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Saihanba--Ecological Protection Construction and Its Impact Evaluation on the Environment

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Abstract: *Due to historical overload, grazing and fire, the ecological environment deteriorated into a desert. In order to bring Saihanba to life, after the unremitting efforts of generations, Saihanba became a green barrier across the southern edge of the Inner Mongolia Plateau, preventing the Hun Shanak Desert from moving south and maintaining sand source for the capital, maintaining water and soil and water conservation. In this paper, according to a large number of data statistics, some references and the actual investigation of Saihanba, the structural evaluation model of Saihanba in resisting wind and sand resistance, protecting the environment and maintaining ecological balance and stability was selected.*

Keywords: *Saihanba--Ecological; Environmental protection; Evaluation model*

1. Introduction

Due to historical overload, grazing and fire, the ecological environment deteriorated into a desert. In order to bring Saihanba to life, after the unremitting efforts of generations, Saihanba became a green barrier across the southern edge of the Inner Mongolia Plateau, preventing the Hun Shanak Desert from moving south and maintaining sand source for the capital, maintaining water and soil and water conservation.

Saihanba plays an important role in resisting wind and sand, protecting environment, maintaining ecological balance and stability, etc. In this paper,we select appropriate indicators, collect relevant data, and build the evaluation model for the impact of Saihanba on the ecological environment, in order to quantitatively evaluate the impact on the environment after the restoration of Saihanba; that is, to comparatively analyze the environmental conditions before and after the Saihanba restoration.

2. Model establishment and solution

According to a large number of data statistics, some references and the actual investigation of Saihanba, the structural evaluation model of Saihanba in resisting wind and sand resistance, protecting the environment and maintaining ecological balance and stability was selected.

The role of Saihanba in protecting the environment is mainly reflected in improving the air quality in the surrounding cities. According to the survey data, the Saihanba Forest Farm has played an important role in improving the air quality in Beijing. According to the specific characteristics of Saihanba and the current evaluation means, the value of forest services like releasing oxygen, producing negative ions, releasing terpenoids and reducing air pollutants is evaluated.

2.1. Environmental impact assessment model

The direct effect of Saihanba forest is reflected in wind resistance and sand resistance. Its value evaluation is divided into direct value and indirect value. Direct value evaluation mainly includes the following aspects: the protection evaluation of windproof and sand fixation on agricultural products. According to the calculation of several forest ecological benefits of forestry ecological projects by relevant Chinese experts, each hectare of forest can reduce the desert propulsion area by 0.1075 hectares per year, and can prevent farmland within 1.27 hectares from being affected. The average income of local crops is 8,700.0 yuan / ha. Saihanba Mechanical Forest Farm has a woodland area of A ha. Saihanba Machinery Forest Farm reduced the desert advance by 0.1075A hectares, to prevent 1.27A hectares of surrounding farmland disaster. Indirect

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value is difficult to directly produce a direct value of about 1.27A×8700 million yuan to estimate money. According to the ratio of direct value and indirect value of 1:4.5, its total value B in wind and sand resistance is about 5.5×1.27×8700 yuan.

$$B = 5.5 \times 1.27A \times 8700 \quad (1)$$

The value of the oxygen released is evaluated by the alternative engineering method. The amount of the released oxygen calculates the total forest biomass increment according to the tree accumulation and growth volume and the average wood density, and then the annual oxygen released by the trees is calculated according to the photosynthesis formula. According to the photosynthesis equation, by releasing 2.67t of oxygen per 1t of fixed carbon, the oxygen price is 1,000 yuan / t. Assuming that Saihanba has fixed carbon C tons per year, the value of oxygen is $D = 2.67C \times 1000$ yuan per year.

