, by converting all the data [4] into great values and using excel sheets to form intermediate type indicators, the mathematical formula is established. Let $\{x_i\}$ be a set of intermediate type indicator sequences and the best value is x_{max} , and the forwarding formula is as follows [5]:

$$M = \max\{|x_i - x_{best}|\}, \tilde{x}_i = 1 - \frac{|x_i - x_{best}|}{M} \quad (1)$$

Normalizing the data on top of the first step, the mathematical formula is expressed as follows:

$$Z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}} \quad (2)$$

Entropy weight method calculates the weight, calculates the information entropy of each indicator, and calculates the information utility value [6-8]. Normalize it to get the entropy weight of each indicator, the mathematical formula is as follows:

$$E_1, E_2, \dots, E_k \tag{3}$$

The weights of each indicator are then calculated by information entropy. The formula is as follows:

$$W_i = \frac{1-E_i}{k-\sum E_i} \quad (i = 1,2,3 \dots k) \tag{4}$$

The resulting values are evaluated, where the range of values is [0,1], and the closer to 1 indicates a better sample score. It indicates a better effect.

2.2 Results of the distance between superior and inferior solutions (TOPSIS) analysis

The weight calculation results of the entropy weighting method show that the weight of oxygen release/million tons is 21.897%, the weight of carbon dioxide absorption/million tons is 21.897%, the weight of forest wood storage/million cubic meters is 21.897%, the weight of cultured water/billion cubic meters is 23.081%, the weight of covered area/million mu is 5.614%, and the weight of forest cover is 5.614%. The maximum value of the index weight is water content/billion cubic meters (23.081%), and the minimum value is forest coverage (5.614%) (Table 1). [9,10]

Table 1 Calculation of index weights

Item	Information entropy value e	Information utility value d	Weights
Oxygen release/ton	0.879	0.121	0.219
Carbon dioxide absorption/ million tons	0.879	0.121	0.219
Forest tree stock / million cubic meters	0.879	0.121	0.219
Water content/billion cubic meters	0.872	0.128	0.231
Coverage area / million mu	0.969	0.031	0.056
Forest cover	0.969	0.031	0.056

The calculation results of TOPSIS evaluation method are shown in Figure 1. The data in this graph are from 1962 to 2021, and its horizontal coordinates 1 to 59 in the graph indicate 1962 to 2021 in that order [4].

The comprehensive score index in the figure is positively correlated with the year. With the growth of the year, the comprehensive score index of Saihan Dam increases in turn. This shows that the ecological environment of Saihan Dam is getting better and better with the growth of years, with a large increase in recent years. It can be seen that the ecological protection measures of Saihan Dam are effective.

