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Study on EDP Risk Based on Grey Prediction Model

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ABSTRACT. *Due to global warming, sea levels have risen and some island nations have been in danger of disappearing completely, which spawns a huge number of environmentally displaced persons (EDP).In order to solve the problems of resettlement of islanders with human rights and protection of indigenous culture, we have launched a study. Firstly, in order to predict the number of people at risk for EDP, a gray prediction model was used to predict the number of EDP migrants who are forced to leave their homes result environmental disasters by 2030, accounting for 42.86% of global migrants. At the same time, we established a population risk model and combined the fence map calculation function of ArcMaP software to obtain the distribution map of the population facing EDP risk. The population risk distribution map with the geographic location of the migrating country was established, high-risk areas of cultural loss was obtained, like Eastern and South Asia, Western Europe, etc. Secondly, we should raise the protection of EDP human rights and culture to the level of policy protection. After consulting the literature, we obtained seven indicators of human rights and cultural protection, establishing a multi-level comprehensive analysis model, and obtained the top four indicators of human rights and the top four indicators of cultural weights .We combined the weights of various indicators to make recommendations on the protection of human rights and cultural policies of EDP in immigrant countries.*

KEYWORDS: *EDP, Grey forecasting mode, Greenhouse effect*

1. Introduction

According to research, the global average temperature has risen by 1 degree Celsius compared to the industrial era due to greenhouse gas emissions, which has a profound impact on ecosystems and humans. The ocean becomes warmer, more acidicand less productive [1]. Melting glaciers and ice caps have caused sea levels to rise and extreme coastal incidents have become more severe. Researchers have identified that as sea levels have risen, the several island nations such as Maldives, Tuvalu, Kiribati are in danger of disappearing completely[2]. We know that when the island nation's land disappears, the island's population will undergo unpredictable changes [3]. But what is certain is that those EDP not only need to be relocated to different places to survive because of unsuitable environment and

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homes, but also they at the risks of losing human rights, losing their unique culture and destroying their lifestyles.

2. An Analysis of the Scope of the Issue

2.1 The Number of People At Risk

2.1.1 Grey Prediction Model

The gray prediction model is mostly used to develop small sample data based on the behavioral characteristic data of the gray system, so as to obtain the mathematical relationship among factors or the factors themselves. This article mainly uses the gray prediction model to predict the changing trend of the distribution of the population at risk in the five continents of the world.

2.1.2 Model Establishment and Solution

First, we analyze the number of people at risk and the risk of cultural loss on the island country. Based on the analysis results, we determine that the EDP problem is mainly analyzed from the two aspects of population disaster coefficient and disaster probability. We find out the statistics of population exposure, population disaster coefficient and probability of disaster occurrence over the years, and predict the possible EDP in 2030 according to the growth rate of each year.

After accumulating changes in the number of displaced persons each year, the trend of the number of people at risk can be obtained. The sample data is substituted into the model calculation. The MATLAB software is used to fit the forecasting fit of the total number of migrants as shown in Figure 1 (see Appendix 1 for the code):

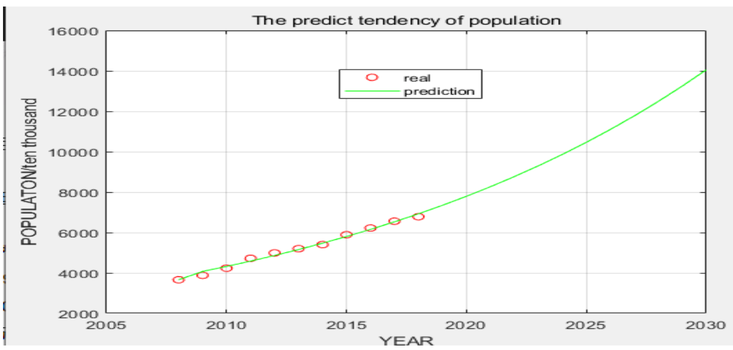

Fig.1 Trend prediction of migrant population

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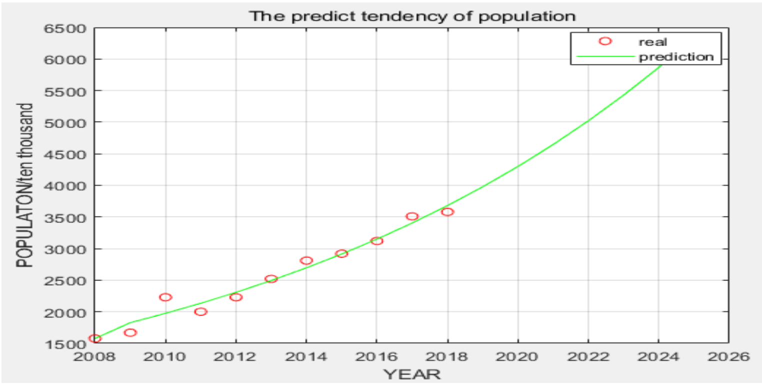

