

# EDP Immigration Policies Report Based on Logistic Model and SEIR Model

## Summary

In order to solve the EDP immigration problem which has been increasingly tense in recent years, and the problem that many unique cultures may disappear after immigration. In the first part we define the concept of EDP in our paper and research the EDP population over the last 20 years. Then we use Malthus Model and the improved Logistic Model to predict the number of EDP in 2050. After that, we set up the evaluation system of culture, which can be divided into two main kinds, one is material culture and the other is immaterial culture. Then we subdivide it into a few small classes. Considering that different types of cultures have different preservation difficulty, cultural value and uniqueness, we established an Analytic Hierarchy Process (AHP) Model to rank their value weight in the process of refugee migration, laying a foundation for further research.

Next, we move on to our most important part, which is that we hope to test the feasibility of moving EDPs to other countries by using our unique SEIR Model based on our findings. We look for the target countries in several ways, such as the carbon dioxide emissions by different countries, or the convenience migrating to different countries, or countries with similar cultures as the target countries. Through our model, we finally select countries which cause least cultural loss as our ultimate target countries. Through the calculation of our model, we also come to the conclusion that it is not feasible to allocate the number of EDP according to the carbon emissions, so we hope to solve this problem through policies.

The following part is based on our conclusions above, we make policy recommendations to protect the rights of the EDP from infringement and, through our proposed policies, engage the whole world in addressing this issue and ease the burden on the ultimate target countries. After making the proposal, we once again verified the effectiveness and feasibility of our policy through our previous model.

Then, supported by our model, we measured the importance of our policies to countries in terms of social and temporal values.

Lastly, we re-examined several of our models and evaluated them. However, there are still some shortcomings. In the future research, we will further improve the data, making it closer to the reality, so that it can be widely used in the world.

**Keywords:** EDP; AHP Model; SEIR Model; Cultural assimilation; Human rights

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# 1 Introduction

## 1.1 Background

Due to excessive carbon dioxide emissions and frequent human activities, global temperatures have been rising in recent years, and the continued melting of the Antarctic and arctic glaciers has contributed to rising sea levels. Data show that sea levels have risen more than 10 centimeters since the 20th century[1]. The scientists predict that sea level rise will affect more than 80 million people by 2050, according to a paper in the journal nature. Floods, tsunamis and other natural disasters will continue to threaten people's lives. More seriously, if this rate continues, many of the lower archipelago countries will be submerged. Four typical countries are the Maldives, Tuvalu, Kiribati and the Marshall Islands. Now if the rise in sea levels is irreversible, these countries will inevitably sink.

Our primary concern is the fate of the indigenous people in these countries. We hope to find a suitable place for them to live without compromising their human rights and losing their culture. But the reality is that it's hard to find land that doesn't belong to other sovereign states, and it's hard to convince any country to give them a piece of land for free to re-establish their own state and government, so we can only consider moving them to other countries. But the country will have its own native culture and unique policies. In this way, there may be conflicts between their culture and the local culture of other countries, and their human rights may be affected by the policies of the local countries, which we do not want to see. So we're going to use data analysis, multiple models to predict where these displaced people are going to be, and we're going to provide policy advice to the United Nations to make sure that environmental refugees can safely move to new homes and continue their culture.

Our model will include multiple parameters to assess the risks posed to refugees by different migration schemes, taking into account their human rights, their culture. We will verify the feasibility of our model in reality. It also provides policy advice to the countries receiving refugees through the conclusions to ensure the safe and smooth migration of refugees. We hope that through our research, we can help these people who will lose their homes.

## 1.2 Assumptions

As discussed above, we make several assumptions in our model. In latter part of the essay, we may relax some of these assumptions to deal with different issues.

- Sea levels are rising at a steady rate.
- The EDPs are equal in different countries, and increase at a unique rate.
- The culture in different countries are special
- The total number of people moving into the recipient country over a given period of time is constant, that is deaths are balanced by births in the original country.
- Every EDP is equally receptive to the new culture.
- The condition in each receiving country is maintained equal.

## 2 Analysis

### 2.1 The definition of EDP

By consulting the literature on climate migration[2], there are three main causes of climate migration.

- **Temperature rise threatens ecological balance**

Climate change leads to temperature rise, which seriously threatens the ecological balance, resulting in reduced production of agriculture and forestry, instability of people's lives and regional disorder, such as malaria and forest fires.

- **Precipitation change increases survival cost**

Extreme precipitation intensity increases sharply with temperature rise (precipitation intensity increases by 7% for every 1 degree increase in temperature), which may lead to flood disaster.

- **Melting glaciers and rising sea levels affect security**

The greenhouse effect caused by greenhouse gases such as carbon dioxide accelerates the melting of glaciers, resulting in the gradual rise of sea level in recent years, which will increase by at least 40cm by 2100.

All three of these motivations are climate migration, but the temperature rise is on a global scale, and the flood disaster caused by precipitation change is not inevitable, so migrating does not constitute a sufficient condition for the first two factors, the fundamental factor is that the local economy development is comparatively backward, makes the local people's spontaneous immigrate to more developed countries, which is not consistent with the 'must relocate' in the EDP definition.

For the third cause, sea level rise is irreversible. By 2050, many island nations will have sunk directly into the sea. As a result, the people of many small island states in Oceania and the Maldives will have to migrate to other countries to survive. Therefore, according to the definition of EDP, we identify the population of these countries as EDP, taking into account the existence of some French and American countries in the south Pacific island countries, which are not included in the EDPs

- We concluded that countries with sinking risks are Maldives, Tuvalu, Kiribati, the Marshall Islands, Fiji, Solomon, Nruwallis and Futuna Islands, Cook Islands, Palau, Northern Mariana Islands, Micronesia, Tonga, Guam and Avanu.
- The number of people at risk of existing EDP is the total population of the above countries, currently 25,522,191.

