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A Study on the Influence of Saihanba on Ecological Environment

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Abstract: *In this paper, we study the impact of Saihanba on the ecological environment. Specifically, the method of grey correlation analysis was used to analyze the correlation between water conservation, carbon sequestration, oxygen release and the annual change curve in Saihanba area. Secondly, it analyzes the influence of Saihanba on Beijing's ability to resist sand and dust, and uses the grey relational analysis method to analyze the correlation between each index of Saihanba and the daily change curve of Beijing's sandstorm days. Considering factors such as climate, soil, vegetation and topography, the RWEQ model was used to establish the ecological protection models of Saihanba in Xinjiang and Saihanba in Inner Mongolia, and the quality of their windbreak and sand fixation materials was calculated. Finally, an approximate average of the three forest areas per year was used to predict the annual carbon dioxide absorption using a grey forecasting model.*

Keywords: *Gray relational analysis, RWEQ model, Grey prediction model, Saihanba forest farm*

1. Introduction

After the founding of the people's republic of China, the communist party of China established a large number of state-owned forest farms. Most of the areas where these state-owned forest farms are located are barren hills and wastelands. Through the establishment of state-owned forest farms, the ecological environment of barren hills and wastelands has been restored and ecological civilization has been developed. The development of state-owned forest farm can be divided into two stages: first, during the planned economy period, the main task of state-owned forest farm is afforestation, forest cultivation, forest tending, etc., so that the ecological environment of forest region is improved preliminarily compared with the initial period of the founding of the people's republic of China. Since the 1990s, the concept of sustainable development has penetrated into forestry development, and the state has set up nature reserves and forest parks in state-owned forest farms. With the reform of state-owned forest farms, state-owned forest farms have embarked on the road of ecological civilization development and become an important carrier of ecological civilization construction.

Saihanba Forest Farm maintains and manages the forest, further restoring the ecological environment. Since the 1990s, the national Saihanba forest park and nature reserve have been established successively, and Saihanba has gradually transformed from barren hills and wastelands in the early days of the founding of the people's republic of China into a demonstration area for ecological civilization construction. The ecological evolution of Saihanba district reflects the transformation of the relationship between man and nature from "human-centered theory" to "respect for nature and harmonious coexistence between man and nature". Under this transformation, Saihanba forest farm gradually embarked on the road of ecological civilization development.

In this paper, we use the three indicators of water conservation, carbon dioxide absorption and oxygen release, the impact of the forest coverage area of Saihanba forest farm on the ecological environment was analyzed. In addition, the impact of the restoration of the Saihanba forest farm on the ability of Beijing to resist sand and dust storms was analyzed through the correlation between the number of sandstorm days and the forest farm area. Finally, a grey prediction model is established to analyze the area of forest protected areas.

2. Grey Correlation Analysis

Since 1962, with the increase of the forest coverage area of Saihanba forest farm, its impact on the

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ecological environment has become more and more significant. Three indexes of water conservation, carbon dioxide absorption and oxygen release are used to analyze its influence. The method used in this question is grey correlation analysis, which can effectively analyze the correlation between these three indicators and forest cover area. The basic steps of grey correlation analysis are shown in Fig. 1.

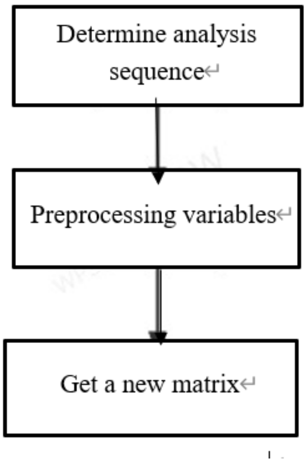

Figure 1: Basic steps

Gray relational analysis steps:

Step 1: Firstly, the reference sequence reflecting the characteristics of the system behavior and the comparative sequence affecting the system behavior should be determined.

Step 2: As the data in each factor column in the system may be different in dimension, it is not convenient for comparison or it is difficult to get a correct conclusion during comparison. Therefore, dimensionless data processing is generally required in grey relational degree analysis. There are two main methods.

