

# Construction of Ecological Environment System based on Comprehensive Evaluation Model

Shaokang Zhang, Haoran Bai, Zhizhen Fu

School of Science, North China University of Technology, Tangshan 063210, China

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## Abstract

The ecological protection red line is determined based on the niche suitability score, and six indicators of forest coverage, monthly precipitation, PM2.5 concentration, CO2 emissions, topographic undulation and water supply in each province are selected to construct ecological protection The red line evaluation index system measures the niche suitability of the ecological protection red line. The weight of the six indicators is determined by the analytic hierarchy process. Then the niche suitability score calculation formula is used to calculate the comprehensive score of the niche suitability of each province in the country , And use the Echart module to make a score distribution map. According to the relevant data, select the three-digit ecological protection red line, and compare the nine cities of Tianjin, Shanxi, Jiangsu, Shandong, Henan, Yunnan, Gansu, Qinghai, Ningxia Hui Autonomous Region, and Xinjiang Uygur Autonomous Region below 3 points. Ecological protection zones have been established in three provinces. According to calculations, an increase in the area of broad-leaved forest by 100 km<sup>2</sup> can reduce annual CO<sub>2</sub> emissions by 10,000 tons and release 7,300 tons of O<sub>2</sub>. This shows that the establishment of ecological reserves has a positive effect on carbon neutrality.

## Keywords

Echart Module, Analytic Hierarchy Process, Ecological Protection Red Line.

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## 1. Introduction

The red line of ecological protection is an important institutional innovation of China's environmental protection and the bottom line of ecological environmental safety. The ecological protection red line refers to the need to implement strict protection of space boundaries and management limits in terms of natural ecological service functions, environmental quality and safety, and natural resource utilization, in order to maintain national and regional ecological security and sustainable economic and social development, and protect the people healthy. Specifically, the ecological protection red line can be divided into ecological function guarantee baseline, environmental quality and safety bottom line, and natural resource utilization online.

## 2. Model Establishment

### 2.1 Data Preprocessing

By establishing the six indicators that affect the construction of the ecological region, and collecting data on these indicators in the provinces of the country, the precipitation we collected in the provinces of the country is the daily statistics from 2000 to 2018, so we adopt the same data processing method to reduce The data is compressed to get the average precipitation of each province. In order to ensure the uniformity of the data format, we process the ranking of provinces in the data to ensure that the order is consistent, and provide data support for the establishment of a score model for the ecological environment of all provinces across the country.

## 2.2 Connotation Definition of Suitability and Construction of Evaluation Model

In accordance with the scientific, representative and operability principles of the indicator system construction, Refer to the evaluation framework selection indicators in the "Guidelines for Delineation of Ecological Protection Red Lines" issued by the Ministry of Environmental Protection and the National Development and Reform Commission in 2017. Finally, six indicators of forest coverage, topographic undulation, monthly precipitation, water supply in various provinces, PM2.5 concentration and CO2 emissions are selected to build an ecological protection red line evaluation index system. According to the situation of various provinces in China, it is judged whether it is necessary to establish a protected area.

Quantitative measurement of the niche suitability of the ecological protection red line [1]. According to the different nature of the factors, the indicators are divided into three categories:

The first category is a positive influence factor. On the basis of meeting the minimum ecological needs, the larger the index value, the better. The ecological suitability is:

$$F_k = \begin{cases} 0 & x_k < D_{kmin} \\ \frac{x_k}{D_{kopt}} & D_{kmin} \leq x_k < D_{kopt} \\ 1 & x_k \geq D_{kopt} \end{cases} \quad (1)$$

The second category is the moderate factor, that is, in a suitable interval, the value is too large or small will become the limiting factor, and its ecological suitability is:

$$F_k = \begin{cases} 0 & x_k \leq D_{kmin}, x_k \geq D_{kmax}, \\ \frac{x_k - D_{kmin}}{D_{kopt} - D_{kmin}} & D_{kmin} < x_k < D_{kopt} \\ \frac{D_{kmax} - x_k}{D_{kmax} - D_{kopt}} & D_{kopt} < x_k < D_{kmax} \end{cases} \quad (2)$$

The third category is negative influencing factors. For such factors, the ecological suitability is:

$$F_k = \begin{cases} 1 & x_k \leq D_{kmin} \\ 1 - \frac{x_k - D_{kmin}}{D_{kmax} - D_{kmin}} & D_{kmin} < x_k < D_{kopt} \\ 0 & x_k \geq D_{kopt} \end{cases} \quad (3)$$

