Problem Chosen	2023	Team Control Number
E	MCM/ICM Summary Sheet	2308458

Say NO to Plastic Waste

Summary

Plastic products are loved by more and more people because they are cheap, convenient and easy to manufacture, but while it brings convenience to people, it also brings many hazards. The vast majority of plastics cannot be degraded and recycled, so they can only be disposed of in landfills or by incineration， which causes great damage to environment. The efficient plastic-recycling problems has received our attention.

To begin with, to estimate the maximum level of single-use plastic product waste, we developed the UPI model， substitute the found data into python's fitting function to solve for it, finally obtain the result that **when the percentage of single-use plastic is 25%, the maximum level of single-use plastic waste is 652662825.9 tons in 2020.**

Second, we also use the UPI model, assuming the passing rate of environmental single-use plastic input reduction is 15%. Substitute the data for the solution and get the result: **when the proportion of single-use plastic is less than 25%,** the plastic waste can be reduced to reach an environmentally safe level.

Third, we found that problem three is the addition of multiple constraints to the UPI model (Unrestricted Plastic Input Model), so we built the MPI model (Multi-restriction Plastic Input Model). The global use of single-use plastic products is predicted to reach a minimum level in **2030**. The introduction of relevant government policies and the global reduction in the use of single-use plastic products will have an impact on the masses. We infer that in **2023**, about the third year after the implementation of the policy, **people's resistance to the new policy is the highest.**

The last problem, it is obvious that solutions to the plastic product waste problem vary from region to region as factors such as GDP vary. We built an evaluation-type model that considers various factors and scores our selected countries as a way to judge its impact. In order to solve this unfair problem, we propose **cross-regional cooperation**, we all work together to control plastic waste and guard a better home.

For sensitivity analysis of the MPI model, we chose the initial change in the production ratio of plastic substitutes and the initial change in the proportion of disposable plastic harmless disposal as independent variables and sensitivity as dependent variables, respectively. The corresponding sensitivities were obtained by varying the above two independent variables separately and ensuring that the other conditions remained unchanged. The maximum sensitivity does not exceed 0.07. Therefore, we can consider the model is comparatively stable.

Keywords: single-use plastic; UPI model; MPI model; environment; comprehensive evaluation

Contents

1 Introduction

1.1 Problem Background

Since the 1950s, the plastics manufacturing industry has grown exponentially due to the varieties of uses for plastics, such as food packaging, consumer products, medical devices, and construction. While there are significant benefits, there are concerns about the negative impacts associated with increasing plastic production. Plastic waste is having a serious impact on the environment, and it is predicted that if we continue at current trends, there will be more plastic in the ocean than fish by 2050.What's worse, the rise of disposable and single-use plastic products has led to an entire industry dedicated to creating plastic waste. It has also been shown that plastic products are used for a significantly shorter period of time than is required to properly reduce plastic waste. Therefore, to solve the plastic waste problem, it is necessary to slow down the process of plastic production and improve the management of plastic waste.

Figure 1

Figure 2

1.2 Restatement of the Problem

Considering the background information and restricted conditions identified in the problem statement, we need to solve the following problems:

- Problem 1
  Develop a model to estimate the maximum level of single-use or single-use plastic product waste that can be safely mitigated without further environmental damage. Among many factors, you may need to consider the source of these wastes, the magnitude of the current waste problem, and the availability of resources needed to treat the waste.
- Problem 2
  Discuss the extent to which plastic waste can be reduced to achieve environmentally safe levels. This may involve consideration of factors affecting plastic waste levels, including but not limited to sources and uses of single-use or disposable plastics, the availability of alternatives to plastics, the impact on citizens' lives, or the policies of cities, regions, countries, and continents to reduce the use of single-use or disposable plastics and the effectiveness of such policies. These factors may vary by region, so considering region-specific constraints may make some policies more practical and

effective.

- Problem 3

  Using your model and discussion, set a target for the lowest level of global use of single-use or disposable plastic products that can be achieved, and discuss the implications of reaching that level. You can consider the ways in which human life could be changed, the environmental impact, or the impact on the multi-trillion dollar plastics industry.
- Problem 4

  While this is a global problem, its causes and effects are not the same from country to country or region to region. Discuss the equity issues raised by the global crisis and your expected solutions. How do you suggest ICM address these issues?

