

Construction of Ecological Conservation and Assessment of Its Impact on Environment

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Abstract. In recent years, the restoration of Saihanba Forest Farm in China has achieved gratifying results. In this paper, the environmental situation of Saihanba forest farm before and after restoration was analyzed, and the ecological protection model was popularized, and constructive suggestions were put forward to strengthen the attention to environmental management and protection in the Asia-Pacific region. This paper compares and analyzes the environmental conditions before and after the restoration of the Saihanba Forestry Reserve through quantitative analysis methods to evaluate the impact of Saihanba on the ecological environment; quantitatively evaluates the impact of Saihanba on the resistance to dust storms in Beijing through the selection of evaluation indicators and data collection; collects relevant data from different parts of China to determine the location, number or scale of ecological reserves to be established in China and evaluates the impact of establishing these ecological reserves on China's carbon neutrality targets.

Keywords: Environmental impact factor model; Principal component analysis; Expert scoring method.

1. Introduction

Lucid waters and lush mountains are mountains of gold and silver. China is committed to the strategy of sustainable development. Faced with the destruction of natural environment caused by long-term economic development, the most long-term and effective method is to restore and establish ecological civilization system. China has been promoting the 12-year greening campaign since 1956^[1]. These decades of afforestation and ecological restoration campaigns have restored Saihanba forest farm from a desert to a greenwood farm, which is a gratifying result^[2]. It has made great contribution to the improvement of the natural environment.

For the assessment of the environmental status of Saihanba before and after the restoration, this paper always adhere to the concept that clear water and green mountains are gold and silver mountains. Through the comparison of indirect economic value on environmental protection, intuitively show the impact of the forest farm on the environment before and after the restoration^[3]. Based on the environmental condition of Saihanba Forest Farm after restoration in 2021, the weight of forest in environmental protection was determined by the proportion of indirect economic value in environmental protection, such as water conservation, carbon fixation and oxygen release, in the total indirect economic value. The environmental impact factor model is established based on this weight, which is convenient to judge the ecological value system of each region^[4].

The second quest to establish a model the influence of sihanba against dust storms in Beijing, this paper will collect nearly sixty years sihanba forest farm of related data as independent variables, the number of dust storms in Beijing as a dependent variable, principal component analysis, analysis the main factors influencing the dust storms in Beijing, and establish relevant mathematical model^[5].

2. Model assumptions and notation

2.1. Assumptions

1. Assume that the geographical area of Saihanba remains unchanged for a long time
2. Assume that cost prices do not change with time when calculating indirect value for quantitative analysis.
3. It is assumed that only the ecological benefits brought by forest plants are considered, and the potential ecological benefits of microorganisms and animals are not considered.

2.2. Notations

Important notations used in this paper are listed in Table 1.

Table 1 Notations

Symbol	Description
W	Water conservation ($m^3 \cdot yr^{-1}$)
R	Average rainfall ($mm \cdot yr^{-1}$)
A	Forest farm area (km^2)
E	Average evapotranspiration of trees ($mm \cdot yr^{-1}$)
P	Unit storage cost ($yuan \cdot m^{-3}$)
S_1	The uptake of CO_2 ($t \cdot yr^{-1}$)
S_2	The release of O_2 ($t \cdot yr^{-1}$)
Q_1	The cost of fixing CO_2 ($yuan \cdot t^{-1}$)
Q_2	The releasing of fixing O_2 ($yuan \cdot t^{-1}$)
Q	Total absorption of SO_2 ($t \cdot yr^{-1}$)
N	Main nutrient contents in each forest system (t)
M	The total area of each forest system (km^2)
K	Fertilizer price ($yuan \cdot t^{-1}$)
q	The ability to absorb SO_2 ($t \cdot km^{-2} \cdot yr^{-1}$)
ω	Environmental impact factor

3. Model construction and solving

3.1. Calculation of indirect economic value

The methods of forest service function and its evaluation in China were used to evaluate the indirect economic value of Saihanba.

