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Research on the evaluation model of the ecological impact of the Saihanba based on multiple regression

Bingshu Li[1], Shuyuan Zhang[1,*], Shixu Wang[1], Ning Li[1], Luocheng Wang[2]

[1]*Shandong University of Science and Technology, Tai ' an, Shandong, 271000, China*

[2]*Shandong First Medical University (Shandong Academy of Medical Sciences), Tai'an, Shandong, 271016, China*

*Corresponding author

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Abstract: To establish an evaluation model of Saihanba's impact on the ecological environment, this paper establishes a multiple regression model of the ecological environment index and Saihanba index and normalizes the coefficient items in the model to confirm the weight coefficient. Finally, an evaluation model of Saihanba's impact on the ecological environment was established, and the impact of Saihanba's restoration on the environment was quantitatively evaluated.

1. Introduction

Saihanba plays an important role in resisting wind and sand, protecting the environment, maintaining ecological balance and stability, etc. We selected appropriate indicators, collected relevant data, and built the evaluation model for the impact of Saihanba on the ecological environment, 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

2.1 Model establishment

To establish an evaluation model of Saihanba's impact on the ecological environment, this paper considers quantified ecological environmental indicators, taking the number of days when air quality is extremely good than Class II as an important indicator of the ecological environment. Other indicators include forestry land area, forest area, forest coverage, etc.

To express the relationship between the Saihanba index and the ecological environment, a multiple regression model is established as follows.

$$Y_{AIR} = \alpha_0 + \alpha_1 X_{FLA} + \alpha_2 X_{FC} + \alpha_3 X_{POFC} + \varepsilon \quad (1)$$

Among them, Y_{AIR} represents the ecological environment index, the specific data is the number of days when the air quality reaches the level of excellence. X_{FLA}, X_{FC}, X_{POFC} is the Saihanba index, and the specific data is forestry land area, forest area, and forest coverage. α is a constant coefficient. ε is

a random error term.

In this regard, by establishing a multiple regression model of ecological environment indicators and Saihanba indicators, the relationship between the ecological environment and Saihanba can be expressed.

To specifically use Saihanba to evaluate the ecological environment, the multiple regression model established by the ecological environment and Saihanba index is used to normalize each data item involved in the Saihanba index, and the mathematical model is established as follows. Among them, λ_{FLA}, λ_{FC}, λ_{POFC} represents the normalized results of forestry land area, forest area, and forest coverage.

$$\lambda_{FLA} = \frac{|\alpha_1|}{|\alpha_1| + |\alpha_2| + |\alpha_3|}$$

$$\lambda_{FC} = \frac{|\alpha_2|}{|\alpha_1| + |\alpha_2| + |\alpha_3|}$$

$$\lambda_{POFC} = \frac{|\alpha_3|}{|\alpha_1| + |\alpha_2| + |\alpha_3|}$$

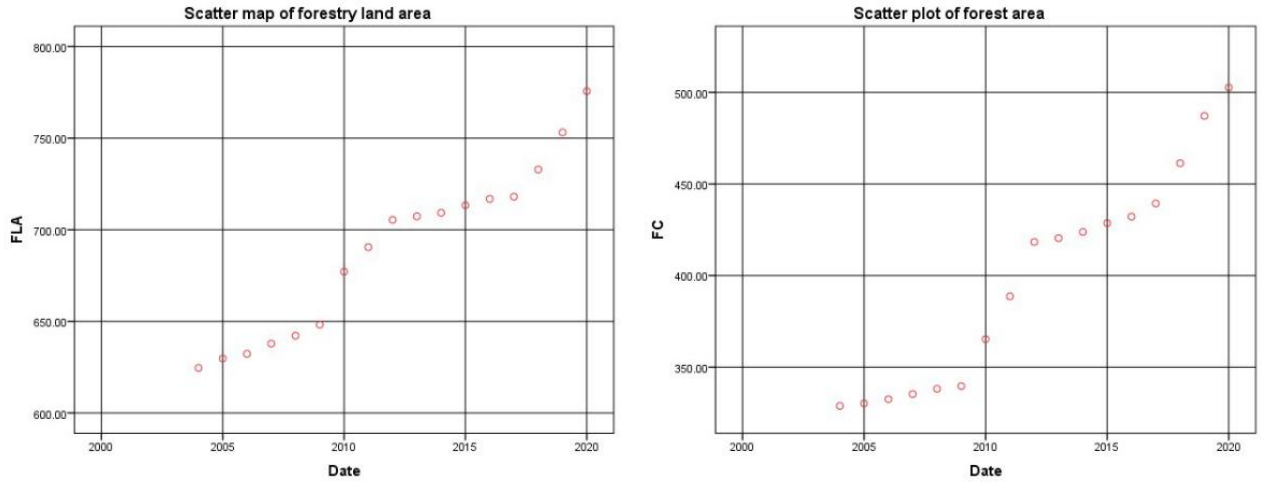
The established multiple regression model can only express the relationship between the ecological environment index and the Saihanba index. In this regard, consider optimizing the model, using λ_{FLA}, λ_{FC}, λ_{POFC} as the weight coefficient to establish an evaluation model of Saihanba's impact on the ecological environment. Z_{EM} is the evaluation index of the ecological environment.