### 2.2 The number of people at risk

Based on the trend of sea level rise, a large number of island countries will be submerged in 30 years. We collected nearly 20 years' data on the population of at-risk countries such as Maldives, Tuvalu and Kiribati. Using the Malthus Model, the number of EDP population is predicted with 2050 as the target year. (only partial country data are shown here)

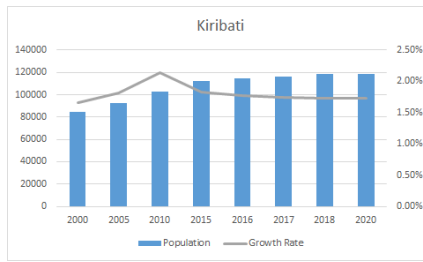


Figure 1: Kiribati

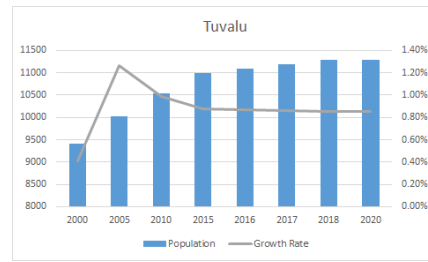


Figure 2: Tuvalu

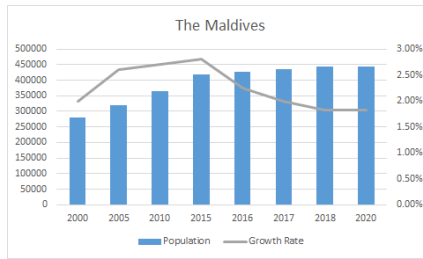


Figure 3: Maldives

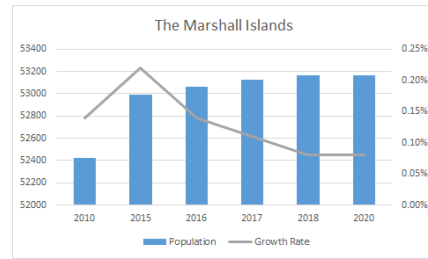


Figure 4: The Marshall Island

According to the model assumption, the increment of population from time  $t$  to time  $t + \Delta t$  is:

$$x(t + \Delta t) - x(t) = rx(t)\Delta t$$

We can solve it by taking the derivative with respect to  $t$  and substituting in the special matrix:

$$x(t) = x_0 e^{rt}$$

The trend in the tables show that the population growth rate of the countries should gradually decrease, which is reasonably explained by the fact that the residents of these island countries have begun to migrate gradually with the rising sea level. Back in November 2001, tuvalu leaders said in a statement that their efforts to combat rising sea levels had failed and that the country would gradually evacuate and relocate to New Zealand. And they all have negative immigration on average. Therefore, with the continuous decrease of land area and climate migration of island countries, the growth rate should be continuously reduced. Increase the pure competition here  $-b^2$  to reduce the pure growth rate

The size depends on the speed of migration. If climate migrants move out of the country faster, it will be larger. The converse is less. Reestablish the equation

$$\begin{cases} \frac{dx}{dt} = x(a - bx) & (a, b > 0) \\ x(t_0) = x_0 \end{cases}$$

Solve the two equations simultaneously:

$$x(t) = \frac{ax_0}{bx_0 + (a - bx_0)e^{-a(t-t_0)}}$$

Matlab was used to solve the problem, and the final prediction of population of these countries facing the risk of flooding in 2050 was as follows:

$$\begin{cases} \text{Maldives} & 576,435 \\ \text{Tuvalu} & 178,085 \\ \text{Kiribati} & 14,580 \\ \text{The Marshall Islands} & 65,868 \end{cases}$$

Sum the population in the EDP range, so we predict that the EDP population will reach 3,921,380 in the future.

## **2.3 The value of culture**

### **2.3.1 Definition of culture**

According to the definition of "cultural heritage" by UNESCO, cultural heritage is divided into "material cultural heritage" and "intangible cultural heritage". In this regard, we classify the culture of the EDP as follows:

#### **1. Material cultural heritage**

Material cultural heritage is a historical relic existing in physical form, including historical relics, historical buildings and human cultural sites. Most of the island countries are small in size and geographically dispersed. Due to the particularity of their location, there are not a large number of historical buildings, and only part of the site remains as a world war ii battlefield remains as the battlefield of world war ii. Therefore, we unify the historical buildings and historical relics through the index of "historical relics", while human cultural sites are measured as a separate index.

In the future, these countries will be submerged. Due to the unportability and vulnerability of human cultural sites and historical relics, these material cultural heritages will inevitably be sunk into the sea as sunk costs. Therefore, we believe that this part will have a low weight in the assessment of cultural importance.

#### **2. Immaterial cultural heritage**

Immaterial cultural heritage mainly includes three aspects:

- (a) Customs: including production methods, such as farming; Lifestyle, such as eating habits; Arts, such as ethnic customs and other cultural factors that cannot be quantified.
- (b) Religion: religion is the belief and basis of many national cultures. Religion affects the value orientation, way of thinking and ethical concept of a nation.
- (c) Language: language and characters are the basic elements and distinctive signs of culture, and the important carrier of cultural inheritance, development and prosperity.

Immaterial cultural heritage is the fundamental factor to measure cultural differences, and the influence brought by foreign cultures is often reflected in immaterial cultural heritage. Therefore, we expect that immaterial cultural heritage will occupy a high proportion in the measurement of cultural value.