1) Conserve water

By regional water balance method, calculating the amount of water conservation of forest farm

$$V_1 = W \cdot P = (R - E) \cdot A \cdot P \quad (1)$$

Where, V is the economic value of the annual water content of the forest farm (yuan), and W is the water conservation amount of the forest farm ($m^3 \cdot yr^{-1}$), R is the average rainfall in the area where the forest farm is located ($mm \cdot yr^{-1}$); A is the area of forest farm (km^2), E is the average heat loss of trees in the forest farm ($mm \cdot yr^{-1}$), P is unit water storage cost ($0.67 \text{ yuan} \cdot m^{-3}$).

According to the data collected^[3], it shows that in 2021, the forest coverage rate of Saihanba mechanical Forest Farm is 82%, and the annual water conservation is 284 million cubic meters. In

1962, the forest coverage rate of Saihanba Forest Farm is 11.4%. Since the water conservation amount per square meter of forest does not change with time, the water conservation amount of Saihanba forest farm in 1962 can be estimated as 39.5 million cubic meters.

Thus formula (1) can be simplified as

$$V_1 = 0.63 W = 0.63(R-E)A \quad (2)$$

Where, W is the water conservation amount of forest farm ($\text{m}^3 \cdot \text{yr}^{-1}$), R is the average rainfall in the area where the forest farm is located ($\text{mm} \cdot \text{yr}^{-1}$); A is the area of forest farm (hm^2), E is the average heat loss of trees in the forest farm ($\text{mm} \cdot \text{yr}^{-1}$).

According to Formula (2), it can be calculated that the indirect economic value brought by water conservation in 1962 is about 26,465,000 yuan, and the indirect economic value brought by water conservation in 2021 is 190,280,000 yuan.

2) Fix carbon dioxide and release oxygen

$$V_2 = S_1 \times Q_1 + S_2 \times Q_2 \quad (3)$$

Where, S_1 , S_2 are respectively the content of carbon dioxide absorbed by forest and the content of oxygen released by forest, Q_1 , Q_2 are respectively the cost of carbon sequestration and oxygen release stipulated by afforestation law.

In this paper, in order to facilitate the determination of the impact of forest farm recovery period on the indirect economic benefits, we determine the ecological benefits of forest carbon sequestration and oxygen release by using the Cost method of Afforestation in China 273.3 yuan $\cdot \text{t}^{-1} \text{C}$ and 369.7 yuan $\cdot \text{t}^{-1} \text{O}_2$.

Therefore, Formula (3) can be simplified as

$$V_2 = 273.3S_1 + 369.7S_2 \quad (4)$$

Where, S_1 and S_2 are respectively the content of carbon dioxide absorbed by the forest and the content of oxygen released.

The collected data shows that^[3] in 2021, the Saihanba Forest Farm fixed 803,300 tons of carbon dioxide and released 598,400 tons of oxygen. For the lack of existing data on the content of fixed CO_2 and released O_2 in Saihanba Forest Farm in 1962, we calculated the content of fixed CO_2 and released O_2 per square meter of forest by using the existing data in 2021 through proportional conversion method, and then based on the forest area in 1962, It is estimated that in 1962 the forest farm fixed $11.96 \times 10^4 \text{t}$ of carbon dioxide and released $8.32 \times 10^4 \text{t}$ of oxygen.

By putting the data into formula (4), it can be calculated that the economic value of the forest farm in air purification in 1962 was $6.34 \times 10^7 \text{ yuan}$, and that in 2021 was $4.56 \times 10^8 \text{ yuan}$.

3) Nutrient circulation and storage

The forest system will absorb the surrounding nutrients during the growth process, and these nutrients will continue to circulate in nature along with the circulation of the ecosystem, reducing the use of fertilizers to some extent^[6]. So calculate the indirect economic value of forests in terms of nutrients. Due to data limitations, in this study, we only estimated the economic value of the main nutrient elements nitrogen, phosphorus and potassium in forest dry matter by studying their total contents^[7].

$$V_3 = \frac{N}{M} AK \quad (5)$$

Where, N is the total amount of nitrogen, phosphorus and potassium in each forest system, M is the area of each forest system, A is the area of forest farm, and K is the average price of chemical fertilizer in China.

In value calculation, the average price K of chemical fertilizer in China is $2549 \text{ yuan} \cdot t^{-1}$ to calculate.

