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Plastic pollution load Model based on Stepwise regression Analytic hierarchy process

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Abstract: *This paper focuses on plastic pollution, which is the key problem in national environmental problems. With the increasing influence of plastic pollution, in order to measure the impact of plastic pollution, reasonable intervention measures are put forward, and environmental load rate model is established. In this paper, the stepwise regression method is used to estimate the maximum pollution level that can be achieved in the world from the aspects of population density, vegetation cover, industrial level and economic level, so as to provide reference for global pollution control.*

Keywords: *Stepwise regression method, Parameters, Plastic pollution, Intervention measures*

1. Introduction

Since the 1950s, plastics have been widely used in industries such as packaging and medical supplies because of their versatility, portability and low cost. Although plastics play an important role in human life [1-4], they do great harm to the earth's environment because of their unbreakability and the toxicity of raw materials. The harm of disposable plastic waste to the ecological environment and human health has attracted extensive attention from the international community. This paper constructs a model of a country's capacity to carry plastic pollution, involving a variety of concepts and elements [5].

2. Construction of Analytic hierarchy process Model

2.1 Defining Environmental Carrying Capacity

Environmental carrying capacity is also called environmental bearing capacity or environmental endurance [6]. It refers to the limit of the environment's ability to support human social and economic activities in a certain period and in a certain environmental state. Its and dweller standard of living, economic level, industrial level think close.

2.2 Model building

The Analytic Hierarchy Process is a multi-objective decision analysis method combining quantitative and qualitative analysis [7], which quantifies the experience of decision makers, which is more practical in the case of complex structure of targets (factors) and lack of necessary data [8].

2.3 Steps

a) The establishment of hierarchical structure

Target layer: optimal,

Criteria: program influencing factors:

Scheme level: three schemes are set as follows:

b) Construct judgment matrix

In order to get a quantitative judgment matrix by pairwise comparison between factors, the scale of 1~9 is introduced.

c) Consistency test

The eigenvector, lambda Max, corresponding to the maximum eigenroot of the judgment matrix, is

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normalized to W. The so-called consistency test refers to determining the allowable range of inconsistency for A.

Test with the consistency index:

$$CR = \frac{CI}{RI} \quad CI = \frac{\lambda_{\max} - n}{n-1} \tag{1}$$

3. Metrics for Environmental carrying capacity

3.1 Demographic Indicators

(a) Population Destiny: The denser the population, the less able they are to cope with pollution, because they have to cede most of their land to national activity.

(b) Residents' Satisfaction: Residents' satisfaction is the satisfaction of the country and the environment of the community, which to some extent reflects people's living standards.

3.2 Economic Metrics

(a) Real Gross Domestic Product (GDP): It refers to the final results of production activities of all resident units in a country (or region) calculated according to the national market price within a certain period. It is the core indicator in China's economic accounting system and reflects the economic strength and market size of a country (or region). A high GDP usually means a country has plenty of money

(b) Industrial development level: The level of industry represents a country's production capacity as well as its technological level. Whether the market can be done to measure environmental products, how to deal with waste is determined by the industrial level.

4. Impact of Reaching the Lowest Level

4.1 Fitting and regression process

Here, the method of curve fitting is used for analysis.

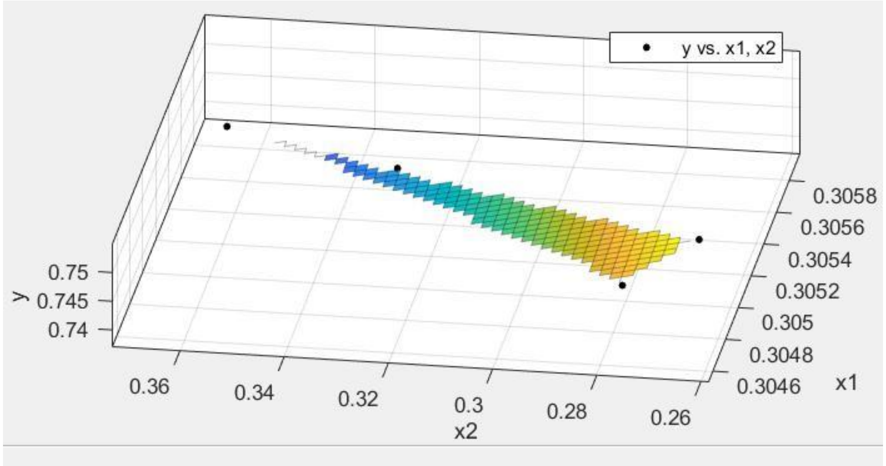

Figure 1: Curve fitting result

Step-by-step regression processing:

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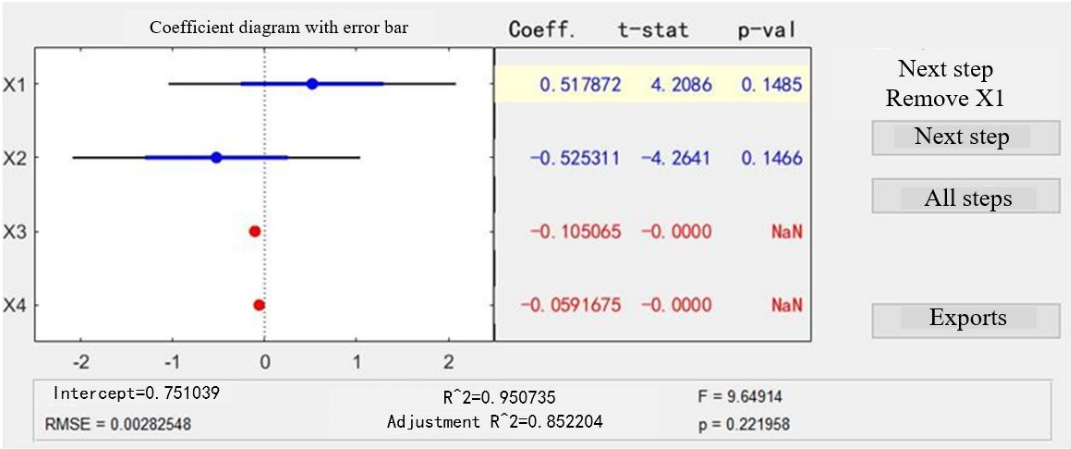

Figure 2: Stepwise regression results

4.2 Model solving

X1: area of forest

X2: industry increase

X3: population destiny

X4: GDP

Y: EPI

Y = 0.517872×X1-0.525311×X2+0.751039

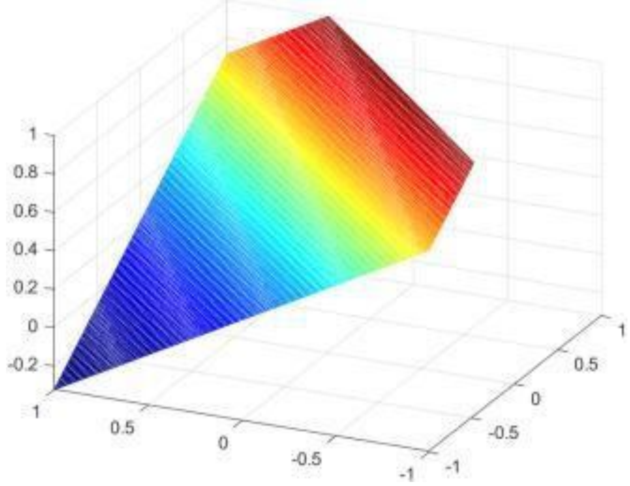

Figure 3: Multivariate result

In the construction of the above model, the effects of the population density of variable X3 and the GDP of variable X4 on the dependent variable Y environmental performance index were not significant and were removed. The relationship between the forest coverage rate of variable X1 and the industrial added value of X2 and the dependent variable was Y = 0.517872×X1-0.525311×X2+0.751039.

Through the modeling, it is obvious that in the improvement of environmental performance index, forest area has a positive effect on the environment, while industrial added value has a negative effect on the environment. Moreover, from the coefficients of the two variables, industrial added value has a slightly more significant effect on environmental performance index.

The trend of X1 and X2 is shown here:

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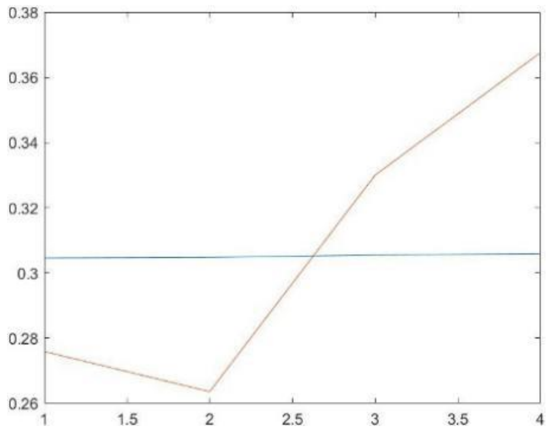

Figure 4: Trend of X1 and X2

It can be seen from the image that the growth rate of industrial output is much higher than that of forest area, so with the development of time, the amount of garbage that can be held in the environment will reach a critical value. According to the changing trend curve of the model and independent variables, when x1 = 0.3115 and x2 = 0.9965, y reaches the critical value of 0.3889, and the environmental capacity index is about 40.