### 2.3.2 Cultural assessment model

In order to better understand the cultural factors above, we need to determine the weight of these factors. Referring to the Analytic Hierarchy Process(AHP) model, we build a model to measure the weight of these major factors. The importance of ruins, historical relics, customs, religion and language were compared in order of importance on a scale from 1 to 9. We asked experts to rate and calculate the weight of these five cultural factors:

	Ruins	Historical relics	Customs	Religions	Languages
A	0.0341	0.0865	0.1698	0.4305	0.2791
B	0.0359	0.0572	0.1357	0.4965	0.2746
C	0.0405	0.0779	0.2096	0.2529	0.4191
Valuation	0.0368	0.0739	0.1717	0.3933	0.3243

Figure 5: AHP Model

For this sort of ordering, we explore its feasibility. In the AHP model, the method testing “Consistency Index” is generally adopted to detect the evaluation model. The consistency index is calculated by calculating the eigenvalues and eigenmatrices of the original evaluation matrix

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

And using the random method to construct 500 sample matrices: to randomly extract Numbers from 1 9 and their reciprocal to construct the positive reciprocal matrix, and to obtain the average value of the  $\lambda_{\max}$  characteristic root

$$RI = \frac{\lambda_{\max} - n}{n - 1}$$

Get the consistency ratio

$$CR = \frac{CI}{RI}$$

When the consistency ratio is  $CR < 0.10$  considered to be valid, we calculate according to the model

$$CR = [0.0303 \quad 0.0799 \quad - 0.0642]$$

By contrast matrix, we get the weight relation among different factors. The results are also consistent with our initial expectations: immaterial cultural factors, such as religious belief and language, have a higher relative value and a greater proportion in the measurement system due to the relative uniqueness of language and religion. Material culture, such as relics, etc., is difficult to flow in the process of refugees’ migration, and the loss of its value is inevitable. Therefore, the proportion of cultural value is relatively low.

## 3 Model

### 3.1 Indroduction of the model

For the risk of cultural disappearance, we firstly focus on cultural conflict and cultural assimilation. According to the paper, when there is a difference between the cultures of the countries moving in and the countries moving out, cultural conflicts are inevitable due to cultural diversity and cultural variability, and cultural conflicts often result in cultural assimilation[3] However,

according to the fact that the countries moving out are island countries with a small population and a weak culture, and the countries moving in have a large population and their culture is the mainstream one, the final result often is that their culture is assimilated in the constant collision between culture and culture, losing its particularity and causing cultural losses. Therefore, how to reduce or avoid the phenomenon of cultural assimilation is what we need to pay attention to when we choose which country to move in.

We select of target countries in different indicators, such as carbon dioxide emissions by different countries, China and the United States, India. Or the convenience migrating to different countries, such as Australia, New Zealand and Singapore. Then we measured the flexibility of the original culture in different countries by using the cultural value weights we had previously obtained, and using the infectious disease model to simulate the process of cultural assimilation

### 3.2 Parameter

1.  $r_1$ : The number of people the EDPs come into contact with each day

$r_1$  is the local population that we defined that EDP may contact every day after moving into the target country. We defined  $r_1$  by calculating the population density of the target country. When each EDPs contacts more local population every day, it is more likely to promote the communication between different cultures. In other words, it is more likely for the origins to be influenced by local culture, which leads to the phenomenon of cultural assimilation.

2.  $\beta_1$ : Direct assimilation rate

$\beta_1$  represents the possibility of EDP assimilation after it moves into the target country, and also the speed of assimilation. It is the probability of infection in the model of a common infectious disease, and we describe the original culture like an infectious disease, where one person has the probability of assimilating other people they come into contact with.  $\beta_1$  is affected by many parameters. Through our previous research, several factors affecting  $\beta_1$  are below:

$$\beta_{ij} = f(L_{ij}, R_{ij}, C_{ij}) \quad (1)$$

$$L_{ij} = \begin{cases} 0 & \text{Official languages are the same} \\ 1 & \text{Official languages are different} \end{cases} \quad (2)$$

If the receiving country includes the language of the original country, climate refugees do not need to change their own language intentionally, and therefore do not cause major changes in their language and culture. If the native language of the receiving country does not include the language of the sending country, the language habits of the descendants of the moving refugees will be fundamentally changed.

$$R_{ij} = 1 - \frac{\text{card}(R_i \cap R_j)}{\text{card}(R_i \cup R_j)} \quad (3)$$

In order to measure the influence of the religion of the receiving country on the religion of the sending country, the number of religions in the receiving country and the religion of the sending country were calculated after the intersection or union of the specific religions



of the receiving country and the religion of the sending country.

$$C_{ij} = \delta(1 - \frac{1000}{L_{ij}}) \quad (4)$$

So we can calculate that

$$\beta_1 = \theta_1 L_{ij} + \theta_2 R_{ij} + \theta_3 R_{ij} \quad (5)$$

$\theta_1, \theta_2, \theta_3$  Are the weights of language, religious culture and customs obtained through AHP model above. However, it is important to note that historical sites are not considered in our model due to their low liquidity and difficulty in measuring their value.

3. N: the number of EDPs who are not familiar with new culture

N represents the total number of EDPs that have moved into the receiving country

4.  $\alpha$ : The probability of semi-assimilation reverse

It represents the probability that someone in a semi-assimilated state will not be assimilated. In other words, it is a person who is in the shock of foreign culture, hesitating between two cultures, but for some reason he does not have the probability of being assimilated. It can also be interpreted as the probability that a person in the incubation period will not eventually develop the disease in a common infectious disease model.

5.  $\gamma$ : The probability of turning semi-assimilation to assimilation

$\gamma$  is contrast to  $\alpha$ . It means that the likelihood to turn semi-assimilated people into assimilated ones.

6.  $r_2$ : The number of people a semi-assimilated person comes into contact with each day

Referring to the number of EDPs a semi-assimilated person is likely to be exposed to on a daily basis, which is determined by the EDP population density of the country.