1.3 Our Work

We analyzed the question, and then first finding the data related to the question, which are plastic categories and quantity, plastic production. Next, we formulate two models, the first one is UPI model (Unrestricted plastic input model), the second one is MPI model (multi-restriction plastic input model). Find the parameters that determine the model, solve the model, in the end obtain the corresponding results. Our work as shown in the Figure 3.

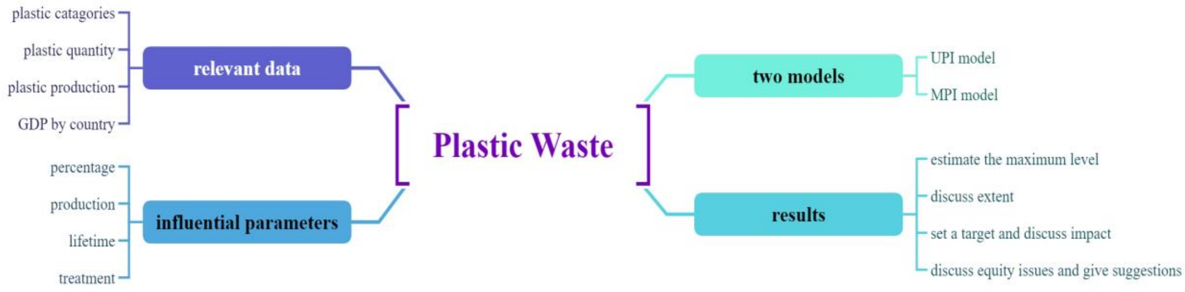

Figure 3: our work

2 Assumptions and Justifications

1. We assume that there are only three ways to dispose of plastic waste, which are landfill, incineration, and recycling.

In fact, there are many ways to dispose of waste, but the three most widely used are the above [1], so we can ignore other ways of waste disposal.

2. We assume that the pollution caused by recycling waste as a disposal method is 0.

Unlike landfills and incineration, recycling has almost no negative impact on the environ ment and brings many benefits [2], so we consider the pollution caused by it to be 0.

3. We assume that the rate of environmental plastic input reduction is qualified when it is greater than 15%.

Since global plastic production is on the rise, if we do not restrict its production, we cannot change its positive growth trend. Therefore, we interpret "no further damage to the environment" in the title as meaning that the proportion of environmental plastic input reduced by more than 15% after changing the proportion of single-use plastics, that is, the qualifying line is 15%.

3 Notations and Data Sources

The key mathematical notations used in this paper are listed in Table 1.

Table 1: Notations used in this paper

Symbol	Description	Unit
t	current year	
$W_j(t)$	j-type plastic waste volume	ton
$D(t)$	environmental plastic input	ton
$P_j(t)$	j-type plastic production volume	ton
$P(t)$	plastic production volume	ton
k_j	percentage of j-type plastics(j=1,2,…,8)	%
LT_j	j-type plastic lifetime	year
$C_i(t)$	percentage of disposable plastic disposal methods	%
$\alpha_i(t)$	percentage of the i-th treatment in year t(i=1,2,3)	%
γ_i	pollution degree of the i-th treatment	%
$h(t)$	policy intensity in year t	%
$\beta(t)$	productivity of plastic substitutes	%
$m(t)$	percentage of harmless disposal of single-use plastics in year t	%

The data we collected used in this paper are listed in Table 2.

Table 2: Data and Database Websites

Database Names	Database Websites
Primary plastic production,2015	https://ourworldindata.org/plastic-pollution
Global plastics production	https://ourworldindata.org/plastic-pollution
GDP by country	https://www.kylc.com/stats/global/yearly_overview/g_gdp.html

4 UPI Model: Unrestricted Plastic Input Model

4.1 Data Description

Figure 4 shows the global production of different plastic categories in 2015, where j=1 indicates packaging production and also single-use plastic production; j=2 indicates building and construction production, and so on.

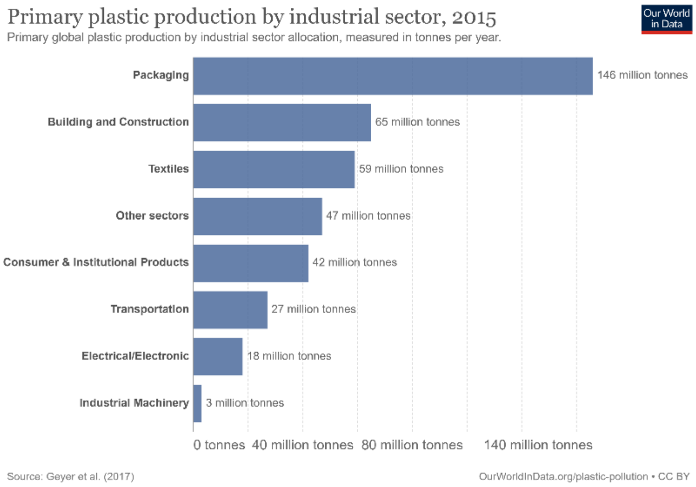

Figure 4

Figure 5 shows the global plastics production from 1950 to 2019, which is important to our analyze for problems.