Therefore, the formula can be simplified as:

$$V_3 = 2549 \frac{N}{M} A \quad (6)$$

Where, A is the area of forest farm, N is the total amount of nitrogen, phosphorus and potassium in each forest system, and M is the area of each forest system.

According to the division of forest belts in China, Saihanba area belongs to the cold temperate coniferous forest. According to the nutrient content of each forest belt given in the literature^[6]. It can be seen that the area of cold temperate coniferous forest is $13.1 Mhm^2$, and the content of main nutrients in trunk is $2.9 \times 10^6 t$. According to the calculation, the economic value of this part was $6.00 \times 10^6 \text{ yuan}$ in 1962 and $4.32 \times 10^7 \text{ yuan}$ in 2021.

4) The purification sulfur dioxide

Total annual absorption of SO_2 in forests:

$$Q = qA$$

$$V_4 = qAH \quad (7)$$

Where, Q is the total amount of SO_2 absorbed by the forest farm annually; A is the area of forest farm, q is the SO_2 absorption capacity of forest, and H is the investment and treatment cost of SO_2 .

According to the method of average SO_2 management cost adopted by nanjing institute of environmental science of sepa in the "China biodiversity situation research report", the investment and treatment cost of SO_2 is $600 \text{ yuan} \cdot t^{-1}$ to calculate economic value.

The formula can be simplified as:

$$V_4 = 600qA \quad (8)$$

A is the area of the forest farm, and Q is the SO_2 absorption capacity of each species.

SO_2 absorption capacity of coniferous forest is $215.6 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$

By calculation, in 1962, the economic value brought by absorption of SO_2 by the forest farm was $1.38 \times 10^9 \text{ yuan}$, and the indirect economic value brought by 2021 was $9.90 \times 10^9 \text{ yuan}$.

5) Dust detention

Forest purifies the value of dust, can use the average unit administration cost that cuts dust to evaluate.

$$V_5 = apA \quad (9)$$

Where, a is the dust retention capacity of each tree species, A is the area of forest farm, and P is the operation cost of dust removal.

According to the dust removal operation cost of $170 \text{ yuan} \cdot t^{-1}$ to calculate economic value

The formula can be simplified as:

$$V_5 = 170aA \quad (10)$$

According to the determination, the dust retention capacity of coniferous forest is $33.2t \cdot hm^{-2} \cdot yr^{-1}$. After adding saihanba forest area to calculate, the dust removal value of forest farm in 1962 is $6.05 \times 10^6 \text{ yuan}$, and that in 2021 is $4.32 \times 10^8 \text{ yuan}$.

6) Water and soil conservation

Land conservation amount:

$$Z = Z_2 - Z_1 = T_2 A - T_1 A$$

Actual erosion:

$$Z_1 = T_1 A$$

Potential erosion:

$$Z_2 = T_2 A$$

In the formula, Z represents the amount of land conservation, Z_1 , Z_2 are the actual and potential erosion respectively. T_1 , T_2 are the actual erosion modulus and potential soil erosion modulus of all kinds of forests respectively, and A represents the area of forest farm.

According to the research^[7], it is found that the actual erosion modulus of coniferous forest soil in cold temperate zone of China is $500 t \cdot km^{-2} \cdot yr^{-1}$; Potential soil erosion modulus corresponds to the upper limit of water and wind erosion modulus according to the "intensity level" of soil erosion classification in China is $8000 t \cdot km^{-2} \cdot yr^{-1}$.

Therefore, the formula simplifies to:

$$Z = Z_2 - Z_1 = 7500A$$

Where, A is the area of forest farm.

According to the calculation, the soil conservation amount of Saihanba in 1962 is $7.98 \times 10^5 t$, and the soil conservation amount in 2021 is $5.74 \times 10^6 t$.

① Forests reduce the asset value of lost land

According to the soil conservation amount of Saihanba calculated above, according to the soil thickness and bulk density of cold temperate coniferous forest and the total asset value of Saihanba mechanical forest farm is 23.12 billion yuan, respectively, the economic loss reduced by reducing soil loss per year is estimated.

$$V_6 = 170aA \quad (11)$$

According to the calculation, the loss of land assets reduced by Saihanba Forest Farm in 1962 is $6.18 \times 10^7 \text{ yuan}$, and the loss of assets reduced in 2021 is $4.44 \times 10^8 \text{ yuan}$.