The value of forest producing negative ions is evaluated by alternative engineering method based on the amount of negative ions produced by the forest. The measured results show that the Saihanba Mechanical Forest Farm produces 1.151,024 negative ions every year. The value of releasing terpenoids was assessed by the alternative engineering method based on the concentration value of terpenoids in the forest air in Saihanba Mechanical Forest Farm. Assuming that the terpenoids released from the forest of Saihanba

Mechanical Forest Farm is Et, the actual value of the terpenes is calculated that the material based on the market conditions is 2 yuan / kg, yielding an income of $F = 2E$

Reducing the value of air pollutants mainly includes reducing the service value of sulfur dioxide, nitrogen oxide and dust arrest, first calculate the annual amount of sulfur dioxide, nitrogen oxide and dust arrest, and then take the average treatment cost of these pollutants as an alternative price to calculate the cost of forest reducing air pollutants.According to the average value of relevant indicators in Hebei Province in the China Forest Accounting Research under the Framework of Green National Economy, Saihanba Mechanical Forest Farm absorbs 13,365.85 annually, nitrogen oxide 1195.05t and dust arrest 156389.65t.

The 2014 emission charge standard is 2.4 yuan / kg, and the dust arrest cost is 2.3 yuan / kg.

$$J = 2.4 \times (G + H) + 2.3I \quad (2)$$

The total income K created by Saihanba Forest in protecting the environment is:

$$K = D + F + J = 2.67C \times 1000 + 2E + 2.4 \times (G + H) + 2.3I \quad (3)$$

The evaluation of the value of forest maintenance biodiversity is the shannon-Wiener index method.The index reflects species richness, using the empirical data of practical surveys to maintain biodiversity value in ecosystems of different richness levels, and then calculates the index results.The calculation formula is:

$$U_1 = \sum S \times A_i \quad (4)$$

Evaluation model of Saihanba:

$$G = B + K + U \quad (5)$$

Table 1: Shshown by survey data

Symbol	Number	Unit
A	74690.85	t
C	101284.854	t
E	104748300	t
G	13365.85	t
H	1195.05	t
I	156389.65	t

G = 5.393 billion was calculated

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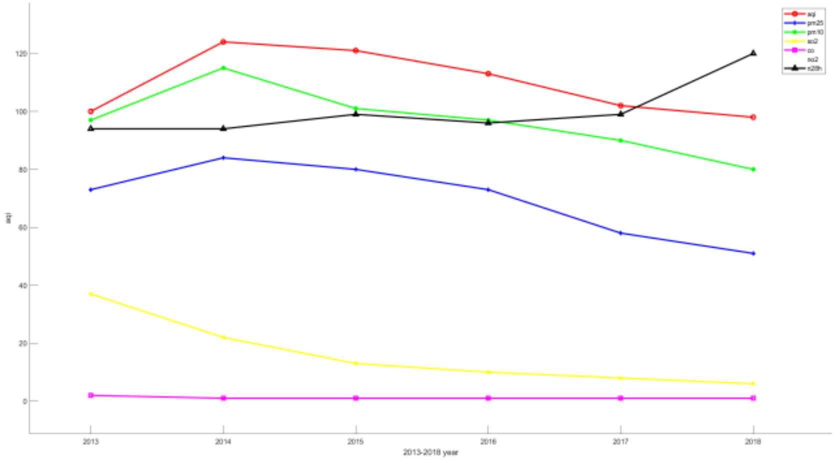

Figure 1: 2014-2018 Beijing Air Quality

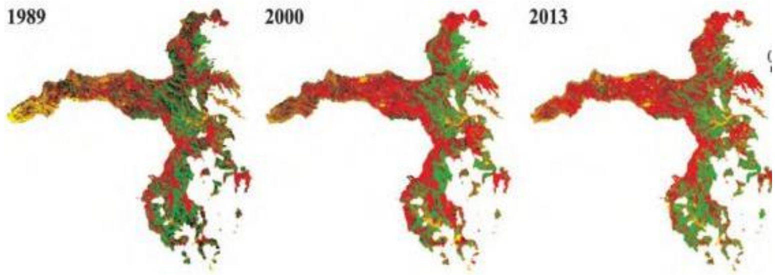

Figure 2: Saihanba Nature Reserve in 1989,2000 and 2013

2.2. Comparative environmental impact analysis

In the figure, in 1989, grassland, artificial forest and natural secondary forests, were the main vegetation types between 1989 and 2013.Overall, shrubs and plantations changed the fastest rate during the study period.