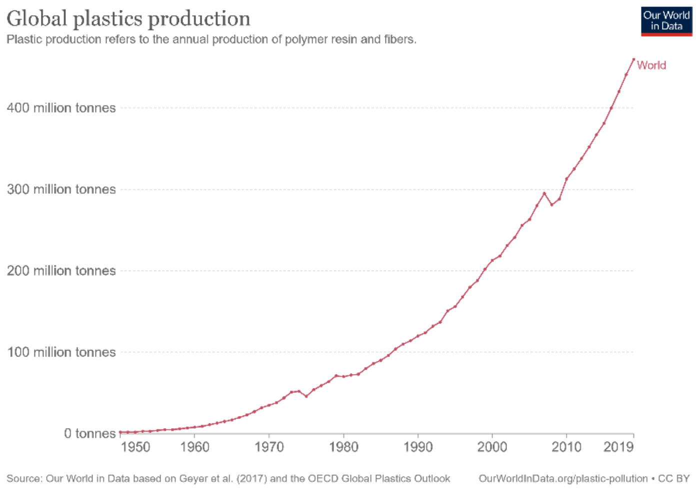

Figure 5

4.2 The Establishment of UPI Model

In problem 1, in order to find the maximum level of single-use or single-use plastic product waste, we need to find the maximum value of the function $W_j(t)$. The amount of type j plastic waste is equal to the product of the amount of type j plastic produced and the percentage in the time period from the year after the end of the life of type j plastic to the current year .From the Figure 5 we could find that the data started in 1950, so the expression for the current year is $T=t-1950$; the year after the end of life of j-type plastic is $T=t-LT_j-1950$. So, we can obtain

$W_j(t)$ as

$$W_j(t)=\sum_{T=t-1950}^{T=t-LTj-1950}\sum_j P_j(T)k_j \tag{1}$$

D(t) is the amount of environmental plastic waste input, and we sum the disposable plastic and other types of plastic separately to obtain the following expression

$$D(t)=\sum_i W_1(t)C_i(t)\gamma_i+\sum_{j=2}^{8}W_j(t)\alpha_i(t)\gamma_i \tag{2}$$

Taking the above factors into account, the UPI model is established as follows.

$$\begin{cases} W_j(t)=\sum_{T=t-1950}^{T=t-LTj-1950}\sum_j P_j(T)k_j \\ D(t)=\sum_i W_1(t)C_i(t)\gamma_i+\sum_{j=2}^{8}W_j(t)\alpha_i(t)\gamma_i \end{cases} \tag{3}$$

For problem 1, based on the data collected above, we substitute into the python fitting function to make predictions (as shown in the Figure 6), the blue line represents 36% of single-use plastic and the orange line represents 25% of single-use plastic. Predicted the variation of environmental plastic input with year, with different percentages of single-use plastics.

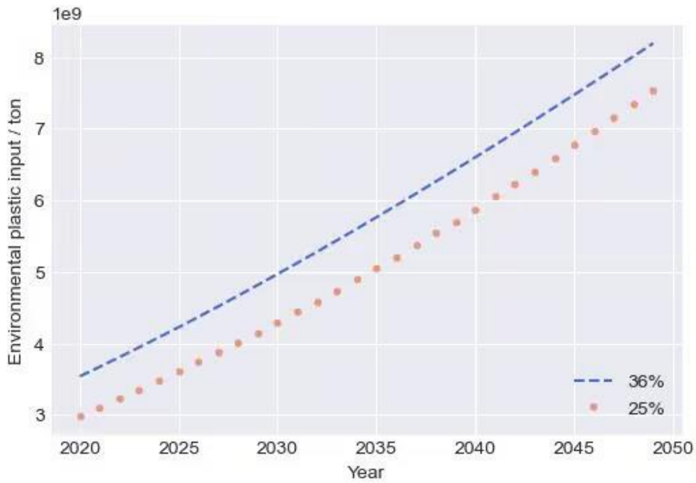

Figure 6: Variation of environmental plastic input with year (UPI)

From the Figure 6, we find clearly that no matter the percentage of single-use plastic, the environmental plastic input is rising year by year. **For problem 1, when the percentage of single-use plastic is 25%, the maximum level of single-use plastic waste is 652662825.9 tons in 2020.**

For problem 2, we also use the python fitting function to make predictions, we adjust the proportion of single-use plastic, from 14% to 34%, then get the environmental plastic input reduction and proportion of environmental plastic input reduction. As shown in Figure 7, the blue bar graph indicates percentage reduction of environmental plastic inputs, the solid green line indicates single-use plastics.