Fig. 2 Changes in the World's Floating Population

As shown in Figure 1, we can see that since 2008, the total number of people moving in the world has continued to increase from an average of about 2.214 million people per year, and has been growing in a manner that is close to a steady rate. So we combined it with the actual situation and found that the annual growth rate is consistent with the phenomenon of the disappearance of multiple island nations and the increase in the number of EDP caused by rising sea levels. According to the prediction model, by 2030, the total number of migrants in the world will reach 140 million, exceeding the target of the number of floating migrants on the planet.

At the same time, we substitute the sample data of the number of population disasters caused by environmental disasters into the model for calculation, perform gray predictions on them, and fit the prediction map of the trend of the world's floating population caused by environmental disasters, as shown in Figure 2. From Figure 2, we can see that since 2008, global warming has accelerated and environmental disasters have increased, resulting in a gradual and rapid increase in the number of people moving in the world. According to forecasting and fitting data, by 2030, the number of migrants in the world due to environmental disasters will reach 60 million, which will account for 42.86% of the total number of migrants in the world. This value is far more than the United Nations' number of EDP Expected value. Therefore, we use the ROC evaluation model to test the predicted values.

2.1.3 Model Accuracy Test

First, we use the ROC evaluation model to test the accuracy of the predicted value. According to the model, the residual and variance of the predicted value are calculated respectively. The residual calculation formula is as follows:

$$\sigma(n)=\sum_{n=1}^{N-1}(x^{(0)}(n)-\overline{x})^{2} \tag{1}$$

the variance calculation formula is as follows:

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$$s^2 = \frac{(x^{(0)} - \overline{x})^2 + (x^{(1)} - \overline{x})^2 + ...(x^{(n-1)} - \overline{x})^2}{n} \tag{2}$$

Substitute the population exposure and population disaster sample data into the model to obtain the predicted residuals of changes in the number of migrants $\sigma_1(n)$ =0.0084, variance $s^2{}_1$ is 0.1193, get population disaster data to predict residuals $\sigma_2(n)$ =0.0577, variance $s^2{}_2$ =0.1972. So we compare the results with the prediction accuracy level table (see Table 1 below):

Table 1 Forecast Accuracy Levels

Forecast accuracy level	Residual	variance
good	(0,0.1]	(0,0.35]
better	(0.1,0.8]	(0.35,0.45]
general	(0.8,0.95]	(0.45,0.5]
worse	(0.95,1)	(0.5,1)

After comparison, we find that the residual and variance test results are better, and the detection values are consistent with the actual situation.

2.2 The Risk of Loss of Culture

2.2.1 Risk Modeling

(1) Overall model

According to the selection criteria of disaster factors, it can be known that population risk zoning focuses on its formation mechanism, and analysis of the factors forming various environmental disasters gives each factor a certain weight for comprehensive partitioning, so a quantitative model is used.

The factors on the right side of Equation(3) are calculated independently by different methods. The combination of the factors is non-linear. Due to the spatial distribution characteristics of risk, these three factors are grouped into a unified spatial framework. With the help of the spatial overlay analysis function, various influence factors are integrated to obtain the risk. In the analysis and calculation, we use the uniform grid operation space frame. After completing the risk mapping, we can get the population risk per unit area. We use it to further determine whether the population of the region will move and determine whether the region's culture is lost, so we get the region where the culture is lost.

(2) Model establishment steps and processes

Before the model is established, each factor needs to be analyzed. The related factor solution formula is as follows:

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Population risk (W)= Population Disaster Coefficient(Q)×Disaster possibility(P)

Which is: $$W = Q \times P \tag{3}$$

Population risk is the reflection of population risk on different exposures, namely:

Population risk (R) = Population exposure (E) ×Population Disaster Coefficient (Q)×Disaster possibility (P)

$$R = E \times W = E \times Q \times P \tag{4}$$

2.2.2 Population Risk Quantitative Analysis

(1) Quantification of risk factors

①Population exposure(E)

The risk analysis calculation we use in the model is a uniform grid space architecture. The grid map-based algebra operation is performed to obtain the population distribution map of the 1km grid in the selected area of population exposure data.