Between 1989 and 2013, grassland, artificial and natural secondary forests were the primary vegetation types, with a small proportion (Table 2) showed the area of grassland, shrub and natural secondary forests, with dynamic values of-0.4%, -2.9%, respectively -0.1%, of which, grassland and natural secondary forests were found in 2000 – 2013.The area increased by 20.20 and 27.83 km2, respectively, and the dynamic value was 2.5%; Overall, the shrub forest and plantations changed the fastest rate. From the comprehensive dynamic attitude, the study area was 0. 7% between 1989 and 2013, which indicates the slow rate of vegetation cover during the period.

Table 2: Area of the different vegetation types in the study area from 1989 to 2013

Type	1989		2000		2013		Single dynamic degree (%)			Comprehensive dynamic degree (%)		
	Area (km²)	Percentage	Area (km²)	Percentage	Area (km²)	Percentage	1989—2000	2000—2013	1989—2013	1989—2000	2000—2013	1989—2013
GD	294.79	30.8	246.90	27.5	267.10	26.9	-1.6	0.6	-0.4			
SD	174.11	18.2	109.60	12.6	54.24	6.1	-3.7	-3.6	-2.9			
AF	189.27	18.8	250.70	28.9	302.80	34.2	3.3	1.5	2.5	1.1	0.6	0.7
SF	298.87	31.2	260.64	30.0	288.47	30.5	-1.3	0.8	-0.1			
OT	38.73	4.1	22.93	2.4	33.62	3.5	-4.1	3.3	-0.6			

GD: Grassland; SD: Shrub forest; AF: Plantation; SF: Natural secondary forest; OT: Others The same below

As can be seen from Table 3, from 1989 to 2000, vegetation type area changes had 2 obvious characteristics: shrub forest was mainly transformed into grassland (37.11 km2) and natural secondary forest (34.99 km2), and mainly from natural secondary forest (65.01 km2) and shrub forest (29.68 km2), and shrub forest and plantations from 2000 to 2013

From 1989 to 2000, natural secondary forest and grassland began to transfer, mainly from shrub forest (21.34 km2) and plantation (37.27 km2). Notably, bare land occupied a large proportion of other types, and the conversion object was mainly grassland, from 1989 to 2000 and from 2000 to 2013.

Table 3: Change matrix of all vegetation types in study area from 1989 to 2013 (km2)

Period	Type	GD	SD	AF	SF	OT
1989—2000	GD	186.68	19.90	14.89	19.87	22.69
	SD	37.11	49.50	29.68	34.99	0.81
	AF	12.26	9.58	141.36	22.92	0.38
	SF	19.13	22.51	65.01	191.97	0.10
	OT	7.52	0.21	0.39	0.07	14.59
2000—2013	GD	167.45	25.60	41.39	20.55	8.52
	SD	22.58	13.06	39.39	21.34	1.67
	AF	37.27	6.60	168.94	19.68	4.87
	SF	14.34	0.98	40.55	207.12	0.59
	OT	27.78	0.36	0.70	0.31	13.51

HL indicators for grassland from 1989 – 2000 and 2000 – 2013 14.63 and 4.13, respectively, corresponding P-values of 0.83 and 0.29, respectively, both greater than 0.05, indicating good model fitting (Table 4). According to Wald statistics and significance level (P <0.05), between 1989 and 2000, respectively, the main explanatory variables were negatively correlated to the distance from the road, the closer the more likely the area was to turn to other vegetation types. Between 2000 and 2013, important explanatory variables were slope cosine, elevation, distance from road, and afforestation area, in which grassland changes were positively associated with slope cosine, indicating that other vegetation types were more likely to turn to grassland in Yin slope direction. Overall, the effect of anthropogenic activity on grassland changes was more significant, but decreased in importance.