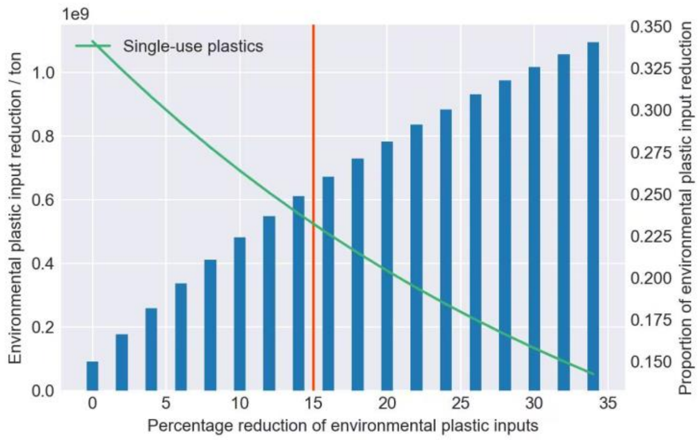

Figure 7: Variation of environmental plastic input reduction with single-use plastic percentage

We have previously assumed the qualifying rate is 15% for environmental plastic input reductions, in the Figure 7, we use the solid orange line to indicate the 15% passing rate. When the proportion of single-use plastic waste is greater than 25%, the environmental plastic input reduction is unqualified; when the proportion of single-use plastic waste is less than 25%, the environmental plastic input reduction is qualified. Therefore, **when the percentage of single-use plastic is less than 25%, plastic waste can be reduced to reach an environmentally safe level.**

5 MPI Model: Multi-restriction Plastic Input Model

5.1 Noun Description

As explained in hypothesis three, we cannot solve the global plastic waste problem if we do not put limits on plastic production, so we introduce the following constraints.

Policy intensity:

We introduce the concept of policy intensity to reflect the intensity of global restrictive policies on plastic products, and require it to have the characteristics of increasing year by year. This makes sense, since plastic waste is so hated around the world that restrictions on plastic will only increase gradually. We used the deformation of sigmoid function to fit the formula. sigmoid function is the S-shaped growth curve of natural biological population, and its increasing change characteristic in the range of 0 to 1 can well reflect the change of policy intensity. So,

$$h(t) = \frac{1}{1+e^{-(t-\mu)}} \tag{4}$$

μ is the adjustment parameter of the equilibrium position of the curve, and the selection of its value is related to the initial value. Here, the policy intensity in the first year of policy implementation is selected as 0.02. The rationality of this data lies in that it conforms to the government's exploration in the policy trial phase and will not produce too high intensity and cause great social unrest. Therefore,

$$h(0) = 0.02 \tag{5}$$

By simple calculation we can get that

$$\mu = \ln 19 \tag{6}$$

Therefore, we have

$$h(t) = \frac{1}{1+e^{-(t-\ln 19)}} \tag{7}$$

Production ratio of plastic substitutes:

We introduce the concept of the production ratio $\beta(t)$ of plastic substitutes to represent the problem that the utilization rate of plastics decreases due to the generation of new technologies over time. Since a large proportion of single-use plastics come from straw use, we used this product substitute as the data source for our analysis. We analyzed the changes of non-degradable disposable plastic straws after the implementation of the plastic ban in China, in which 19.8% of non-degradable disposable plastic straws were replaced by degradable straws, and this proportion showed an increasing trend, so we set the growth rate as 0.01.

$$\begin{cases} \beta(t) = (1+\Delta\beta)\beta(t-1) \\ \beta(0) = 0.198 \\ \Delta\beta = 0.01 \end{cases} \tag{8}$$

Single-use plastic harmless disposal ratio:

In order to reduce environmental damage and change the growth trend of environmental damage in the whole plastic industry, we introduced the concept of harmless treatment. Harmless treatment refers to a treatment method that minimizes the damage of plastics to the environment so that it is completely close to zero. We learned that Finland recycles a staggering 90% of single-use beverage bottles through vending machine-like machines, which is a lesson for us. However, considering the different economic strength and national conditions of each country, our initial value is set at 0.3 and an annual growth rate of 0.01. After the initial value is selected, sensitivity analysis is carried out to demonstrate its correctness

$$\begin{cases} m(t) = (1+\Delta m)m(t-1) \\ m(0) = 0.3 \\ \Delta m = 0.01 \end{cases} \tag{9}$$

5.2 The Establishment of MPI Model

The MPI model adds constraints to the UPI model, so its name is multi-restriction plastic input model.