②Population Disaster Coefficient(Q)

The disaster situation mainly comes from IDMC. We sort and analyze the disaster disaster data with population changes, screen the scale and intensity of environmental disasters, and use the Pearson correlation coefficient method to obtain environmental disasters through statistical correlation methods. Correlation comparisons between the elements of disaster losses, such as Table 2, take the scale of the disaster to characterize the intensity of the disaster. The injured population includes casualties and migrants.

Table 2 Correlation Coefficient Between Disaster Strength Index and Disaster-Affected Bodies

Pearson correlation coefficient	Damaged population	direct economic loss	Collapsed building
Disaster scale	0.412	0.389	0.464
Disaster intensity	0.281	0.271	0.312

By establishing the disaster loss standards for the migrant population and the scale of the disaster, the disaster population and the disaster function curve are fitted. Because there is currently no internationally applicable grading standard applicable to environmental disasters, the scale of disasters is measured by the degree of damage and extreme sports intensity, which are divided into grades 1, 2 and 3,see Table 3.

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Table 3 Population Migration Rates under Different Disaster Scales

Disaster scale	Population migration in function $y=5\times10^{-3}e^{1.700967x}$
1	0.027396216
2	0.150110533
3	0.822492128

③Disaster possibility(P)

The global scale is divided into five continents. Due to the large number of countries, we select representative countries on each continent for research. Based on the time distribution of environmental disasters in 2008-2018, calculate the probability of disasters of different scales (times/years).

(2) Population risk analysis

Because the population risk is determined, we use the fence map calculation function of ArcMaP software to superimpose and analyze each impact factor to obtain the population risk distribution map.

In the first step, we comprehensively consider the population disaster loss coefficient and the possibility of disasters to form a population risk distribution map. In the second step, we superimpose the population risk distribution map and population exposure to obtain a population risk distribution map. You can further get the population risk level, as shown in Table 5, divided into five levels.

Table 5 Population Risk Classification

Population risk level	Lowest danger zone	$W = 0$
	Low risk area	$0 \leqslant W < 0.0005$
	medium risk area	$0.0005 \leqslant W < 0.005$
	high risk area	$0.005 \leqslant W < 0.01$
	highest risk area	$0.01 \leqslant W$

Based on the population risk distribution map, combined with the cultural protection of EDP in the country of immigration, and the original geographical location, five high-risk areas of cultural loss were identified.

From the result, we could know that the distribution of high-risk areas of cultural loss is characterized by low cultural self-confidence, urgent migration plans due to harsh environments, and lack of cultural protection policies in potential migrating countries, like South Asia, Eastern Asia, Western Europe, East North America, Southeast Africa.

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3. Conclusion

Human beings today face many common challenges and need to solve many global problems. These issues have a bearing on the survival of the entire human race, restricting human development, and have become global issues that need to be addressed urgently. The EDP issue is one of the major issues. Global warming, rising sea levels, the fall of island nations and the displacement of EDP have made the homeless and weak. humankind has only one Earth, each nation coexist in one world. We live in the same home, sea levels rise, homes are destroyed, brothers and sisters suffer into EDP, how can we stand by? According to the latest UNHCR Global Trends report and UNHCR's important annual survey of EDP conditions around the world The report [9] shows that due to climate change, sea level rise and island nation fall, currently more than 70.8 million EDP have been forced to flee their homes. This unacceptable number is 20 times that of 20 years ago, nearly 70. The highest record of the year has become an extremely serious global problem. Global issues, global concerns, mutual consultation, mutual assistance, interdependence, joint action, shared responsibility, the strong help the weak, and build a community of shared future for mankind. Improving the ability to receive and settle EDP, protecting its human rights and culture, allowing EDP to survive and reproduce, and to inherit and innovate culture, should be the inevitable choice to solve EDP problems. The determination of membership degree and weight and the selection of algorithm has algorithm, we will be cautious about these issues in the future, and on the basis of in-depth analysis of specific issues, the reasonable determination of various parameters and algorithms in order to make the evaluation results as scientific, reasonable and objective.

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