Table 4: Parameters of logistic regression model for grassland change

Perid	Independent variable	β	SE	Wald χ^2	Significane	expβ
1989—2000	Distance to water	0.15	0.78	3.64	0.06	1.12
(HL=14.63 P=0.83)	Distance to roads	−0.25	0.08	8.91	0.00	0.78
	Constant	−2.39	0.97	87.75	0.00	0.09
2000—2013	Cos(aspect)	0.76	0.14	29.34	0.00	2.14
(HL=4.13 P=0.29)	Distance to roads	−0.11	0.06	7.99	0.05	0.83
	Elevation	0.52	0.14	12.78	0.00	1.59
	Afforestation area	−0.14	0.77	4.55	0.03	0.84
	Constant	−1.51	0.05	67.72	0.00	0.21

HL in scrub bush 1989-2000 and 2000-2013 3.38 and 6.36, respectively, corresponding to P values of 0.91 and 0.61, respectively, and the fitting effect was good (Table 5). From Wald statistics and significance level (P <0.05), between 1989, the important explanatory variables were total afforestation investment, distance from water, slope and elevation in 2000, and the regression coefficient of total investment in afforestation was 0.25, which showed a positive correlation with shrub forest changes, indicating that intensified local afforestation activities caused some damage. From 2000 to 2013, the important explanatory variables were distance from the water area, worker wages and road distance, indicating that the impact of anthropogenic activity began to weaken, and natural factors such as distance from the water area began to become important influencing factors of shrub forest changes.

Table 5: Parameters of logistic regression model for shrub change

Period	Independent variable	β	SE	Wald χ^2	Significance	expβ
1989—2000	Slope	0.12	0.05	5.47	0.03	1.12
(HL = 3.38,	Distance to water	0.13	0.06	7.09	0.01	1.14
P = 0.91)	Elevation	−0.28	0.12	4.27	0.02	0.76
	Total inves-tment of afforestation	0.25	0.09	7.46	0.01	1.29
	Constant	−1.29	0.56	41.01	0.00	0.28
2000—2013	Distance to water	0.13	0.07	5.66	0.01	1.18
(HL = 6.36,	Distance to roads	−0.17	0.07	5.30	0.02	0.84
P = 0.61)	Employees salary	−0.24	0.10	5.47	0.01	0.78
	Constant	−2.03	0.72	98.46	0.00	0.13

1989-2000 and 2000-2013, HL in the study area was 8.94 and 6.10, respectively, the corresponding P-values were 0.35 and 0.60, respectively, the fit was ideal. From the Wald statistic significance level (P <0. 05), Between 1989-2000, Important explanatory variables are the number of workers, total investment in afforestation, slope cosine, and elevation, among, the statistical number of workers is 43.86, Clearly higher than that observed for the other explanatory variables, it shows that human activity during this period was crucial to the growth of plantation. From 2000 to 2013, Important explanatory variables are elevation and worker wages, it indicates that natural factors began to dominate during the period, and work with artificial activities to promote the growth of plantations (Table 6).

Table 6: Correlation coefficients of logistic regression model of plantation change

Period	Independent variable	β	SE	Wald X^2	Significance	expβ
1989—2000 (HL = 8.94, P = 0.35)	Total investment of afforestation	0.32	0.07	21.38	0.00	1.38
	Distance to roads	-0.25	0.08	8.98	0.02	0.77
	Elevation	0.23	0.08	7.94	0.01	1.26
	Elevation	0.34	0.10	11.27	0.001 41	
	Number of employee	0.37	0.05	43.86	0.00	1.45
	Constant	-0.27	0.46	36.25	0.00	0.75
2000—2013 (HL = 6.10, P = 0.60)	Employee salary	0.42	0.17	5.85	0.00	1.53
	Elevation	0.32	0.09	12.18	0.00	1.39
	Constant	-0.88	0.05	36.18	0.00	0.41

The HL was 15.11 and 10.28,2000 and 2013,2013 with corresponding P values of 0.06 and 0.95, respectively. The Wald statistics and significance level (P <0.05) showed significant explanatory variables between 1989-2000, slope sinusoidal, and the number of the workers. From 2000 to 2013, important explanatory variables were slope sinine and road distance, where a positive correlation with the slope sinine showed that natural secondary forests began to increase in the Yang slope during this period (Table 7).