LP(t) is the plastic production in year t after the introduction of the limit, then it should satisfy

$$LP(t) = [1-h(t)] \times [1-\beta(t)] \times P(t) \tag{10}$$

After the introduction of the limit, the amount of waste of plastic type j in year t, $LW_j(t)$, is different from that before the introduction of the limit, $LW_j(t)$ should be equal to the product of the amount of waste of plastic type j in year t after the introduction of the limit and its share in the corresponding time period, i.e.

$$LW_j(t) = \sum_{T=t-1950}^{T=t-LT_j-1950} \sum_j LP_j(T) k_j \tag{11}$$

The environmental plastic input *LD(t)* in year t is also different from the previous one after the introduction of the restriction

$$LD(t)=\left[\sum_{i} LW_1(t)C_i(t)\gamma_i+\sum_{j=2}^{8} LW_j(t)\alpha_i(t)\gamma_i\right]\times[1-m(t)] \tag{12}$$

For problem 3, considering the above factors, we build the MPI model, substitute the collected data, use python fitting function, then obtain the Figure 8. The solid blue line indicates actual environmental plastic input, the two dotted lines predicate the futural environmental plastic input, where the orange one is prediction according to UPI model, that is, without the addition of constraints; the blue one is prediction according to MPI model, with added constraints.

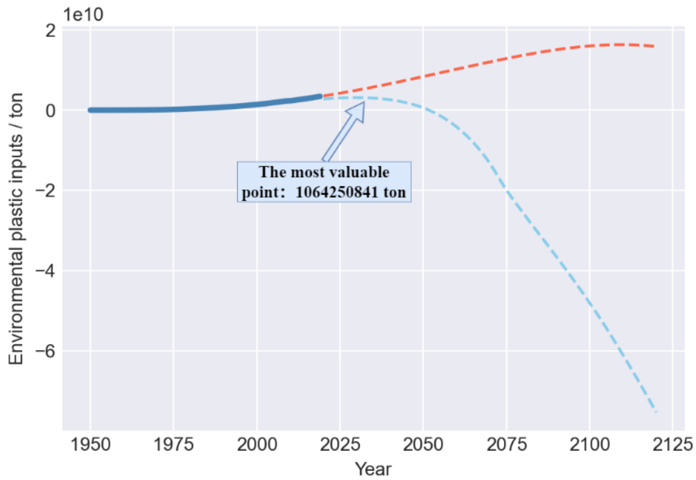

Figure 8: Variation of environmental plastic input with year (MPI)

From Figure 8, we predict that **the global use of single-use plastic products could reach a minimum level by 2030, and the minimum level is 241113492.24 tons.**

5.3 The Impact for Achieving Minimum Level

In MPI model, the intensity of set policies increases gradually over time, while people's acceptance of new things always has a changing process. Therefore, too fast implementation of the policy will lead to the increase of people's resistance[3]. We introduced the resistance degree *RES (t)* to describe this value. As for the function expression of *RES (t)*, we choose normal distribution function to describe it, which is reasonable, just as people's understanding of new things is also carried out in the way of normal distribution.

$$RES(t)=\frac{1}{\delta\sqrt{2\pi}}e^{\frac{-(x-\mu)^2}{2\delta^2}} \tag{13}$$

As for the values of μ and δ, we only discuss the values of μ, because we pay more attention to when people's resistance reaches the maximum, so as to facilitate the government departments to adjust or publicize, so as to deepen people's acceptance and support for the policy.