② Soil erosion has taken away a large number of soil nutrients

The contents of soil nutrients vary from soil to soil. Limited by data, we only studied the total contents of nitrogen, phosphorus and potassium in soil.

$$V_7 = KNZ \quad (12)$$

In the formula, K is the average price of chemical fertilizer in China, N is the total content of main nutrients in soil of each forest, and Z is the soil conservation amount.

If the average price of fertilizer in China is $2549 \text{ yuan} \cdot t^{-1}$, to estimate the economic value added by forest conservation.

The formula can be simplified to:

$$V_7 = 2549NZ \quad (13)$$

According to the data, the contents of N, P and K in the soil of cold temperate coniferous forest in China are $2.2 \times 10^6 t$, $3.0 \times 10^5 t$ and $2.0 \times 10^7 t$ respectively. The soil conservation amount in Saihanba was $7.98 \times 10^5 t$ in 1962, and $5.74 \times 10^6 t$ in 2021. It is calculated that the loss of nutrients taken away by keeping the land reduced was $1.09 \times 10^8 \text{ yuan}$ in 1962 and $7.85 \times 10^8 \text{ yuan}$ in 2021.

③ The soil eroded by rain will flow with water flow to everywhere,

the general soil erosion of 24 percent of the quicksand silting in reservoirs, rivers, lakes, sediment deposition reduces the decline of reservoir, river, lake water storage, to a certain extent, increase the occurrence of drought, flood disaster^[8]. More reservoirs are needed to reduce drought and flooding caused by sediment deposition to some extent. The cost of reservoir engineering in China is $0.67 \text{ yuan} / m^3$, so the indirect economic value brought by reducing silt in rivers and lakes is:

$$V_8 = 0.67 \frac{Z}{\rho} \quad (14)$$

Where, Z is the amount of soil conservation, and ρ is soil density.

It is calculated that the reservoir construction cost saved by water and soil conservation in Saihanba Forest farm is $1.60 \times 10^5 \text{ yuan}$ in 1962 and $1.15 \times 10^6 \text{ yuan}$ in 2021.

To sum up the indirect economic benefits brought by the above three kinds of soil conservation, the total economic value of Saihanba to soil and water conservation was $1.71 \times 10^8 \text{ yuan}$ in 1962 and $1.23 \times 10^{10} \text{ yuan}$ in 2021. Indirect economic value of Saihanba Forest Farm in 2021 after restoration is shown in Table 2.

Table 2 Indirect economic value of Saihanba Forest Farm in 2021 after restoration

year	In 2021
Water Conservation (yuan)	1.90×10^8
Fixed CO2 and released O2 (yuan)	4.56×10^8
Nutrients (yuan)	4.32×10^8
Purification of SO2 (yuan)	9.95×10^6
Dust retention (yuan)	4.32×10^8
Estimated annual loss of soil erosion reduction (yuan)	4.44×10^8
Annual economic value of soil loss reduction (yuan)	7.85×10^8
Indirect economic value of reducing sediment deposition in rivers and lakes (yuan)	1.15×10^6
Soil and water conservation	1.23×10^9
Total indirect value	2.36×10^9

According to the proportion of the economic value of the above parts, the weight of forest farm in water conservation, carbon fixation and oxygen release, nutrient fixation, dust retention and water and soil conservation were determined to be 0.08, 0.19, 0.02, 0.18 and 0.52 respectively^[9]. Because the proportion of sulfur dioxide purification capacity in forest farms is too small, its impact on the environment is ignored. According to the weight determined above, we determine the environmental impact factor model to judge the impact of forestland planting on the environment^[10]:

$$\omega = 0.08\alpha_1 + 0.19\alpha_2 + 0.02\alpha_3 + 0.18\alpha_4 + 0.52\alpha_5 \quad (15)$$

In the formula, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ represents the ratio of different forest conditions to the capacity of water conservation, carbon fixation, oxygen release, nutrient fixation, dust retention and water and

soil conservation per unit area of the region and to the capacity of Saihanba Forest Farm to the area per unit area in 2021 as the measurement standard.