Initial value treatment:

$$x_i(k) = \frac{x_i(k)}{x_i(1)} \qquad k = 1,2,\dots,n; i = 0,1,2,\dots,m \tag{1}$$

Mean processing:

$$x_i(k) = \frac{x_i(k)}{\overline{x_i}} \qquad k = 1,2,\dots,n; i = 0,1,2,\dots,m \tag{2}$$

Step 3: Calculating the correlation coefficient:

$$\xi_i(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|} \tag{3}$$

Step 4: Calculate the correlation degree

Because the correlation coefficient is the correlation degree value between the comparison sequence and the reference sequence at each moment, its number is more than one, and the information is too scattered to facilitate overall comparison. Therefore, it is necessary to concentrate the correlation coefficient at each moment into a value, namely, calculate its average value, as the quantitative expression of the correlation degree between the comparison sequence and the reference sequence. The correlation degree RI formula is as follows:

$$r_i = \frac{1}{n}\sum_{k=1}^{n} \xi_i(k), k = 1,2,\Lambda,n \tag{4}$$

Step 5: Correlation ranking

The correlation degree is sorted by size, and if R1 < R2, the reference sequence Y is more similar to the comparison sequence X2. After the correlation coefficient between Xi(k) sequence and Y(k) sequence is calculated, the mean value ri is called the correlation degree between Y(k) and Xi(k).

The amount of water conservation is closely related to vegetation type, coverage, litter composition, soil layer thickness and soil physical properties. The analysis of the amount of water conservation can conclude the impact of Saihanba forest farm on water resources, namely, the impact on the ecological

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environment. The carbon and oxygen ratio seriously affects air quality and restricts urban development. The study on the carbon dioxide absorption and oxygen emission of Saihanba Forest farm reflects the important role of Saihanba forest farm in carbon sequestration and oxygen release, and thus reflects the important impact of Saihanba on the ecological environment.

The forest cover area, forest water conservation, carbon dioxide absorption and oxygen release of Saihanba are modeled. The forest cover area, water conservation, carbon dioxide absorption and oxygen release are shown in Fig.2, Fig.3, Fig.4and Fig.5, respectively.