Table 7: Parameters of logistic regression model for the natural secondary forest

Period	Independent variable	β	SE	Wald X^2	Significance	expβ
1989—2000 (HL = 15.11P = 0.06)	Number of employee	0.23	0.07	10.67	0.00	1.26
	Distance to roads	-0.50	0.09	25.94	0.00	0.65
	Sin(aspect)	-0.30	0.08	14.00	0.00	0.73
	Constant	0.54	0.11	11.52	0.00	1.72
2000—2013 (HL = 7.28P = 0.95)	Distance to roads	0.14	0.08	3.24	0.07	1.15
	Sin(aspect)	0.16	0.08	3.65	0.05	1.84
	Constant	-2.40	0.08	89.41	0.00	0.09

As can be seen from Table 1, from 1989 to 2000, vegetation type area changes had 2 obvious characteristics: shrub forest was mainly converted into grassland (37.11 km2) and natural secondary forest (34.99 km2), mainly from natural secondary forest (65.01 km2) and shrub forest (29.68 km2), and shrub forest and plantations from 2000 to 2013 From 1989 to 2000, natural secondary forest and grassland began to transfer, mainly from shrub forest (21.34 km2) and plantation (37.27 km2). Notably, bare land occupied a large proportion of other types, and the conversion object was mainly grassland, from 1989 to 2000 and from 2000 to 2013.

3. Conclusion

The innovation point of this paper is to use various indicators and determine their weights, and establish the evaluation model through the correlation analysis and the principal component analysis, so as to obtain an intuitive data, which has a good guiding significance for the screening and evaluation ecosystem, and the need to establish an ecological nature reserve. At the same time, to improve the economy of China and even the global economy, natural, the level of ecological development is easy to calculate, has the promotion value of practical application.

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Collection Effect of Fully Covered Rare Earth Mine Roadway ((S202013434018)); Calculation of Critical Liquid Injection Strength for In-situ Leaching of Bare-foot Ionic Rare Earth Mine (S202113434018)).

References

[1] Wang Winter Solstice, Zhang Dongyan, Jiang Fengling, Bai Ye, Zhang Zhidong, Huang Xuanrui. Saihanba North China larch Forest Status Index model [J]. Journal of Applied Ecology, 2015, 26(11): 3413-3420.

[2] Wei Shikai, Fan Shunxiang, Zhang Yuzhen, Huang Xuanrui, Zhang Zhidong. Main vegetation type dynamics and its driving force of Saihanba Nature Reserve [J]. Journal of Applied Ecology, 2018, 29(04): 1170-1178.

[3] Qin PengYao, Yang Huijuan, Jiang Fengling, Zhang Shubin, Tian Xiaomin, Huang Xuanrui, Zhang Zhidong. Quantitative Classification of natural Plant Communities in Saihanba Protection Reserve, Hebei Province [J]. Journal of Applied Ecology, 2016, 27(05): 1383-1392.

[4] Wu Qiang, Chu Cong Ying, Song Wei, Zhang Peng, Gao Chao, Gu Jiancai, Lu Guiqiao. Soil Nutrient Study of camphor thpine plantation in Saihanba [J]. Forestry Resource Management, 2016(01): 90-98.

[5] Yuan Ye, Sun Guolong, Yuan Meiyan, and Zhang Zhidong. Elevation distribution pattern of plant species richness in Saihanba [J]. Journal of Anhui Agricultural University, 2017, 44(03): 496-501.

[6] Fu Lihua, Yu itao, Cheng Shun, Xu Zhongqi, Li Yumin. Forest ecosystem Service Value Evaluation of Saihanba Mechanical Forest Farm, Hebei Province [J]. Forestry and Ecological Sciences, 2019, 34(04): 386-392.