Due to the lack of data, we calculated the value of water conservation, carbon fixation and oxygen release of the Saihanba forest in 1062. By assuming that the same forest has the same impact on the environment per unit area, we obtained the impact data of the Saihanba mechanical forest farm in 1962:

Water conservation: $3.95 \times 10^7 m^3$

Fixed amount of carbon dioxide: $11.96 \times 10^4 t$

Amount of oxygen released: $8.32 \times 10^4 t$

Fixed amount of absorbed nutrients: $2.34 \times 10^3 t$

Dust retention: $3.53 \times 10^5 t$

Soil conservation: $7.98 \times 10^5 t$

The above values are put into formula (15) for calculation, and the environmental impact factor of Saihanba in 1962 is 0.13764.

Comparative analysis of the environmental impact of Saihanba Forest Farm before and after restoration is shown in Table 3.

Table 3 Comparison of environmental impact of Saihanba Mechanical Forest Farm before and after restoration

In terms of	In 1962	In 2021
Water conservation / 100 million cubic meters	0.395	2.84
Fixed carbon dioxide per t	119600	860300
released oxygen over t	83200	598400
Fixed nutrients /t	2355.419847	16942.49364
The amount of dust/t	353248	2540906.667
Soil conservation /t	798000	5740000
Environmental impact factor	0.13764	1

From the comparison in the above table, we can see that the restoration of Saihanba Forest Farm has a huge impact on all aspects of the environment. After the restoration, the fixed amount of carbon dioxide increased from $11.96 \times 10^4 t$ to $86.03 \times 10^4 t$, which is of great significance for China to achieve the goal of carbon neutrality and carbon peak. Dust retention increased from $3.53 \times 10^5 t$ to $2.54 \times 10^6 t$, greatly improving air quality and reducing the possibility of dust phenomenon.

3.2. The impact of Sehanba on Beijing's resistance to sandstorms

Set y_1 as the dependent variable, which refers to the number of strong sandstorms per decade in Beijing from 1961 to 2020. x_1, x_2, x_3, x_4 respectively represent the independent variables: the total forest area in Saihanba during 1961-2020, the total savings of living trees during 1961-2020, the average annual precipitation during 1961-2020, and the vegetation coverage rate in Saihanba during 1961-2020. The following Table 4 is solved by principal component regression analysis.

Table 4 Parameter estimation of each influencing factor

variable	The estimate	Standard error of	T value	P values	Variance inflation factor
Constant term	61.4808	45.3381	1.3561	0.4045	0.0000
X1	0.0072	0.0052	1.388	0.3975	1393.764
X2	0.0211	0.0159	1.3275	0.411	5.6382
X3	0.0291	0.0969	0.3005	0.8142	2.3417
X4	7.1483	4.6555	1.5355	0.3675	1320.05

The variance inflation factor of the independent variables is $x_1, x_4 \geq 10$, indicating that there is serious multicollinearity among the independent variables.

Therefore, principal component analysis is carried out on the independent variables shown in Table 5.

Table 5 Principal component analysis

The serial number	The eigenvalue	The differential	contribution	Cumulative contribution rate
1	3.2851	2.7785	0.8213	0.8213
2	0.5066	0.2987	0.1266	0.9479
3	0.2079	0.2076	0.052	0.9999
4	0.0004	0.0000	0.0001	1.0000

According to the data in the table, the first principal component has a high contribution rate of 0.8213, indicating that the first principal component has a high degree of generalization model information. The second principal component accounts for 0.1266 of the information of the whole model, and the cumulative contribution rate of the second principal component and the first principal component is 0.9479, more than 90%, and only a small amount of information is lost, which can explain the model well. Therefore, the first two components can be selected to replace the original four variables for dimensionality reduction. Two principal component factors are vegetation coverage rate and precipitation after dimensionality reduction. Feature vectors is shown in Table 6.