7.  $\beta_2$ : The probability that a semi-assimilating person assimilates another

It's the probability that a semi-assimilated person will convert from an assimilated person to an assimilated person.

Table 1: Parameters

Parameter	Description
$r_1$	The number of people the EDP comes into contact with each day
$\beta_1$	Assimilation rate
$N$	The number of EDPs
$R_i$	The aggregate of the religions in $i_{th}$ country
$L_{ij}$	The distance between $i_{th}$ and $j_{th}$ country
$\alpha$	The probability of semi-assimilation reverse
$\gamma$	The probability of turning semi-assimilation to assimilation
$r_2$	The number of people a semi-assimilated person comes into contact with each day
$\beta_2$	The probability that a semi-assimilating person assimilates another
$I(t)$	The number of people who abandon their original culture
$S(t)$	The number of people who are not familiar with the new culture)
$E(t)$	The number of people who oscillate between two cultures
$R(t)$	The number of people who eventually absorb the assimilative culture
$D(t)$	The number of people in a semi-assimilated state who return to their original culture
$\eta$	Impact factor

### 3.3 Application of model

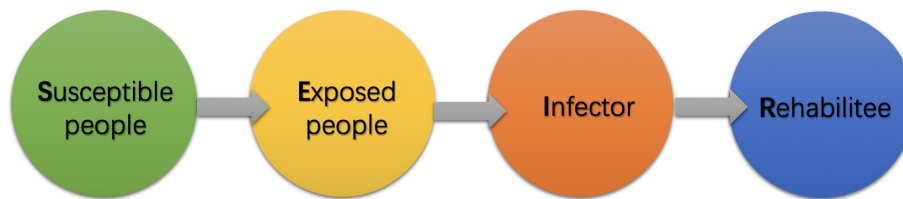


Figure 6: The assimilation process

Through the prediction of the results of refugee migration, we believe that cultural protection should focus on the preservation of original culture under the impact of the culture of the place of migration, that is, to prevent the eventual extinction of original culture. The risk of cultural extinction should be analyzed from the perspective of local culture and its own culture. By evaluating the original culture through the evaluation matrix mentioned above, considering the difference between our own culture and the culture of the place of migration, we can get the probability of cultural assimilation of the culture of the place of migration to our own culture, which can explain the risk of cultural extinction of our own culture. Assuming that every refugee who needs to be relocated has a special culture, it is worth mentioning that although the cultural composition may be similar, it is impossible to be exactly the same in the global culture, so the culture of the destination is special, which is also necessary.

Before moving in, the number of people exposed to the primitive culture can be considered to be the population at that time. Assuming that everyone is equally receptive to the new culture. It's only when the first person from another culture comes in that the foreign culture starts to spread through the primitive culture, so we have at the beginning. As time goes on, the new culture begins to spread widely, and more and more people begin to know the new culture. Meanwhile, the people who know the new culture will also help the spread of the new culture

and accelerate the cultural convergence. The degree of transmission can be considered to be related to the number of people who have not yet understood the new culture and the number of effective communicators  $r_2\beta_2$  within the same time

$$\frac{dS}{dt} = -\frac{r\beta IS}{N} - r_2\beta_2 S$$

As a result, the number of people who only maintain the original culture in a short period of time gradually decreases, which is to say, as long as the time is long enough, everyone with the original culture can know the new culture. It's obvious. And in the process the culture begins to make a trade-off between assimilation and retention. As for the emerging culture, there may be some people who think it is more attractive and gradually believe that the original culture should be abandoned. The probability of this happening is that these people are an extremist, or super spreader. So after turning into such an extremist, the number of ordinary communicators can be used in the following equation.

$$\frac{dE}{dt} = \frac{r\beta IS}{N} - aE + r_2\beta_2 S$$

But as time goes on, they will regain the charm of primitive culture, whose number should first increase and then decrease.

$$\frac{dI}{dt} = aE - \gamma I$$

After that, they will hold a neutral attitude towards the two cultures and gradually move towards cultural convergence.

$$\frac{dR}{dt} = \gamma I$$

Under the initial conditions:

$$R(0) = 0$$

$$E(0) = 0$$

We analyzed the Maldives and Tuvalu. We use population density to estimate the number of transmissions per person. With reference to the number of local population in recent years, we simulated the trend of cultural assimilation after going to different target countries.