Since there is no artificial reduction involved in the model ,this is the optimal state of the environment, that is, the lowest possible level of global waste y=0.7378

Although population density is an important influencing factor, population density does not change much in a short period of time and will not reach its peak quickly. Today, with the increasing development of the health care system, the population will rise steadily. According to the United Nations population trend observation, by 2050, the population of the earth will be slightly more than 9.7 billion, slightly less than 10.9 billion to 2100, and the increase in population brought to the environment is huge and large.

5. Application of Analytic hierarchy process Model to Analysis

The paper selected four countries for analysis: the United States, China, Germany and Vietnam. As the largest economy and the fourth largest country in the world, the United States has a high level of economic development, strong scientific research capacity, leading the world in technology, and EPI has always been in the top 20. As the world's second largest economy and third largest country, China has a high GDP, but as a developing country, its per capita GDP ranks at the back end. Germany and Vietnam are both smaller countries, but one is developed and the other is developing. Germany is also the world's most efficient recycler of waste plastic, at 83%.

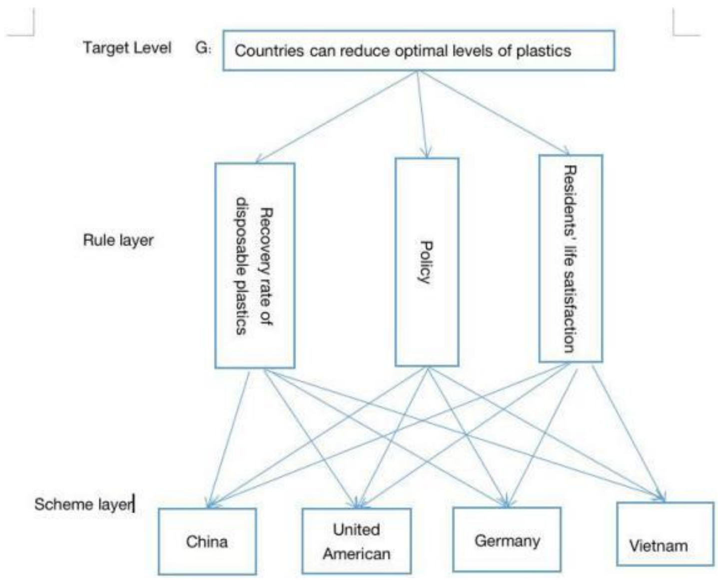

Figure 5: Hierarchical logic construction

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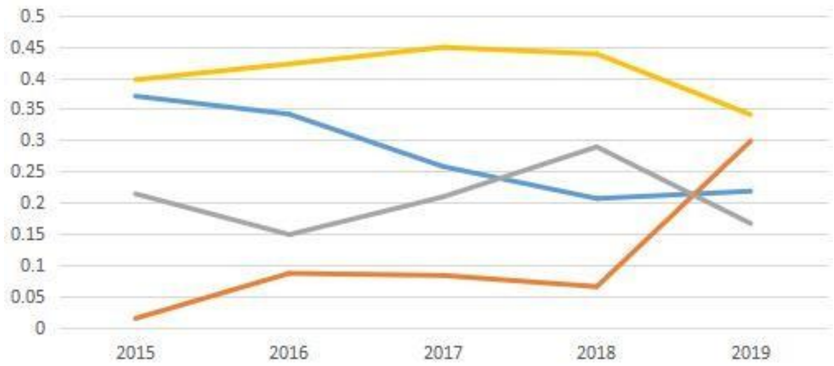

Figure 6: Model result

Assessment of waste reduction level (five-year average) China (0.3704+0.3416+0.258+0.2068+ 0.2185)/5=0.23536 America (0.0152+0.0873+0.0839+0.066+0.2986)/5=0.1102Germany

(0.2143+0.1492+0.2095+0.2894+0.1671)/5=0.20588Vietnam

(0.3967+0.4219+0.4485+0.4379+0.341)/5=0.32162

6. Conclusion

By using the method of stepwise regression, this paper estimates the global maximum pollution level from the aspects of population density, vegetation cover, industrial level and economic level, and establishes the analytic hierarchy process to establish and solve the progressive models of the four countries. In terms of improving environmental performance indicators, forest area has a positive impact on the environment, while industrial added value has a negative impact on the environment. The impact of population density on the environment is multi-angle.

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