Since the ecological protection red line covers indicators of multiple dimensions of the ecosystem, it is necessary to integrate the contribution of each factor to the overall suitability. In this question, the comprehensive weight method is used to determine the comprehensive ecological suitability score model as:

$$F = \sum_{k=1}^n W_k F_k \quad (4)$$

### 2.3 Definition of Ecological Protection Red Line based on Ecological Suitability Model

#### 2.3.1 Index Weight Determination[2-4]

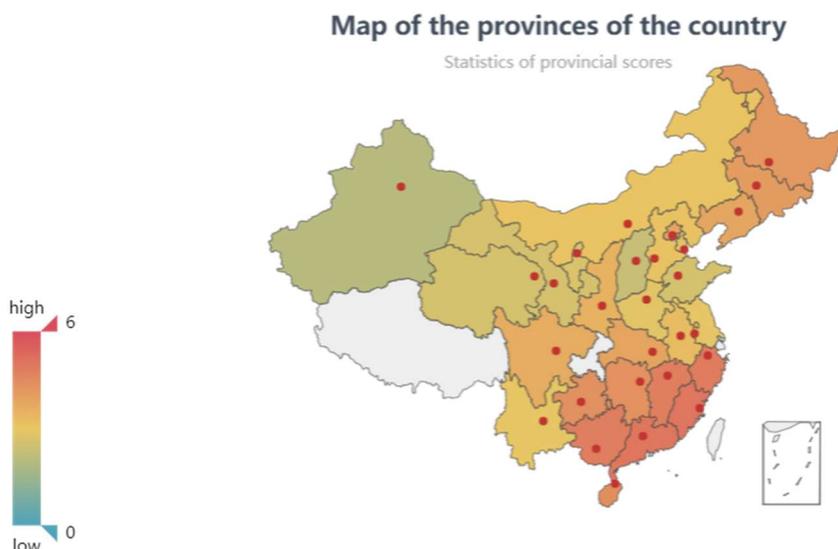
The weight of each indicator is very important for the impact of the evaluation results. In this question model, the analytic hierarchy process of subjective and objective fusion is selected to determine the weight of each influencing factor: First, establish an evaluation matrix of the index system according to the needs of the problem, and then find relevant information to determine the importance of each index in the judgment matrix for comparison and scoring; Secondly, the square root method is used to calculate the eigenvector and maximum eigenvalue of the judgment matrix; Finally, the index weight is calculated through the matrix calculation of the consistency ratio test ( $CR < 0.1$ ). As shown in the following table:

**Table 1.** Weight value table

Factor layer	Weights	Index layer	Weights	Indicator type
natural factors	0.5396	Forest cover rate	0.36	Class 1
		Terrain relief	0.18	Class 2
Importance of water supply	0.1634	Monthly precipitation	0.11	Class 2
		Water supply in each province	0.05	Class 1
Eco-environmental irritation	0.2970	PM2.5 concentration	0.15	Class 3
		CO <sub>2</sub> emissions	0.15	Class 3

#### 2.3.2 Delineation of Ecological Protection Red Line based on Niche Suitability Score

First, use the niche suitability model to calculate the single-factor niche suitability score, and then calculate the comprehensive niche suitability scores of all provinces across the country based on the score calculation formula, According to the research of Deng et al. [5], Included in the ecological protection red line below 3 points. The scores of provinces across the country are shown in the figure below :



**Figure 1.** Province score map

### 2.4 Impact on Carbon Neutrality Goals

According to relevant information, 1 km<sup>2</sup> broad-leaved forest can absorb 100 tons of CO<sub>2</sub> and release 73 tons of O<sub>2</sub>. Xinjiang's CO<sub>2</sub> emissions in 2018 were 493.667 million tons, It is assumed that the area of broad-leaved forest in Xinjiang will increase by 100 km<sup>2</sup> after treatment, Therefore, Xinjiang's annual CO<sub>2</sub> emissions can be reduced by 10,000 tons and O<sub>2</sub> released by 7,300 tons. This shows that the establishment of ecological protection zones has a positive effect on the carbon neutrality of Xinjiang and even the whole country.

### 3. Conclusion

Through the calculation of the ecological suitability scores of provinces across the country, the distribution map of the ecological suitability of each province is obtained. Select provinces with a score of 3 or less to establish nature reserves. The specific provinces are:

**Table 2.** Select ten provinces to score

Provinces	Tianjin City	Shanxi Province	Jiangsu Province	Shandong Province	Henan Province
Score	2.7955	2.3167	2.9129	2.6000	2.8473
Provinces	Yunnan Province	Gansu province	Qinghai Province	Ningxia Hui Autonomous Region	Xinjiang Uygur Autonomous Region
Score	2.9430	2.6083	2.5717	2.6825	2.0173

The Xinjiang Uygur Autonomous Region has the lowest score, and the situation to be governed is particularly urgent. At the same time, it is known through calculations that the establishment of ecological nature reserves can play a positive role in carbon neutrality.

### References

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