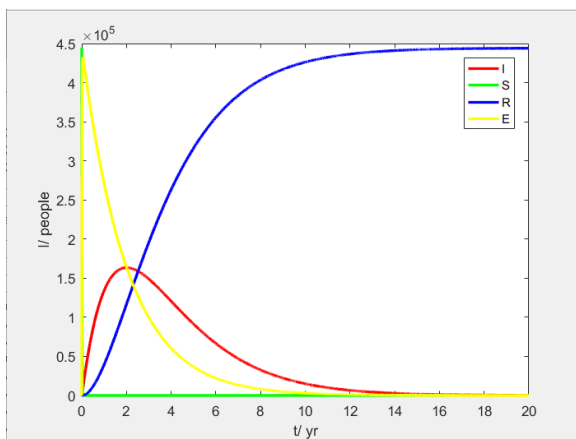


Figure 7: Maldives-India

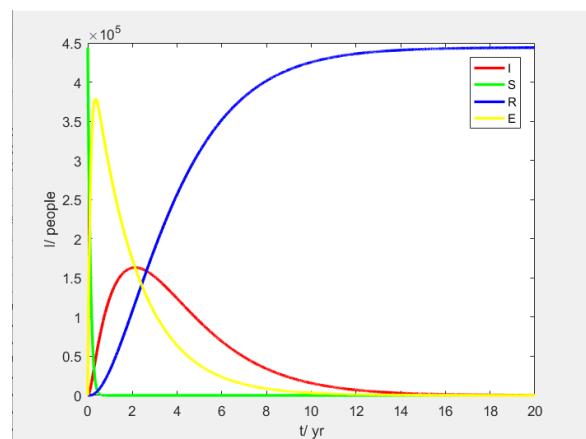


Figure 8: Maldives-Singapore

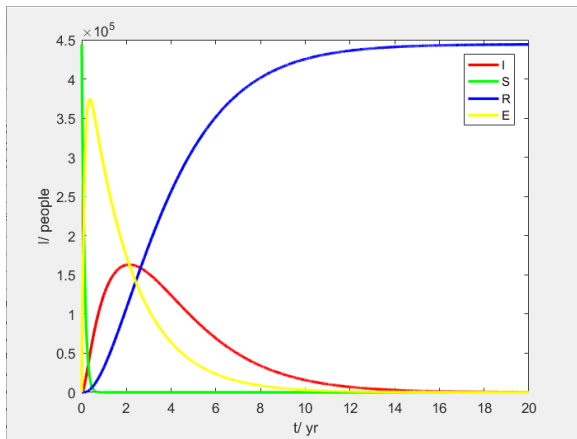


Figure 9: Maldives-New Zealand

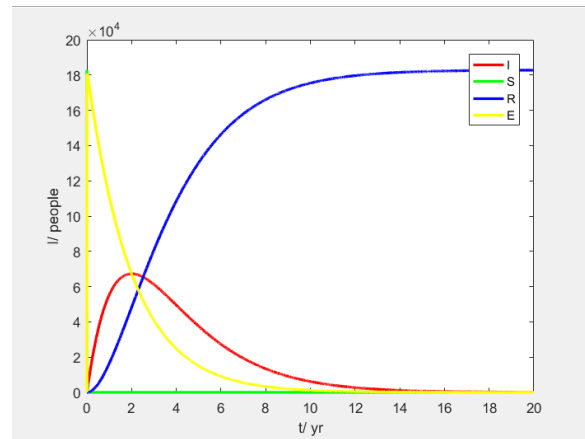


Figure 10: Tuvalu-India

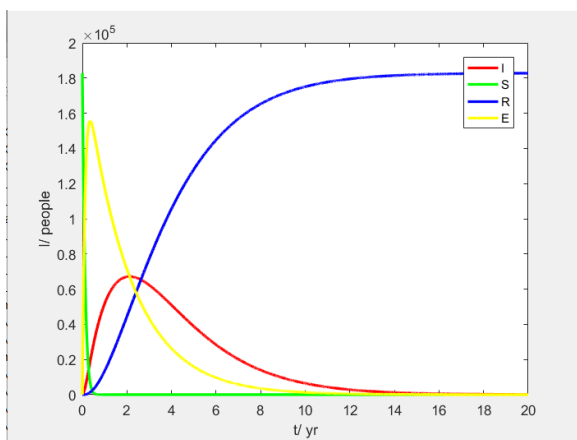


Figure 11: Tuvalu-Singapore

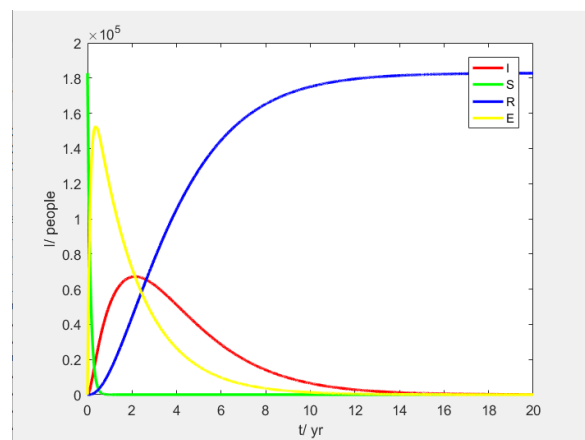


Figure 12: Tuvalu-New Zealand

It is found that when people accept the foreign culture, the number of people who hold a neutral attitude towards the two cultures will gradually increase, and the cultures will move towards convergence. However, this is caused by the model being too strict on the control variables. It is worth mentioning that this model is effective in the short term and can accurately reflect the differences between different countries in a short time. For example, in countries such as India and China, due to the large population density base in a short time, more people will receive the shock from the new culture, which undoubtedly increases the risk for the protection of their original culture. To two cultures at the same time the number of people hold a neutral attitude rise very rapidly, it is associated with cultural similarities and population distribution, in the development of culture, culture produced a specific branch of the Pacific, the bifurcation evident on cultural similarities, and dispersed population is relatively common, and as New Zealand, Singapore and other countries in the initial rapid accept quantity will be relatively lower by about ten percent. Therefore, we believe that relatively close countries, such as Australia, are more suitable as risk-oriented destination countries.

## 4 Policy report

### a. International unification of the EDP concept

- *At present, there is no internationally accepted and unified official definition of EDP, which leads to different attitudes towards EDP and makes it difficult to protect those*

*who really need help. In a broad sense, many EDP immigrants are not only affected by climate, but also influenced by national economy and politics. However, we believe that politically oriented refugees should not be identified as EDP, and the country will be destroyed in the future due to climate should be the only criterion for EDP. Here, we give a more detailed definition of EDP:*

**People who must relocate as their homeland becomes uninhabitable and will definitely disappear in the future due to climate change events.**

#### **b. Set up EDP international protection law**

- *The current international legal system provides only limited protection for those displaced by climate change. In most cases, those displaced by climate change are neither protected by the refugee convention nor by the United Nations framework convention on climate change. [4]The lack of international human rights protection laws and the difficulty of applying climate change law make the EDP more challenging: unlike other refugees, if the EDP is repatriated after a country's demise, stateless status will leave them homeless. So first, there should be an international consensus on the idea of classifying EDPs as refugees. And for the particularity of its climate - induced migration, a protection law against EDP should be established*