As people's understanding of new things is always not expected to be a drastic process, so people's resistance to new policies depends on the speed of implementation of new policies. And we can just take the first derivative of this formula h(t).

$$h'(t)=\frac{e^{-(t-\ln 19)}}{1+e^{-(t-\ln 19)}}\times\frac{1}{1+e^{-(t-\ln 19)}}=h(t)\times\left[1-h(t)\right] \tag{14}$$

The maximum point of the first derivative (ln19,0.5) can be easily obtained by mathematical methods, which will not be explained in detail in this paper. This data shows that **in 2023, about the third year after the implementation of the policy, people's resistance to the new policy is the highest**. Therefore, the government should pay special attention to the public demand in 2023, timely adjust the policy, and strengthen the publicity of ecological protection.

6 Scoring Model: Score for Countries

In our previous model, we analyzed the relevant issues of global plastic waste. We took into account the various differences in economic growth, production and discharge of plastic waste, and mismanagement of plastic across different countries and regions. Based on the established global indicator for reducing disposable plastic usage, we have set different standards for various countries to address this issue in a fair and equitable manner. The specific model and implementation steps are as follows.

6.1 The Establishment of Model 3

Hierarchical Analysis Method (AHP) for determining the weights of the selected indicators including 'GDP', 'Garbage discharged into the ocean per capita', 'Waste plastic production per capita', 'Poor management of plastic waste per capita', and 'GDP per capita'. The weights of each evaluation index calculated by AHP are shown in the Figure 9.

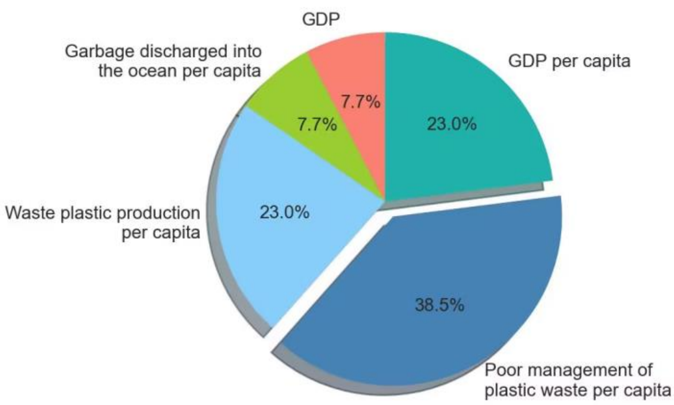

Figure 9: Evaluation index weight

Topsis Entropy Method for scoring each country based on the combination of the indicators and their weights. The countries being evaluated are 'India', 'China', 'Brazil', 'Turkey', 'Singapore', 'Argentina', 'USA', and 'Canada'.

The Topsis Entropy Method calculates the scores of each country by combining the indicators and their weights. The method involves determining an ideal solution and an anti-ideal solution, which represents the best and worst possible outcomes, respectively. The scores of each country are then calculated based on the difference between each country's performance and the ideal solution, as well as the difference between each country's performance and the anti-ideal solution. The final scores take into account both the relative importance of each indicator and the performance of each country.

In order to make the final scores more generalizable, a comprehensive consideration of the above indicators was taken into account in the selection of the countries being evaluated. The final outcome of the analysis provides a comprehensive evaluation of the potential for reducing disposable plastic in the selected countries, which can be used to evaluate the reduction efforts and provide data support for policy making.

After analysis and calculation, we have obtained the final score for each country as shown in Figure 10. From Figure 10, we find that Turkey is the country with the highest score among these countries, which indicates that the country should bear more responsibility for the management of plastic waste. On the contrary, Canada is the country with the lowest score among these countries, indicating that the country has better management of plastic waste and should be allocated a smaller share of the reduction of disposable plastic waste.

The red line in the figure represents the average line of the final score selected by the country, and based on the scores of each country, we have drawn Figure 11, which can intuitively show the scores of different countries and the final disposable plastic waste reduction allocation.

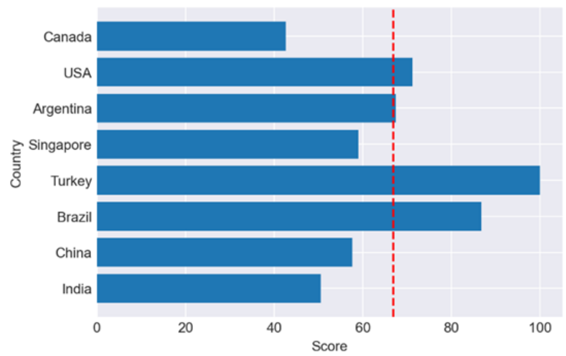

Figure 10: Country score

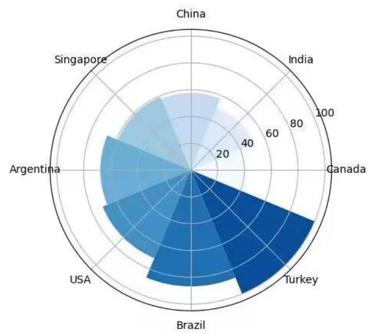

Figure 11: Share of single-use plastic waste reduction by country

In the face of this unfair problem, we propose a solution that can work across regions, and regions that manage plastic waste well can lend a helping hand to help regions that cannot manage plastic waste well, so as to achieve common progress and jointly guard our beautiful home.