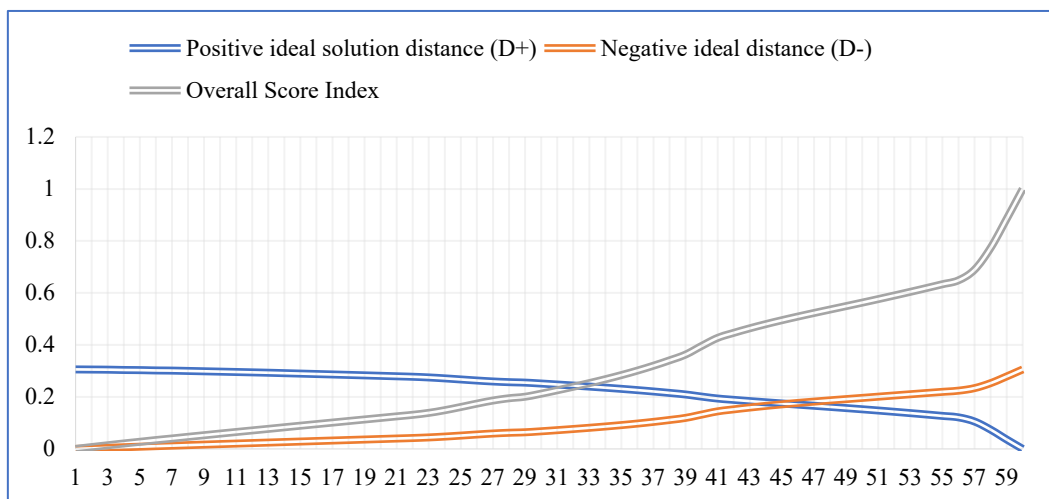
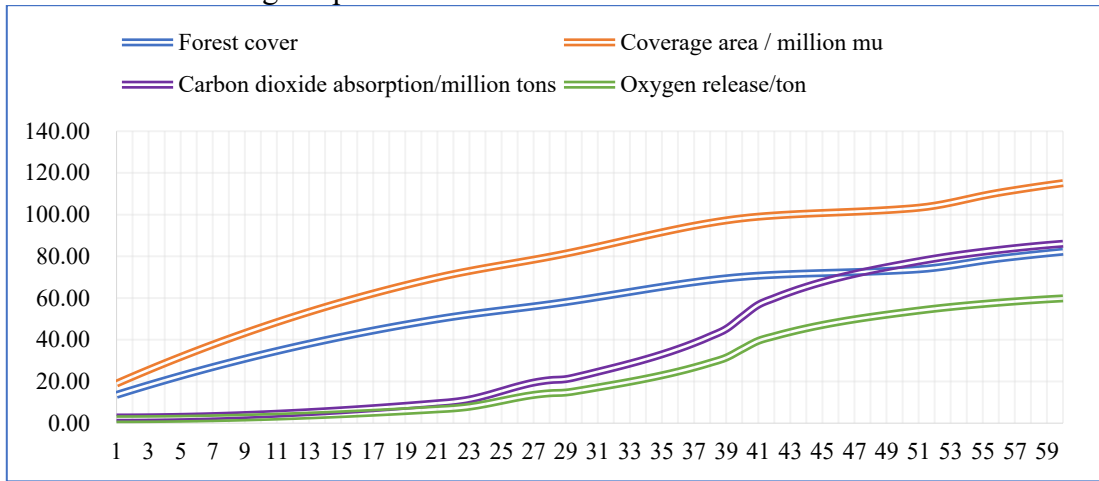


Figure 1 TOPSIS evaluation method calculation results trend graph

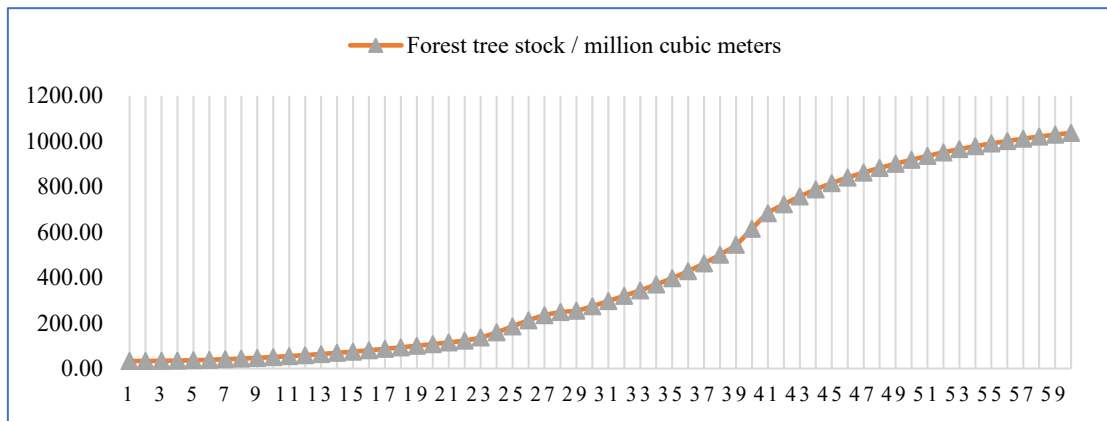
2.3 Excel graph to illustrate the changes in the ecological environment of Saihan Dam from 1962 to 2021

Figure 2 shows that all indicators show an upward trend, which fully shows that the ecological change after the establishment of Saihan Dam ecological protection measures is very effective and provides a reference for other regions in the world. [4]