Table 6 Feature vectors

	Z1	Z2	Z3	Z4
X1	0.5237	0.4282	0.171	0.7164
X2	0.5021	0.235	0.8318	0.028
X3	0.4503	0.7505	0.4837	0.004
X4	0.5205	0.4451	0.2119	0.6971

The standardized characteristic equations of Z1 and Z2 can be obtained from the analysis in Table 4 and the data in Table 5:

$$Z_1 = 0.5237x_1 + 0.5021x_2 + 0.4503x_3 + 0.5205x_4$$

$$Z_2 = -0.4282x_1 + 0.235x_2 + 0.7505x_3 - 0.4451x_4$$

The first principal component is vegetation coverage rate, which is negatively correlated with the number of sandstorm occurrence, so it can be seen that the establishment of ecological zone can effectively resist sandstorm. The second principal component is the precipitation in the ecological area, because the local precipitation can directly affect the growth of plants, and then indirectly affect the occurrence of sandstorms.

The principal components of standardized dependent variables Z_1, Z_2 were analyzed by multiple regression. 1. Analysis of Variance and Parameter estimation are shown in Table 7 and Table 8.

Table 7 Analysis of Variance

Sources of variance	Degrees of freedom	Sum of squares	The mean square	The F value	P values
Return to the	2.0000	4.6753	2.3376	21.5962	0.0166
residual	3.0000	0.3247	0.1082		
A total of	5.0000	5.0000			

According to the data analysis in the table, P value = 0.0166 < 0.05, so the regression equation can be considered to be statistically significant.

Table 8 Parameter estimation

variable	The estimate	Standard error	T value	P values
Constant term	0.0000	0.1343	0.0000	1.0000
Z1	0.5263	0.0812	6.4835	0.0074
Z2	0.2223	0.2067	1.0756	0.3609

According to the result of parameter estimation, the principal component regression equation of standardized data is:

$$Y = -0.3708X_1 - 0.2120X_2 - 0.0701X_3 - 0.3729X_4$$

The principal component regression equation of the original data is:

$$y = 81.0314 - 0.0004x_1 - 0.0100x_2 - 0.0311x_3 - 0.3353x_4$$

3.3. Establishment of ningxia Ecological region

3.3.1 Location determination of ecological zones

Dahezigou, Lingwu City, Ningxia Province, has a low population density and low vegetation coverage, with a temperate continental climate. Because the surrounding area is mined all the year round, the ecological damage is serious. We choose to build an ecological protection area of about 12 square kilometers near the water source here to repair the damaged ecology.

3.3.2. Indirect economic value calculation

1) Water conservation

According to the data^[9], China's forest coverage rate is $2.08 \times 10^8 \text{ hm}^2$, of which temperate coniferous and broad-leaved mixed forest accounted for 0.65%. The area of temperate coniferous and broadleaved mixed forests in China is calculated as $1.352 \times 10^4 \text{ km}^2$. The total water conservation of temperate coniferous and broadleaved mixed forest is $13.60 \times 10^8 \text{ m}^3$, so the water conservation can be obtained $1.01 \times 10^5 \text{ m}^3 \cdot \text{km}^{-2}$.

Therefore, the water conservation capacity of Ningxia established ecological zone is $1.21 \times 10^6 \text{ m}^3$. According to the formula, it can be estimated that the indirect economic value is $8.09 \times 10^5 \text{ yuan}$.

2) The fixation of carbon dioxide releases oxygen

According to the data^[9], the total amount of carbon sequestration and oxygen release in temperate coniferous and broadleaved mixed forests is $5.0 \times 10^7 \text{ t} \cdot \text{yr}^{-1}$ and $1.2 \times 10^8 \text{ t} \cdot \text{yr}^{-1}$ respectively. According to the established ecological area, it can be estimated that the amount of fixed carbon dioxide is $4.44 \times 10^4 \text{ t}$, and the oxygen content released is $1.07 \times 10^5 \text{ t}$. According to the simplified formula, the economic value generated by carbon fixation and oxygen release is $1.21 \times 10^7 \text{ yuan}$, and the economic value brought by oxygen release is $3.94 \times 10^7 \text{ yuan}$.

3) Circulation and storage of nutrients

According to the obtained data^[9], the total content of nitrogen, phosphorus and potassium in the coniferous and broadleaved mixed forest in China's temperate zone is $3.2 \times 10^6 \text{ t}$. According to the area of the established ecological zone, it can be estimated that the fixed nutrient content in the ecological zone is $2.84 \times 10^3 \text{ t}$, and the economic value calculated according to the formula is $7.24 \times 10^6 \text{ yuan}$.