7 Sensitivity Analysis

Sensitivity analysis is the calculation and analysis of the error introduced by the model, the effect of small changes in variables on the model results, etc [6]. In this paper, we perform a sensitivity analysis on MPI model. We choose the initial values of the production ratio of plastic substitutes and the initial values of the proportion of disposable plastic harmless disposal as the independent variables and the sensitivity as the dependent variable. Other conditions are kept constant, change the initial values of the production ratio of plastic substitutes and the initial values of the proportion of disposable plastic harmless disposal respectively, both variations were from -10% to 15%, and two corresponding sensitivity curves were obtained, as shown in Figure 11.

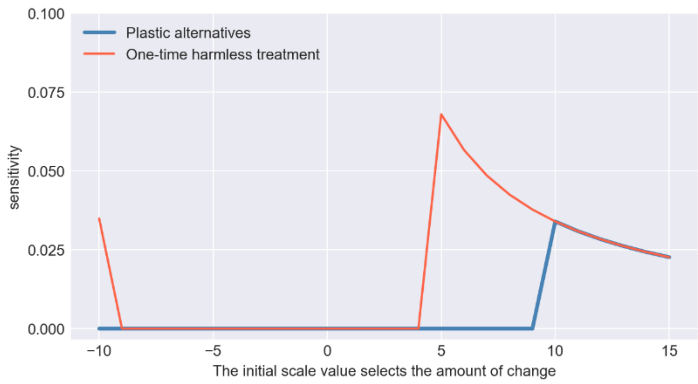

Figure 11: Sensitivity variation curves

From Figure 11, we find that when change initial values of the proportion of disposable plastic harmless disposal, the max sensitivity is 0.068; when change initial values of the production ratio of plastic substitutes, the max sensitivity is 0.034. Both the above maximum sensitivity is small, thus we can consider the MPI model is comparatively stable.

8 Model Evaluation and Further Discussion

8.1 Strengths

1. The UPI model takes into account the service life of plastics of different uses, which is consistent with the actual situation.
2. The MPI model adds reasonable restriction conditions, which effectively changes the growth trend of environmental plastic input.
3. The two models have comprehensive and prudent consideration of problems, real and reliable data sources, and strong stability.
4. The model has strong practicability and clear modeling.

8.2 Weaknesses

1. The selection of some initial values is subjective, we did not find data related to the values, which may cause the results to deviate from the actual.
2. Economic issues are not considered, we did not find data related to the economy.

8.3 Further Discussion (Model Improvement)

In our MPI model, the production ratio of plastic substitutes is added, but its practicality is not taken into account, i.e., the impact of the price and production cost of plastic substitutes and people's acceptance of plastic substitutes. In the model, the production proportion of plastic substitutes grows steadily at a constant rate. After taking into account practical factors, its growth rate should be jointly determined by policy factors, supply factors, demand factors and price factors. However, the extent of this effect requires more adequate data to be deduced, and we did not analyze it due to lack of relevant data. We believe that with more sufficient data, our model will have better fitting ability.

9 Conclusion

For problem 1， We developed a UPI model to estimate the maximum level of single-use plastic product waste, and plotted the variation of environmental plastic waste with year under unconstrained conditions. Environmental plastic waste is found to increase every year regardless of the percentage of single-use plastic product waste, and the final maximum value of single-use plastic product waste in 2020 is 652662825.9 tons.

For problem 2, we assumed a qualifying rate of 15% for the reduction of environmental plastic inputs, that is, when the rate of environmental plastic input reduction is greater than 15%, the percentage of disposable plastic is qualified. We also applied the UPI model, varying the percentage of single-use plastics to derive the corresponding ratio of environmental plastic input reductions, plotted in Figure 4. It was found that the environmental plastic input reduction was decreasing as the percentage of disposable plastic increased, and finally obtained that when the percentage of disposable plastic is less than 25%, the plastic waste can be reduced to reach an environmentally safe level.