$$Z_{EM} = \lambda_{FLA}X_{FLA} + \lambda_{FC}X_{FC} + \lambda_{POFC}X_{POFC} \quad (2)$$

Using the ecological environment index and the specific data of the Saihanba index, the specific evaluation index of Saihanba's ecological environment from 2004 to 2020 can be obtained. The environmental conditions before and after the restoration of Saihan Dam can be compared and analyzed.

2.2 Model solution

We drew scatter plots of Saihanba indicators (i.e., forestry land area, forest area, forest coverage rate) and ecological environment indicators (i.e., the number of days when air quality reaches the second level) from 2004 to 2020 in Figure 1.



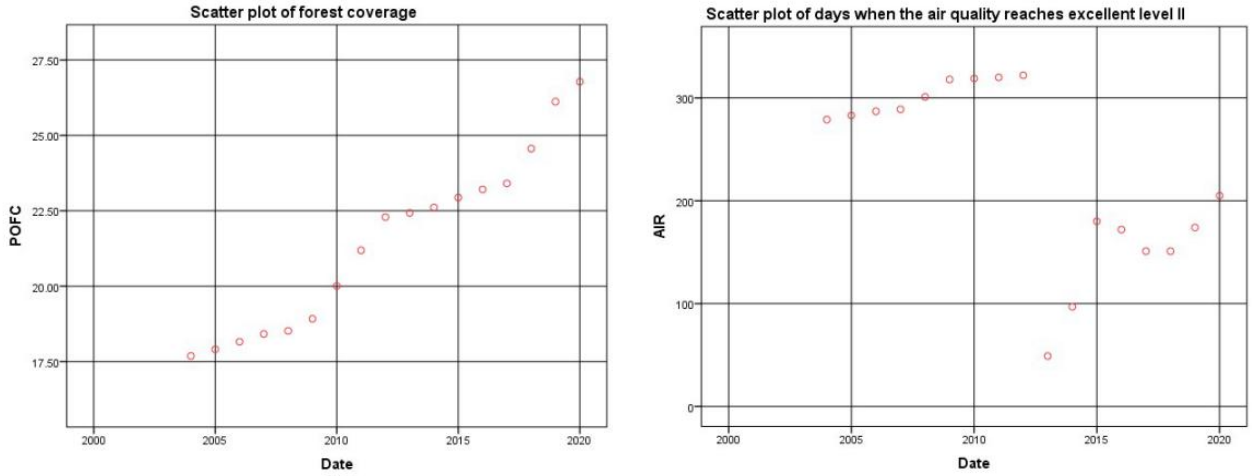


Figure 1: The Saihanba indicators

It can be seen from Figure 1 that the forestry land area, forest area, and forest coverage in the Saihanba index show an upward trend with the change of the year, while the ecological environment index has a clear layered structure with the change of the year.

Furthermore, we drew the correlation coefficient matrix diagram in Figure 2.

