

## Analysis and Solution of Plastic Waste Impact

Borui Gu

North China Electric Power University, Baoding, China.

gbr007@qq.com.

### Abstract

In order to estimate for the maximum number of disposable plastic waste to make sure that will not cause further environmental damage, we first use EI ecological environment status indicators to represent the current global environment level, and to determine the factors influencing indicators: disposable plastic waste sources of different proportion (industrial sources, agricultural sources, daily life source) and processing of plastic waste resource availability (incineration, landfill, recycling method), these factors are associated with the current use of disposable plastic waste. Then, based on multiple regression analysis, this paper established the regression equation of environmental status index and two influencing factors, and quantitatively obtained the relationship between the consumption of plastic waste and environmental level. Second, according to the constraint condition of no further damage to the environment, the maximum consumption of plastic waste is determined by the critical value conforming to EI. Considering different countries' plastic environmental protection policies and citizens' living conditions, and analyzing the sources and uses of plastic products, establish a multiple regression model to obtain the relationship about above influencing factors and EI, and the amount of plastic waste that could be reduced under the standard of ensuring environmental standards.

### Keywords

Multiple regression model, Evaluation model, Fuzzy analytic hierarchy process.

## 1. Introduction

### 1.1 Background

Social resources and environment have always been the basis of human survival and development. With the continuous development of society, people's demand for plastic products continues to expand <sup>[1]</sup>, and the plastic manufacturing industry shows exponential growth. However, because plastic is often a disposable product, the resulting waste of plastic waste has caused serious pollution to the global ecological environment, threatening the survival of mankind.

Therefore, in order to solve the problem of plastic waste, save energy and protect the ecological environment, we need to slow down the process of plastic production and improve the way we deal with plastic waste, so as to reduce or even eliminate the waste of disposable plastics and their wastes.

### 1.2 Our work

Our task is to develop a plan to determine the use of single-use plastics in different environmental conditions. At the same time, the paper discusses the impact of reducing the production of single-use plastic products on relevant policies in different cities, the impact on human lifestyle and the results on the plastic manufacturing industry. Finally, give a global minimum usage goal for single-use plastics, and list any circumstances that might accelerate or hinder your goal and schedule.

## 2. Assumptions

There are many effects of changes in the level of plastics. It is assumed that there are four aspects of factor indicators: Lifestyle, Environment, Plastic industry

Evaluation is objective

### 3. Glossary & Notations

Table 1. Glossary and Notations

glossary		notations
ecological environment indicator		EI
waste sources	industrial sources	$X_1$
	daily life source	$X_2$
	agricultural sources	$X_3$
processing of plastic waste resource availability	incineration	$X_4$
	landfill	$X_5$
	recycling method	$X_6$
production		$X_7$
Urban plastic reduction policy goal		$x_{1k}$
Minimum consumption of plastics		$x_{2k}$

## 4. Model

### 4.1 Model Analysis

We need to discuss the amount of disposable plastic waste that can be reduced to meet the requirements of environmental safety. The factors that affect plastic waste reduction include the use of plastics. More importantly, the amount of plastic waste that can be reduced varies from city to city, region to region, because of different policies on plastic and the degree to which the citizens of that city depend on plastic products. [2] Based on this, this paper establishes a multiple regression linear model based on different environmental policies of different cities and their citizens' plastic consumption level, taking into account the sources and USES of plastics, and determines the linear relationship between EI and its influencing factors. Then, according to the relationship between different influencing factors and the amount of plastic waste, the corresponding amount of plastic waste was determined according to the EI value that reached the environmental safety level, and finally the amount of plastic waste that could be reduced was obtained.

At the same time, plastic substitutes, the source of plastic products and other factors will also affect the amount of plastic waste reduction.

### 4.2 Model Establishment

#### 4.2.1 Multiple linear regression analysis model

I. Factors affecting [3]

(1) use of plastic products.

The use of disposable plastic products produced can be divided into: industrial use, agricultural use, life use, the proportion of waste of plastic products of different use is also different.

(2) policies related to plastics in different cities and citizens' consumption level of plastic products.

Two countries with different degrees of development were selected in China to understand their policies on reducing plastic products. The policy completion degree was analyzed according to the development level of each country, and the impact of different policies on reducing plastic waste was quantitatively determined, so as to obtain the impact on the environmental level.

In order to analyze the impact of citizens on the amount of plastic waste, it is necessary to know the consumption level of plastic products by citizens in different countries, and determine the amount of plastic products that citizens are willing to consume less under the policy.

II. Model equation

After obtaining the data of various influencing factors, the multiple linear regression equation of independent variables (influencing factors) and dependent variables (environmental status indicators) was established:

$$EI = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 x_{1k} + \beta_5 x_{2k} + e$$

### III. The Amount of plastic waste

Obtained from China's environmental indicator specification,  $EI \geq 55$  at a qualified environmental level.

The critical value 55 that EI can reach is substituted into the equation to obtain the corresponding amount of plastic waste, and the reduced amount of disposable plastic waste can be obtained from the current actual amount of plastic waste.

#### 4.2.2 Qualitative analysis of other influencing factors

In addition to the above factors, other influencing factors such as the promotion of plastic substitutes, the source of plastic products and so on also play an important role in the production of plastic waste.

##### 1. Plastic alternatives

With the introduction of new plastic alternatives, the production of plastics will gradually decrease, and as a result, the amount of disposable plastic waste will be greatly reduced.