4) The purification of the SO2

The absorption capacity of SO₂ in broadleaf forest was $88.65 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$, and that in coniferous forest was $215.6 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$ ^[9]. We believe that coniferous trees and broadleaved trees account for 50% of the total. Consequently, we roughly estimate the absorption capacity of sulfur

dioxide in this forest belt is $152.125 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$. Therefore, according to the area established in the ecological zone, we can obtain that the SO_2 content absorbed by this ecological region is $1.83 \times 10^5 \text{ t}$. According to the formula, the indirect economic value can be calculated as $1.10 \times 10^8 \text{ yuan}$.

5) Dust detentions

According to the data^[9], the dust retention capacity of Chinese broadleaved forest is $10.1 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$, and that of coniferous forest is $33.2 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$, so we can estimate the dust retention capacity of coniferous and broadleaved hybrid forest is $21.65 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{yr}^{-1}$, and the dust retention capacity of ecological area is $2.60 \times 10^4 \text{ t}$. According to the formula, the indirect economic value can be calculated as $4.42 \times 10^6 \text{ yuan}$.

6) Soil and water conservation

According to the study^[9], the realistic erosion modulus of soil in temperate coniferous and broadleaved mixed forest is $285 \text{ t} \cdot \text{km}^{-2} \cdot \text{yr}^{-1}$; The potential soil erosion modulus was estimated according to the "intensity level" of the national soil erosion classification level corresponding to the upper limit of water and wind erosion modulus $8000 \text{ t} \cdot \text{km}^{-2} \cdot \text{yr}^{-1}$. According to the formula, the calculation of soil and water conservation amount should be the difference between the potential erosion amount and the actual erosion amount. The amount of soil and water conservation is $9.26 \times 10^4 \text{ t}$ after the establishment of ecological zone.

The soil type of Ningxia region is mostly dark brown soil whose density is $0.84 \text{ t} \cdot \text{m}^{-3}$, and the thickness is 0.5124 m , so the area of soil and water conservation is 21.5094234 hm^2 .

The annual income of China's forestry is $282.2 \text{ yuan} \cdot \text{yr}^{-1} \cdot \text{hm}^{-2}$, and the economic value brought by soil and water conservation is estimated as 6069.95 yuan .

Soil is maintained by the establishment of ecological zones, and nutrients in soil are also fixed accordingly. According to the formula, we can estimate the economic benefits brought by reducing nutrient loss as $1.26 \times 10^5 \text{ yuan}$.

7) conclusion

According to the formula, the indirect economic value of sediment reduction is $1.77 \times 10^4 \text{ yuan}$.

In conclusion, the establishment of an 12 km^2 ecological zone in Ningxia has significant effects on soil and water conservation, soil nutrient consolidation, purification of surrounding air, reduction of SO_2 density in the air, and reduction of net carbon emissions in Ningxia province, which further advances the goal of carbon neutrality in China. Meanwhile, through our evaluation model, the establishment of this ecological zone is expected to increase the total annual economic value of $1.73 \times 10^8 \text{ yuan}$.

4. Conclusion

In this paper, conducted a comparative analysis of the environmental conditions before and after restoration of the Saihanba Forestry Reserve through quantitative analysis methods to evaluate the impact of Saihanba on the ecological environment; quantitative evaluation through the selection of evaluation indicators and data collection to study the impact of Saihanba on the resistance to dust storms in Beijing; collection of relevant data from different parts of China to determine the location, number or scale of ecological reserves to be established in China and to evaluate the establishment of these ecological reserves The impact of establishing these ecological reserves on China's carbon neutrality target was evaluated. Through the selection of evaluation indicators and data collection, a quantitative evaluation was conducted to study the impact of the Saihanba on the resistance to dust storms in Beijing, based on which it was argued that as the greening of the Saihanba expands, there

is an important correlation with the reduction of the frequency and extent of dust storms in Beijing. Finally, relevant data were collected from different parts of China to determine the location, number or size of ecological reserves to be established in China. A desolate area in Ningxia, which could yield the highest potential value after greening, was selected according to the environmental quality assessment model, and the impact of establishing this ecological reserve on China's carbon neutrality target was evaluated.

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