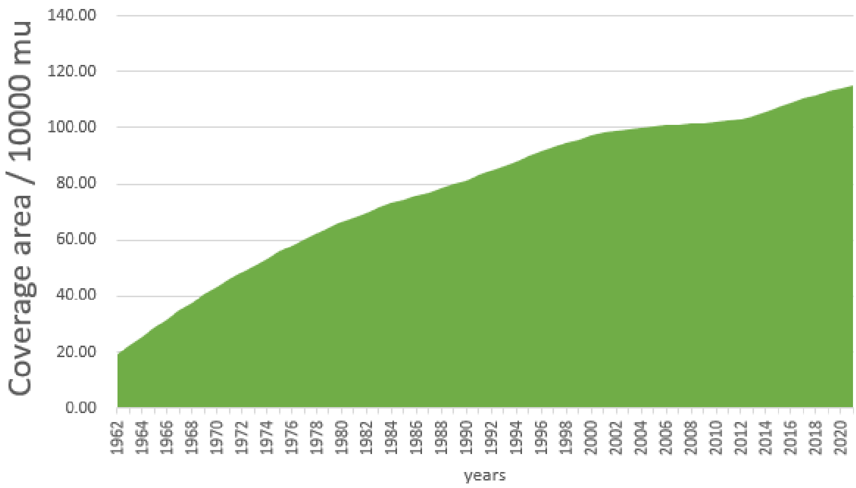

Figure 2: Forest coverage area of Saihanba

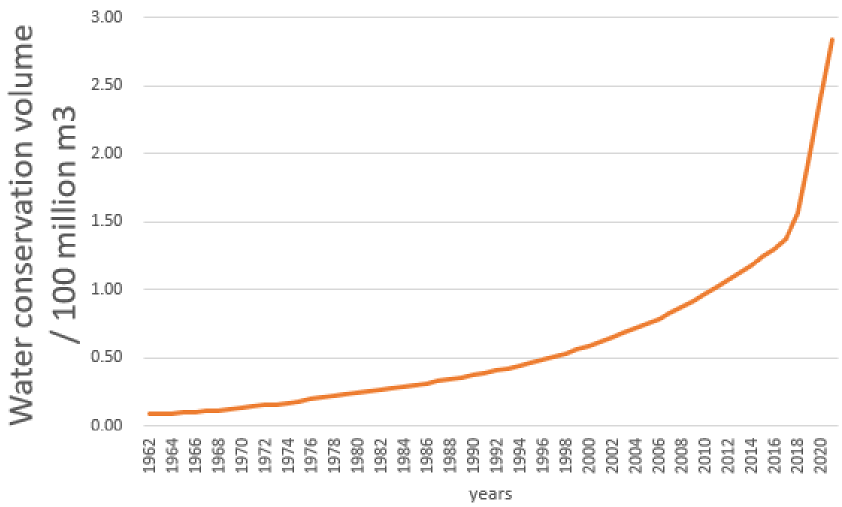

Figure 3: Conservation of water

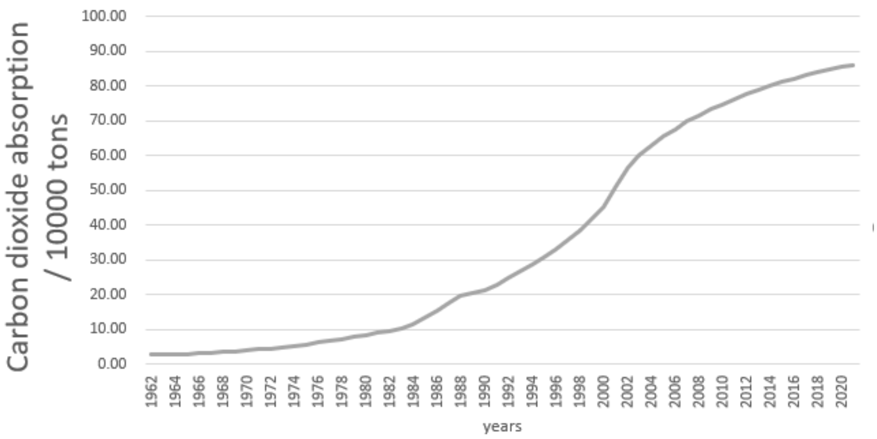

Figure 4: Carbon dioxide absorption

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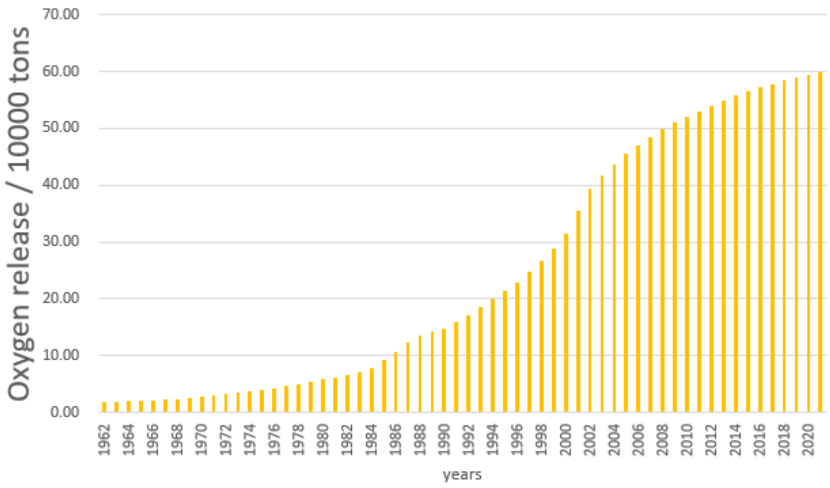

Figure 5: Oxygen release

According to the above data, the grey correlation analysis method is used for modeling:

Step 1: Determining the reference sequence and comparison sequence. Take the forest cover area of Saihanba as the reference sequence X0(k), take the water conservation, carbon dioxide absorption and oxygen release of Saihanba as Xi(k), I as the index serial number, I =1,2,3, k as the k year, k=1962...2021, Xi(k) is the specific index value of column I in the k year.