Nowadays, one of the most popular trends of biodegradable plastics is to improve the biodegradability of polymer composites, among which starch has become an important material. As a completely biodegradable, low-cost, renewable and natural polymer, starch has recently received a lot of attention as a sustainable material that can be developed. Starch -based polymers not only reduce the cost of plastics, but also have a significant impact on degradation.

In addition, polylactic acid, polyhydroxy fatty acid ester, polyhexanolactone and other components can improve the degradability of plastics. The development and promotion of these environmentally friendly alternative materials can help reduce the amount of disposable plastic waste. So as alternatives emerge, the amount of disposable plastic waste that can be reduced will increase, as the amount of disposable plastic products required falls.

##### 2.Sources of plastic

And plastic products by a variety of raw materials processing components, with the progress of science and technology, the recovery and degradation levels of different raw materials continue to improve, the waste of plastic waste is also reduced.

Therefore, these two influencing factors have a positive correlation with the quantity of disposable plastic waste that can be reduced. The larger the promotion ratio, the higher the recycling rate of plastic products, and the more disposable plastic waste can be reduced.

### 4.3 Results

This paper selects the policies and relevant data of China and Japan, and through the analysis of the plastic environmental protection policies of developing countries and developed countries, discusses the impact of different policies and different consumption levels of citizens on reducing the amount of plastic waste.

Table 2. Data Results of China

year	production	policy	citizens	industrial	agriculture	dailylife	EI
2014	7387.8	16	76	0.408	0.013	0.602	72.57
2015	7560.8	18	79.6	0.407	0.04	0.514	72.86
2016	7717.2	20	60.5	0.39	0.05	0.56	69.43
2017	7515.5	26	48	0.296	0.06	0.69	68.87
2018	6253.9	30	45.6	0.277	0.057	0.66	66.32

According to  $EI \geq 55$ , the result is:

	policy	citizens	industrial	agriculture	dailylife
coefficient	0 (omitted)	0.238	-0.00071	0.0028	0.0019

Table 3. Data Results of Japan

year	policy	citizens	industrial	dailylife	EI
2014	9	22.8	20.1	22.8	73.12
2015	6.9	18.4	24.6	18.4	72.17
2016	5.1	13	26.6	13	71.00
2017	4.75	11.4	30.4	11.4	68.33
2018	4.5	11	35.5	64.73	

According to  $EI \geq 55$ , the result is:

	policy	citizens	industrial	agriculture	dailylife
coefficient	0.3999	0.4123	0.2176	0.2005	0.1176

#### 4.4 Analysis

As can be seen from the proportion of plastic waste that can be reduced in two different countries to all plastic waste, developing countries represented by China are still slightly behind developed countries represented by Japan in restricting the production of plastic. It can also be seen from the side, a national policy different environmental policies will have a certain impact on the plastic production and waste volume in the region.

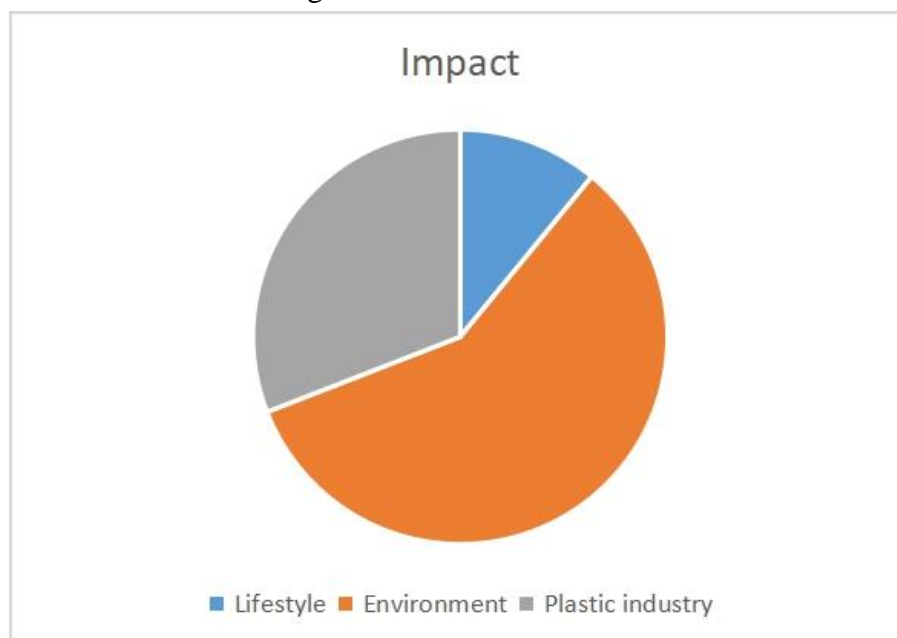


Figure 1. Proportion of plastic waste impact

#### 5. Conclusions

In addition to the amount of plastic produced, the level of plastic waste disposal in different countries or regions affects the reduction of plastic production in this region. We believe that the level of plastic waste treatment can be judged based on three indicators: ① the number of waste treatment plants ②

---

the level of plastic recycling technology ③ the recovery rate of plastics, the greater the data of these three indicators, the higher the level of plastic waste treatment in this area. In other words, less plastic will have a impact on the environment, so there will be less reduction in output.

### References

- [1] <<Mexico city, a megalopolis's war on plastic bags>>
- [2] D.C Wilson, Global Waste Management outlook (International Solid Waste Association and United National Environment Programme,2015)
- [3] Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, 3(7), e1700782.
- [4] Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Science*, 347(6223), 768-771.