#### **c. Encourage multiculturalism and reduce nationalism**

- *Since we have considered the influence of cultural differences on EDP in the model, and selected the country with the least impact as the host country of refugees, the countries that accept EDP should no longer reject refugees because of cultural differences. In fact, the main cause of climate change is not the countries that will disappear, but the countries that will bear the worst effects of climate change. Therefore, the government should strengthen the channelling of the growing nationalism, and clarify the amount of relief for the refugee population, so that it should not affect the living standard of the local residents, so that people of all countries can face the EDP with a more peaceful mind.*

#### **d. Strengthening international cooperation**

- *Countries that do not receive refugees are required to compensate them according to their carbon emissions*

*According to our previous model, it is not reasonable to allocate EDP according to the amount of carbon emissions, but this does not mean that any country can be isolated from this global problem. In order to balance our allocation of EDP, we put forward this proposal: we hope that countries that do not receive refugees will give certain economic compensation to countries that receive refugees according to their annual carbon emissions. Through this policy, not only can relieve the huge pressure faced by the countries receiving refugees, but also can urge the countries with high carbon emissions to control their carbon emissions to some extent.*

- *Establish transparent review measures, monitored by specialized international organizations*

*We suggest that the United Nations establish special monitoring bodies to monitor the living conditions of refugees in receiving countries and ensure that receiving countries fulfil their obligations to guarantee the human rights and legitimate rights of refugees. At the same time, the receiving country that fails to fulfill its obligations will be fined and other punitive measures will be taken to protect the rights of refugees.*

#### **e. Establish a transition period to help refugees adapt to the new environment smoothly**

- *We propose to give the EDPs a transitional period of several years, during which they can enjoy the social security and tax policies of the original countries. At the same time, during this transition period, the countries receiving refugees can gradually improve the policies enjoyed by refugees and make them adapt to the policies of the countries of immigration. This policy can help refugees adapt to their new homeland smoothly and smoothly.*

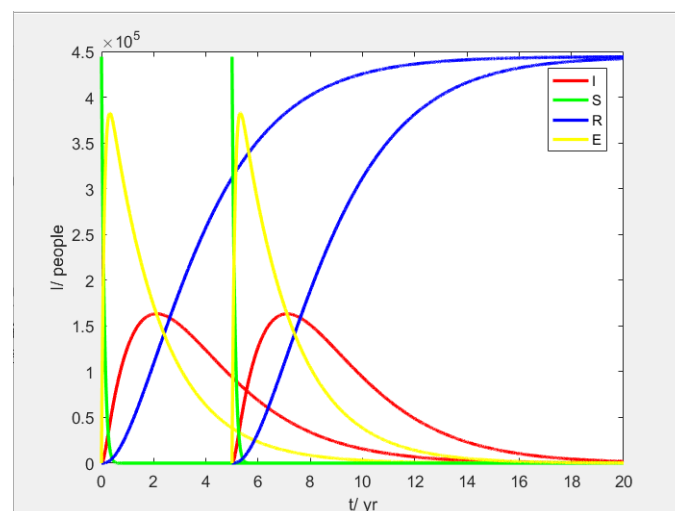


Figure 13: Maldives-Singapore-new

In our model, the transition period is directly reflected in the time at which assimilation begins. When we give the EDPs a transitional period, they are less likely to be influenced by the culture of the country in the first place. This will delay the beginning of the assimilation reaction and the completion of the final assimilation, thus slowing down the process of cultural loss. In this new chart, we take the migration of the maldivian EDPs to Singapore as an example, and we can clearly see the delay in assimilation time, as well as in other countries' models.

#### **f. Establish learning institutions to help EDPs find jobs**

- *According to our survey, there are a large number of refugees whose original survival skills are not suitable for the new countries, which makes it difficult for them to integrate into the new environment. We suggest that the local government establish a unified skills*

*training and learning institution, so that EDP can learn some basic skills, so as to obtain more smooth employment and ensure its economic source.*

### **g. Set up EDP refugee communities**

- *We propose to provide a more centralized living environment for the EDP, which is not only conducive to the unified management of the government, but also more conducive to the cultural protection of the refugee countries. With the destruction of the country, the material civilization will disappear forever, and living customs, languages, religions and so on will be the last proof of the existence of these countries. The experience we have so far shows us that living in large communities can effectively preserve these cultures. Just as Chinatown in the United States, Japan and other places, where display China's long history and culture. Chinatown plays an important role in preserving Chinese culture. Providing such a way of life for EDPs, while preserving its culture, can also bring certain economic benefits to the receiving country due to its characteristics.*

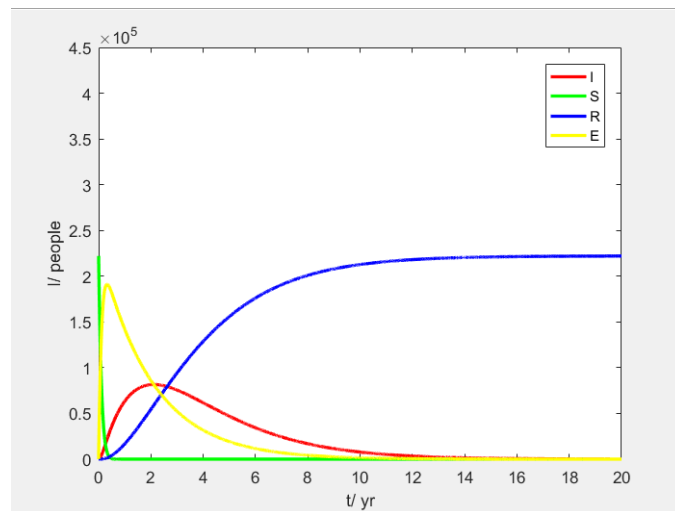


Figure 14: Maldives-Singapore-new

The establishment of the EDP refugee community, which makes them live in a relatively closed environment, actually fundamentally reduces the number of people who may be assimilated. The main reason is that there is no possibility of cultural assimilation if all the people around are of the same culture. As a result, the number of people taking part in the process of cultural assimilation will be significantly reduced. In our model, the result of reducing the initial population significantly reduces the final assimilated population, that is, the EDP culture can be retained to a large extent. We still take Maldives and Singapore as examples, when we establish the EDP gathering place, the population subjected to cultural assimilation is significantly reduced, so as to reduce the cultural loss.