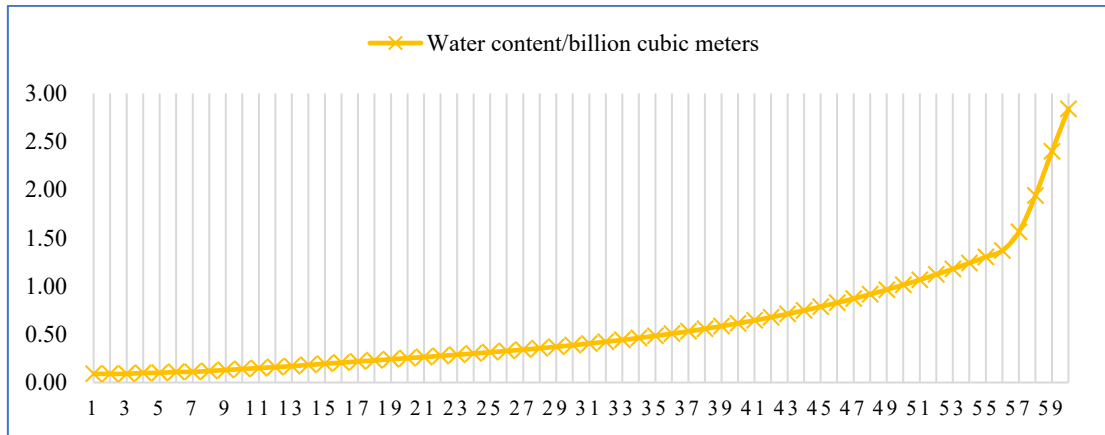
Not only that, but the restoration of the Saihan Dam 's own ecosystem has also brought good ecological impact to its related cities, taking Beijing as an example (Figure 3). The following graph (Figure 2,3) illustrates that the annual carbon emissions in Beijing show a trend of first increasing and then somewhat decreasing. The yearly increase of the area of the Saihan Dam Forestry Park can precisely weaken to some extent the negative impact of the increase of carbon emissions on the environment, and is partly responsible for the decrease of the second half of the curve in the graph. Therefore, it can also explain to a certain extent the necessity and effectiveness of the establishment and implementation of ecological protection measures in the Saihan Dam.



(a)

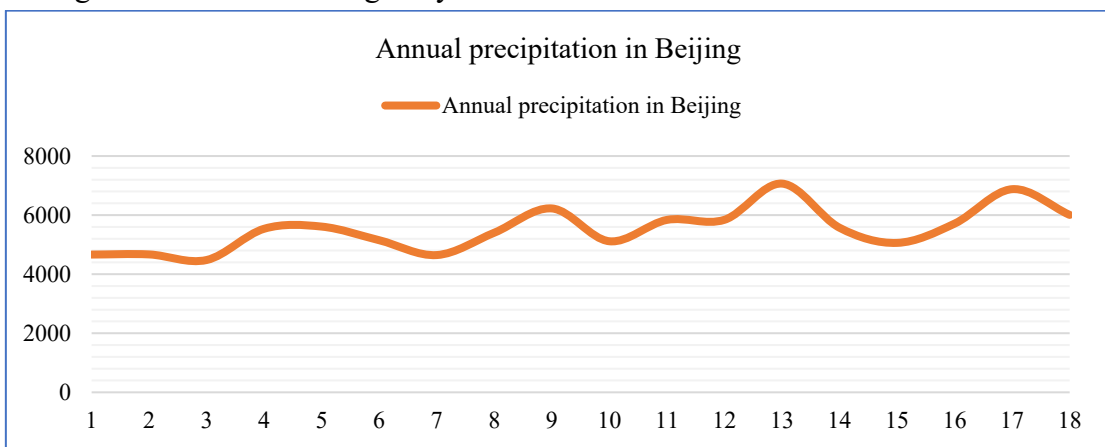


(b)