Problem 3 adds multiple restrictions to problems 1 and 2, so we build the MPI model and plot the variation of environmental plastic waste with year under unrestricted and multi-constrained conditions. Environmental plastic waste was found to show a decreasing trend in the future in the case of multiple restrictions, and the global use of single-use plastic products could reach a minimum level by 2030, and the minimum level is 241113492.24 tons. What's more, due to the introduction of government policies related to plastic waste, the public will have a certain amount of dissatisfaction and resistance to this, through analysis, we get that in 2023, about the third year after the implementation of the policy, people's resistance to the new policy is the highest.

For problem 4, we built an evaluation class model to score our selected countries based on factors such as GDP, Garbage discharged into the ocean per capita, rating the countries we have selected. Ultimately, it was found that each country scored differently, meaning that the impact of the plastic waste problem varied from country to country. Facing this problem, our proposed solution is to cooperate across regions, so that regions that are good at managing plastic waste can lend a helping hand to help regions that cannot manage plastic waste well and achieve common progress.

In the end, plastic waste is very harmful. It is everyone's responsibility to protect the environment, we should do our best to use less plastic products, especially disposable plastic. There is only one earth, we should work together to protect our home.

Memo

To whom it may concern,

We would like to inform you of the results that we found from our analysis into the plastic waste problems.

As we are aware, plastic waste is a significant environmental issue that needs to be addressed. The study conducted on the impact of plastic waste on the environment has highlighted the need for reducing the use of single-use or disposable plastic products. This memorandum aims to summarize the minimum achievable level of global single-use plastic product waste, the timeline for achieving the target, and any factors that may accelerate or hinder the progress towards the goal.

The study used a MPI model to analyze the impact of plastic waste on the environment under multi-constrained conditions. The results show that the global use of single-use plastic products could reach a minimum level by 2030, which is 241113492.24 tons. This minimum level is achievable if multiple restrictions are imposed, such as government policies, cross-regional cooperation, and public awareness.

According to the results of the study, the global use of single-use plastic products could reach the minimum level by 2030. However, it is important to note that the timeline may vary depending on the speed and effectiveness of the measures taken to reduce plastic waste.

The study found that the introduction of government policies related to plastic waste may face public resistance. The highest resistance is expected to be in 2023, the third year after the policy implementation. Additionally, the impact of plastic waste varies from country to country, and cross-regional cooperation may be necessary to address the problem effectively.

In conclusion, the study highlights the importance of reducing the use of single-use or disposable plastic products to protect the environment. The minimum achievable level of global single-use plastic product waste is 241113492.24 tons by 2030. The timeline for achieving the target may vary based on the measures taken and the public's reaction. It is crucial to address the factors that may hinder the progress towards the goal, such as public resistance and cross-regional cooperation, to achieve the target effectively.

Thank you for your attention to this matter.

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Appendices

Appendix 1

Introduce: Evaluation metrics when calculating weights using AHP

Country	GDP/Trillion	Per capita discharges into the ocean	Per capita plastic waste production	Poor management of plastic waste per capita	Per capita GDP/million
India	3.18	0.093	0.01	9.51	0.23
China	17.73	0.049	0.12	8.56	1.26
Brazil	1.61	0.179	0.17	15.62	0.75
Turkey	0.82	0.172	0.21	19.85	0.97
Singapore	0.4	0.028	0.19	0.43	7.28
Argentina	0.49	0.092	0.18	10.4	1.06
United States	23.32	0.007	0.34	0.81	7.02
Canada	1.99	0.006	0.09	0.63	5.2

Appendix 2

Introduce: Relevant code for topsis

```
data=pd.read_excel('data.xlsx')

label_need=data.keys()[1:]
data1=data[label_need].values
[m,n]=data1.shape
data2=data1.copy().astype('float')
for j in range(0,n):
    data2[:,j]=data1[:,j]/np.sqrt(sum(np.square(data1[:,j])))

w=[0.07692308, 0.07692308, 0.23076923, 0.38461538, 0.23076923]
R=data2*w

r_max=np.max(R,axis=0)
r_min=np.min(R,axis=0)
d_z = np.sqrt(np.sum(np.square((R -np.tile(r_max,(m,1)))),axis=1))
d_f = np.sqrt(np.sum(np.square((R -np.tile(r_min,(m,1)))),axis=1))

s=d_f/(d_z+d_f )
Score=100*s/max(s)
for i in range(0,len(Score)):
    print(Score[i])
```