Step 2: Calculating the absolute difference between the reference sequence and the comparison sequence to form the absolute difference matrix, which can be expressed as:

$$\Delta \mathrm{i(k)} = |X\_(i(k)) - X\_(0(k))\,| \tag{5}$$

Step 3: Calculating the maximum value in the absolute difference matrix, the maximum value is max δI(k) , the minimum value is minδI(k).

Step 4: Calculating the correlation coefficient. ρ is the resolution coefficient, which is 0.5 in this paper.

$$\delta\_(i(k)) = \frac{\Delta(min)+\rho\Delta(\max)}{\Delta 0_{i(k)}+\rho\Delta(\max)} \tag{6}$$

Step 5: Calculating the correlation.

$$r_{0(i)} = \frac{1}{N}\sum_{k=1}^{N} \delta_{i(k)} \tag{7}$$

For the impact of the restoration of Saihanba on the ecological environment, we collected the data of forest cover area, water conservation, carbon dioxide absorption and oxygen release from 1962 to 2021. The gray correlation degree can be obtained as:

$$\mathrm{ans} = 0.7050, 0.5910, 0.5910 \tag{8}$$

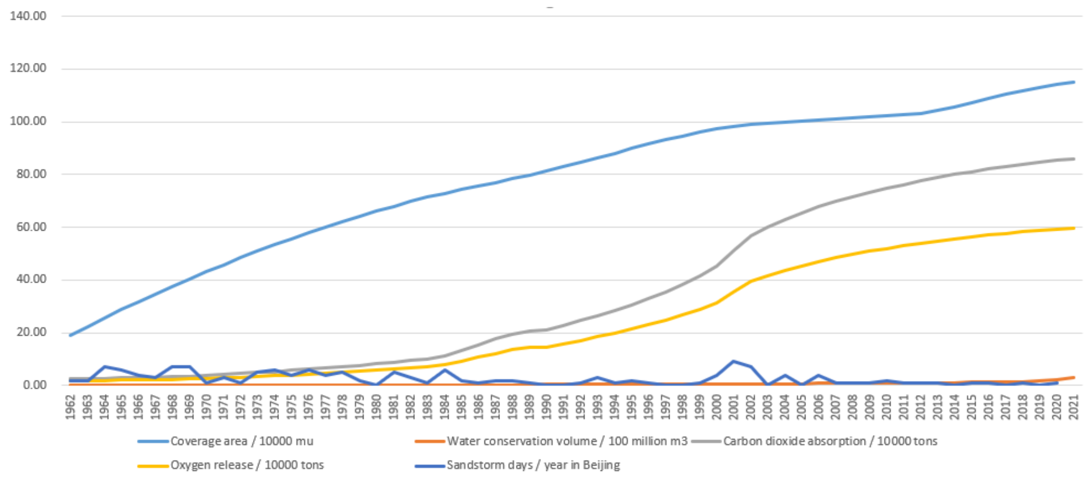

Figure 6: Line chart of sandstorm days in Beijing and changes of selected Saihanba index

Is the main principle of the grey correlation analysis according to the data change curve to estimate the correlation between different data changes, ontology using grey correlation analysis method can be a very good reaction Beijing sandstorm days and Sihanba forest area, water conservation and the relationship between the carbon release oxygen, the indicator diagram are shown in Fig.6.

3. RWEQ Model

RWEQ model is used to estimate the annual quality of windbreak and sand-fixing materials per unit area in Zhundong region of Xinjiang according to the difference between the potential wind erosion under bare soil condition and the actual wind erosion under vegetation cover condition. Wind erosion model is based on the maximum downwind distance, climate factor, surface roughness factor, soil erodibility factor, soil crust factor and vegetation cover factor to calculate soil wind erosion. The vegetation cover index of China is shown in Fig.7.