## **5 Verify our model**

### **5.1 Assimilation Result over time**

Intuitively, it is obvious to consider that for every person who is wavering, if there is an effective cultural protection policy in the receiving country, although some of them will go towards

cultural assimilation and gradually lose their own culture, others will return to their original culture. Considering the influence of cultural protection policies, we introduce the influence factor  $\eta$ , whose meaning is the probability of immigrants returning to the original culture under the protection of relevant policies, which is related to the strength and execution ability of protection policies. The number of returnees can be adjusted using this model:

$$D = \eta R \quad \eta \in (0, 1)$$

Different receiving countries should choose different influencing factors according to their own cultural compatibility and national conditions. For example, in a culture protection policy resolutely implement the recipient countries, their impact factor  $\eta$  is relatively high, mean after received of culture protection policy, immigration country, significantly reduce the impact of culture on the swing of more people (D) to return to the original culture, so the role of culture protection policy. This is also an intuitive reflection of the policy in the adjustment model. If you take a relatively tolerant attitude towards an original group of 10, 000 migrants, with the parameters adjusted, if the recipient country takes a relatively tolerant attitude.

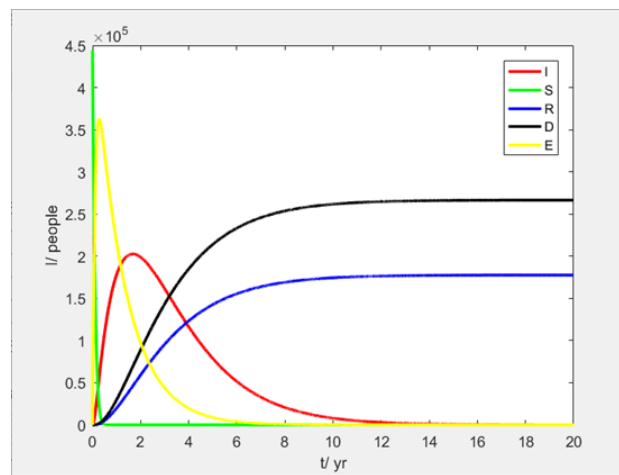


Figure 15: Adjustment of impact factors  $\eta$

After the introduction of the influence factor, we can see that for those countries with higher tolerance, the number of their final returnees will gradually stabilize. Under the condition of a fixed population, the numerical value will directly affect the number of returnees. In addition, it is worth mentioning that in the long run, not all immigrants will move towards cultural convergence through cultural protection policies. The number of people who end up retaining the original culture or accepting cultural integration is numerically dependent. Thus, whether the recipient country can provide an environment conducive to the development of the original culture and its policies will directly affect whether the original culture will die out, while the intensity of the implementation of protection policies will affect the number of people whose future culture remains unchanged.

## 5.2 Parameter change over time

In our former model, we assume that the parameter is constant according to different situations in different countries. However, once EDPs are moving into the receiving countries, the direct assimilation rate  $\beta_1$  and semi-assimilation reverse rate  $\alpha_1$  change over time, which means that we have to take time into parameter consideration, representing as  $\beta_1(t)$  and  $\alpha_1(t)$ . The direct assimilation rate will decrease while semi-assimilation reverse rate will increase as time goes



on because EDPs know that their culture have a unique value thanks to the culture protection policy. So we measure the risk of loss of culture when the policy has been carried out, as the parameter change over time.

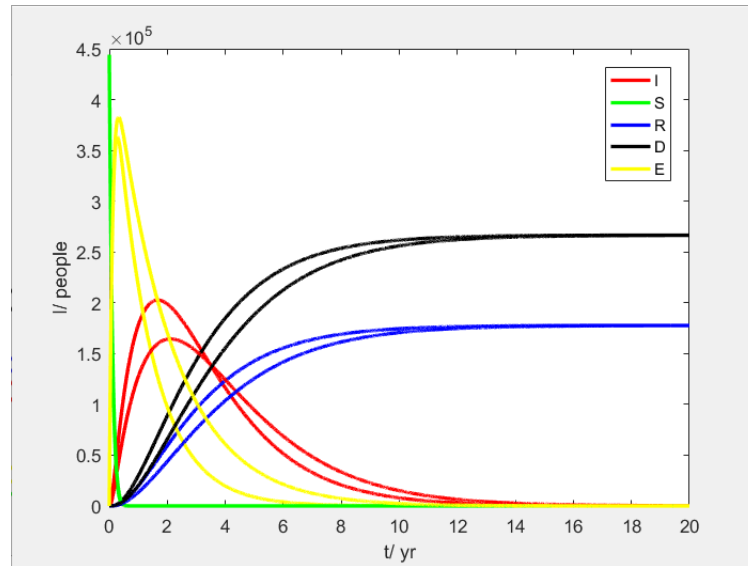


Figure 16:  $\alpha = 0.8$  ;  $\alpha(t) = 1.01 * \alpha$

After the policy carried out, the number of the people who are jumping between the new culture and the original one and the extremist has been decreased, which means that the attraction of the original culture increase. What's more, the year that the most extremists exist is delayed. Above all, the risk of loss of culture is eased based on the culture protection policies.