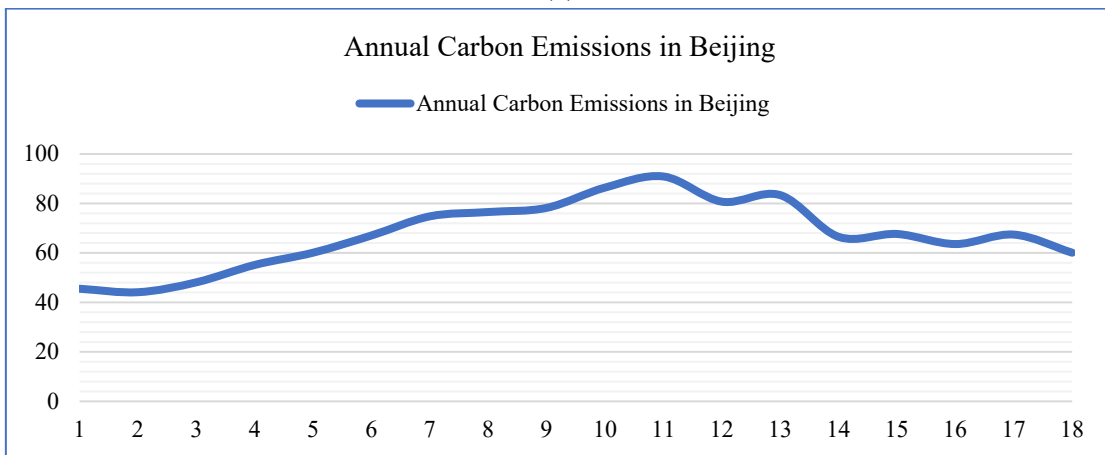


(c)

Figure 2 Trends of ecologically relevant data of Saihan Dam from 1962 to 2021



(a)



(b)

Figure 3 Impact of Saihan Dam ecosystem on Beijing

3. Promotion and evaluation of the model

In the process of concrete use, according to the degree of data dispersion of each index, the entropy weight of each index is calculated by using information entropy, and then the entropy weight is modified according to each index to obtain a more objective index weight.

The main disadvantage of the model is that it requires the current determination of the optimal values of various indexes, which is too subjective and difficult to determine the optimal values of some indexes.

References

- [1] Ya Qiao, Hang Gao. From Saihanba to "Millennium show forest" and "green miracle" [n] Hebei Economic Daily, 2022-04-02 (001)
- [2] Zhongwei Yuan. Current situation, problems and countermeasures of economic development under Saihanba forest [J] Anhui agronomy bulletin, 2022,28 (04): 58-59 + 96
- [3] Changchun Dong. Protection and utilization of Saihanba forest resources [J] Beijing agriculture, 2015 (33): 100-101
- [4] <http://data.cma.cn/site>
- [5] Jiejie Liu, Wei Xia, Zijie Liu, Lixin Zhao, Yongguang Ge, Suan Ge, Xianyang Meng. Construction of steam huff and puff evaluation index based on entropy weight method analytic hierarchy process [J] Energy saving, 2022,41 (03): 8-16.
- [6] Qian Zhang, Wencai Wang, Yun Wang. Establishment and application of comprehensive evaluation model of rockburst based on entropy weight method [J] Mining and metallurgy, 2022,31 (01): 1-6.
- [7] Ping Wang, Liying Gao, Zhenghua Luo, Jinshan Ding, Yongming Liu, Changjing Liang. Research on energy efficiency benchmarking system of oil pump unit based on correlation coefficient entropy weight method [J] Oil and gas field surface engineering, 2022,41 (04): 7-11 + 16
- [8] Zengwen Chen, Qinghua Hu, Zhongxing Chen, Shiwei Li, Wenhui Chen, Hongping Zheng. Study on the evaluation of the construction level and dynamic change of County Ecological Civilization in Fujian based on entropy weight method [J] Environmental ecology, 2022,4 (04): 1-10 + 44
- [9] Xikang Yan, Shida Wang, Yunfei Jia, Ranzhi Diao, Hanlin Xie, Shichao Wang. Study on Evaluation of construction industry competitiveness based on FA improved AHP-TOPSIS method [J / OL] Journal of Engineering Management: 1-6 [2022-05-05].
- [10] Fengping Liu, Ning Sun, Hongxia Hu, Zhenyu Ding. Comparison and selection of remediation technologies for groundwater iron and manganese pollution in production enterprises based on AHP-TOPSIS [J / OL] Journal of Environmental Engineering Technology: 1-13 [2022-05-05].