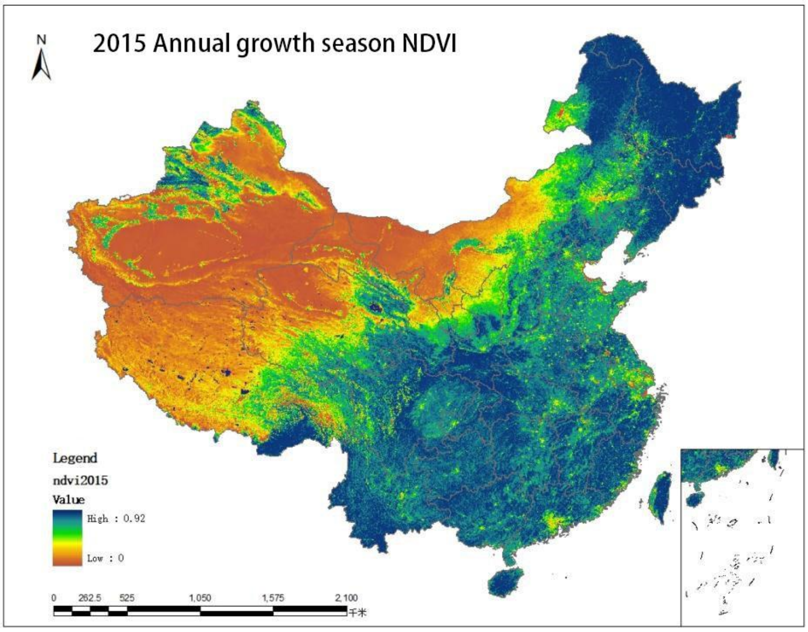

Figure 7: Vegetation cover index in China

RWEQ model is used to estimate the annual quality of windbreak and sand-fixing materials per unit area in Zhundong region of Xinjiang according to the difference between the potential wind erosion under bare soil condition and the actual wind erosion under vegetation cover condition.

The formula is as follows:

$$S_L = \frac{2z}{s^2} Q_{max} e^{-(\frac{z}{s})^2} \tag{9}$$

$$\mathrm{S} = 150.71(WF \times EF \times SCF \times K' \times C)^{-0.3177} \tag{10}$$

$$Q_{max} = 109.8(WF \times EF \times SCF \times K' \times C) \tag{11}$$

$$\mathrm{G} = S_L - \mathrm{S} \tag{12}$$

The WF climate factor is the average of 14.6125 in eastern China [1]. The median value of K' surface roughness factor was 3.28 [1]. For EF soil erodibility factor, the average value of soil erodibility factor in Yili river valley is 0.079 [2]. The median value of SCF soil crust factor in northwest China was 0.475 [3]. C vegetation coverage factor: $\mathrm{C} = e^{-0.0438VC}$.

VC refers to vegetation coverage rate, assuming that vegetation coverage rate reaches 100%, and C value is about 0.645. According to the RWEQ model, the above data can be obtained: the quality of windbreak and sand fixation per unit area of the forest reserve in Zhundong area is about 0.21kg/m^2. The total amount of annual wind erosion in the eastern part of Zhunggong reaches 101,942,800 tons [4]. The area of protected area to be established in zhundong area is 48.54km^2. The area of the protected area established in Zhundong area is approximately the area of Saihanba in 1972. Assuming that the protected area established here is consistent with the ecological environment of Saihanba, the carbon sequestration

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and oxygen release of the protected area is 45,300 tons, which plays a very positive role in carbon neutralization.

Assuming that the ecological protection model of Saihan dam is fully applicable to Palau, according to the data of Saihan dam from 1962 to 1973, the grey prediction model is established by using MATLAB, and the view tool is used to check the area of Saihan dam in which year the amount of carbon dioxide to be absorbed in the establishment of ecological protection area in Palau corresponds. The results are shown in Fig.8.