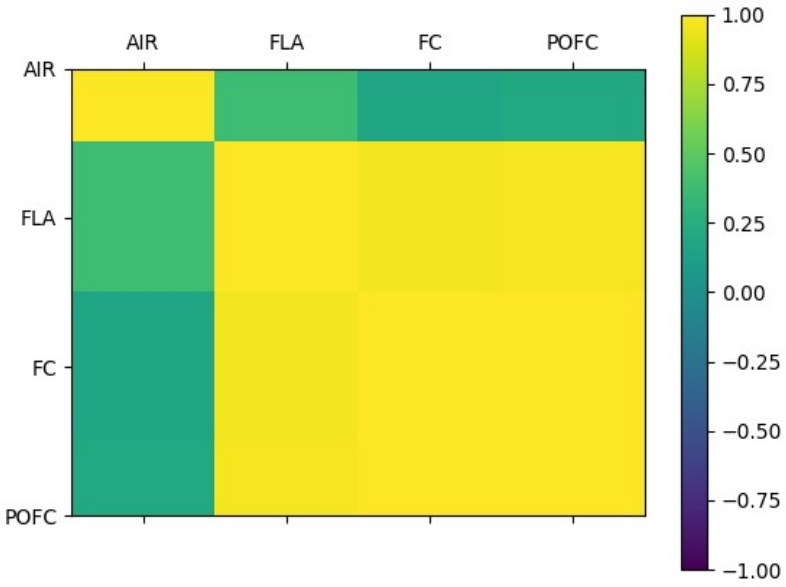


Figure 2: The correlation coefficient matrix

It can be seen from Figure 2 that there is a clear correlation between the Saihanba index and the ecological environment index. In this regard, the changes in Saihanba will have a certain impact on the ecological environment.

After solving, the relationship between the ecological environment index and the Saihanba index is obtained. The Coefficient of determination (R^2) equals 0.84.

$$Y_{AIR} = -179.57 + 1.5676X_{FLA} - 8.9932X_{FC} + 135.5341X_{POFC} \quad (3)$$

The model checking results are listed in Table 1.

Table 1: The model checking results

Model	Unstandardized coefficient		Standardization factor	t	Significance
	B	Standard error	Beta		
(constant)	-179.573	1198.42		-0.15	0.883
FLA	1.568	3.451	0.832	0.454	0.657
FC	-8.993	4.717	-5.992	-1.906	0.079
POFC	135.534	116.16	4.527	1.167	0.264

It can be seen from Table 1 that the test items of the model meet the requirements. The t-test value is positive, which is more reasonable. The significance value is small, indicating that the model is more reasonable. Through the multiple regression expression of the ecological environment and Saihanba index, the influence of Saihanba on the ecological environment can be clearly expressed.

After normalization, the calculated weight coefficients are: λ_{FLA}=0.01073274, λ_{FC} =0.061556, λ_{POFC}=0.927711. Therefore, Saihanba's ecological environment evaluation model is:

$$Z_{EM} = 0.01073274X_{FLA} + 0.061556X_{FC} + 0.927711X_{POFC} \quad (4)$$

Furthermore, the evaluation indicators from 2004 to 2020 are quantified and shown in Table 2.

Table 2: The evaluation indicators from 2004 to 2020

Year	Evaluation indicator
2004	43.35578215
2005	43.70020657
2006	44.10415915
2007	44.57463877
2008	44.88870157
2009	45.41662334
2010	48.31846793
2011	50.99431704
2012	53.99993019
2013	54.27898957
2014	54.67485817
2015	55.32406153
2016	55.82723184
2017	56.46805452
2018	59.04912136
2019	62.30092261
2020	64.11240189

It can be seen from Table 2 that from 2004 to 2020, Saihanba's assessment indicators for the ecological environment are rising, indicating that the establishment of Saihanba will help improve the ecological environment, maintain ecological balance, and make the environment more and more beautiful.

3. Conclusion

It is concluded that before the restoration of Saihanba, the ecological environment is relatively unbalanced, and after the gradual restoration, the ecological environment becomes better and better;

the restoration of Saihanba helps to improve the ecological environment and keep the ecological environment in balance and stability.

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