### 5.3 Summary

From the perspective of model development, it provides a long-term strategy for the measurement of the influence on the time span. So we can predict the EDPs culture risk in the future using our model.

## 6 The importance of our policies

### 6.1 Social value

- *Our policies are of high importance to the global response to EDP migration*

For now, with the exception of the maldives, most of the countries likely to sink as a result of rising sea levels are concentrated in the Oceania region. As we have demonstrated through the model, the longer the distance the immigrants cross, the greater the possibility of their cultural loss, and the greater the risk in the process of migration, so we can only find a suitable target country nearby as the country of immigration. But this creates an unfavorable situation, that is, the pressure of all immigration is concentrated in a small number of countries, and most other countries are not involved in this event. Especially those major emitters of carbon dioxide, which is undoubtedly extremely unfair to EDP and the countries of immigration.

According to the data[5], China's annual carbon emissions rank the top three in the world with 10,432,751 kilotons, the United States' 5,011,687 kilotons and India's 2,533,638

kilotons. But in our model, none of these three countries is suitable as target countries. This is a good reflection of the above problems, countries that are big carbon emitters are not taking on the burden of accepting refugees.

To address this problem, our policy proposals include countries around the world use carbon emissions as a benchmark to fund countries that host refugees. In this way, we share the negative externalities of refugees with most of the countries in the world and make the problem a global problem that every country should pay attention to and participate in solving.

- *To meet the growing needs of immigrants*

Almost every dispute in history has been affected by ethnic and religious conflicts. The religious conflicts brought by European immigrants are becoming more and more prominent nowadays. Pew Survey in 2016 found that: Hungary, Italy, Poland, Greece and other refugees receive percentage of negative evaluation on Muslim groups were 72%, 69%, 66%, 65% [6], Europe's resistance to refugees of different faiths makes it impossible for the two to coexist peacefully, and makes a constant conflict between European: Madrid bombings, the Paris riots... The most fundamental cause of these conflicts is nationalism resulting from religious differences.

At the same time, these island countries also have their national characteristics, such as Kiribati's folk dance. Only on the basis of small ethnic differences and harmonious coexistence of multiple ethnic groups can these national characteristics and customs be fully displayed, so as to preserve these precious cultural wealth. Therefore, in the establishment of the model and the implementation of the policy, we focus on the cultural factors, and give a high weight to the religious factors, as an important indicator to measure whether a country should become a recipient country of EDP.

## 6.2 Value of times

- *Mitigating climate migration pressures*

Since the end of the last century, the number of global immigrants has been on the rise. According to statistics, the number of immigrants worldwide reached 173,588.4 thousand in 2000, and gradually rose to 271,642.1 thousand in 2019. This was particularly true in Pacific island countries such as the Marshall islands, where the number of international migrants rose from 1.9 thousand (2000, 3.7%) to 3.3 thousand (2019, 5.6%) and from 2.3 thousand (2000, 2.7%) to 3 thousand (2019, 2.6%) [7].

In general, these countries have a high demand for immigrants. By adapting our models and policies to each other, we can achieve a quantitative comparison of these countries to target recipient countries, considering human rights and original culture protection, alleviating the migration pressure of climate refugees. While effectively solving the problem of climate refugee orientation, the model can also comprehensively analyze the risk of cultural convergence and find the soil suitable for the survival of the original culture.

## 7 Conclusion

### 7.1 Strengths and weaknesses

#### 7.1.1 Strengths

- In the process of estimating the EDP population, we calculated the characteristic data and natural influences of the original countries, and the adjusted Logistics growth model has an operability in the time span.
- We used AHP model to conduct quantitative analysis of qualitative problems, and obtained consistency test with reference data.
- We introduce a adjusted SEIR model to simulate the assimilation process. It is a new method in this field.
- We give suggestions according to our model. And adjusted the model according to the policy. It combined the model and the policies together.

#### 7.1.2 Weaknesses

- When parameters are introduced, we assume that many variables are a constant, but in the practical case, they will be affected by external factors and become fluctuant.
- When variables are introduced, they are subjective. We did not verify the real names of our parameters, such as a, b, etc. They will be unified in future studies.
- We assume that the spread of culture is caused by only one local resident and that the original culture is not invasive, whereas in real life the spread of culture is two-way and multilateral.
- We do not take into account the cost of cultural communication. In the case of cultural communication, we believe that cultural communication does not need media communication.
- It is not comprehensive for our policy just focus on the culture-protection-oriented countries, because it should be a global strategy.

### 7.2 Conclusion

In this paper, we explicitly discuss the definition of EDP and collect data on the number of people at risk, and predict the number of people it will reach in 30 years. The AHP model is used to analyze the most important indicators of cultural value: language and religion, which establishes a quantified weight factor for the further measurement of cultural differences.

In our opinion, the most special point of EDP compared with other refugees is that their countries be completely destroyed in the future. The irreversibility of cultural loss makes us take cultural indicators as the most important factor to measure the country of EDP's immigration. In order to quantify the differences, We take maldives, tuvalu and other countries as examples, New Zealand, Australia, India, Singapore, China and the United States are the

countries receiving EDP. Meanwhile, we collected detailed data on language types, number of religions and differences in life customs, using the above weighting factor construct a measure of the quantitative indicators of cultural differences. The greater the cultural difference, the more likely it is to cause the rapid loss of culture. SEIR model was used to simulate the cultural loss, that is, the rate of EDP assimilation into local culture, thus, we find a reliable model to find the suitable countries to accept refugees.

In the following work, we developed detailed policies on human rights and cultural protection, and measured the potential impact of proposed policies, which fully reflects the importance of our policies.

Finally, we sincerely hope that our efforts will effectively improve the situation facing the EDP.

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