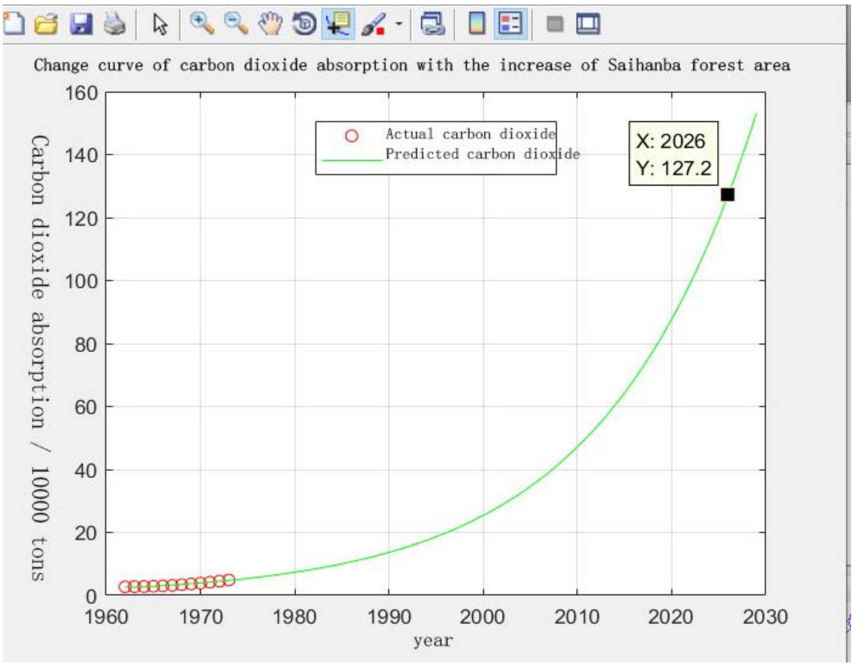

Figure 8: Change of carbon dioxide absorption with the increase of Saihanba forest area

The approximate annual growth of Saihanba forest area is 30 thousand mu, compared with the initial area of 190 thousand mu in 1962. According to data World 2019, Palau's carbon dioxide emissions from fossil fuels are estimated at 1.3 million tons. It can be seen from the results of the grey prediction model that the area closest to Saihanba in 2026 is under the average annual growth of 30,000 mu of forest cover area. It was calculated that the area of protected areas needed to be established in Palau was S_r=19+ (2026-1962) ×3= 2.11 million mu.

This model mainly using gray correlation analysis method, this paper analyzes the Sihanba all kinds of meteorological data, environmental data, such as vegetation coverage data, analyzing data and the correlation between the data to determine the influence of the data of Sihanba environment, the model can be applied to the analysis of ecological protection areas for any local environmental conditions of ascension and resist the role of the bad weather. The RWEQ wind erosion model calculates the soil wind erosion according to the maximum downwind distance, climate factor, surface roughness factor, soil erodibility factor, soil crust factor and vegetation cover factor.

Ecological environment natural resources are the important basis of human production and life, human development should focus on long-term goals, innovation of development mechanism, to achieve sustainable development, rather than sacrifice the physical natural environment for short-term economic development. Therefore, in order to ensure the harmonious development of social and economic development and physical and natural environment, relevant departments need to innovate environmental protection mechanism, abandon the traditional environmental protection mechanism. First, the environment department needs to do a good job of communication with local government, the status quo, analysis of the local ecological environment in advance if you need to create ecological reserves, need calculate about the location of the reserve scale, and then use the government's credibility enterprises involved in the construction of ecological environment protection and pollution control enterprises, and to build a reserve of solid carbon release oxygen ability reach dynamic equilibrium. Second, environmental protection departments should give full play to their own functions, urge relevant enterprises to carry out scientific and technological transformation, optimize industrial structure, reduce pollution emissions, and actively participate in the construction of environmental protection areas. Third, environmental protection departments should strengthen communication and cooperation with relevant

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government units, promote the improvement and promulgation of laws related to environmental protection as soon as possible, and strengthen the management of pollution emission indicators of enterprises.

4. Conclusion

In this paper, we use the grey prediction model is used to analyze the correlation between the forest cover area and the water conservation, carbon fixation and oxygen release in Saihanba, and the correlation between the number of sandstorm days in Beijing and the forest cover area in Saihanba. However, RWEQ model is used to analyze the forest area needed to establish ecological protection area for dust control and sand fixing in Zhundong region of Xinjiang. Finally, the grey prediction model is used to estimate the carbon dioxide uptake in Saihanba in the next 70 years under the premise that the annual forest cover increases by 3 percent.

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