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2018
MCM/ICM
Summary Sheet

How does climate change affect regional instability?

Summary

In order to solve this problem, this article analyses the survey data and applies the method of principal component analysis to determine the four main aspects of the climate impact. In this paper, we attribute the twelve indicators that affect the national vulnerability into four categories.This article uses the analytic hierarchy process(AHP) to find out the weight of the impact of climate factors on indicators, finds out the relationship between vulnerability indicators and climate factors, establishes the national vulnerability assessment model.

In the first issue, this paper takes Finland as an example to establish a preliminary model. Through the model, we find out the main ways and other ways that climate factors affect the national vulnerability, so as to illustrate how climate directly or indirectly affects various indicators and further influences national vulnerability. In the second case, taking South Sultan as an example, we use the model to get the proportion of climatic factors and non climatic factors in vulnerability indicators, and further illustrate that bad climate will aggravate national vulnerability. The third question, taking Japan as an example, established the grey correlation model, find out the decisive factors of climate vulnerability effect, then we increase the proportion of decisive factors, put the data into vulnerability evaluation model, the Japanese national vulnerability increases, reaches a critical value, the sensitivity of the model was verified. Through the analysis we define the critical value. In the fourth problem, this article still takes Finland as an example. This article consults the multi data, and analyzes a series of intervention measures taken by Finland to mitigate the risk of climate change. Combined with these measures and using the model to calculate, the proportion of Finland's climate factor in vulnerability index is reduced, and the overall vulnerability is reduced. Then, the total cost of main intervention measures is calculated by using the economic model. In the fifth issue, this paper selects Urumqi, China as the research object, and finds that the original indicators of the model can not depict the vulnerability of the city well. By adjusting the focus of the vulnerability index, this paper establishes an evaluation model suitable for the use of the city.

The advantage of the model is that 1.The model can clearly analyze how climate change affects the national vulnerability directly or indirectly.2.The model is simple and practical. The disadvantage is that there is certain subjectivity in calculating the weight.

Keywords: **National Vulnerability Index, Climate Change, AHP, Grey Correlation Analysis.**

Contents

1 Introduction

1.1 Background

Climate is the long-term average state of the physical characteristics of the atmosphere, it has stability. However, due to the combination of human activities and natural factors, the global climate is gradually converting. Regardless of the magnitude of the impact of climate change, the poor will suffer the most. The impact of climate change will be more severe in developed countries than in developed countries because poor countries do not have sufficient capacity to solve the problems posed by rising sea levels, disease transmission and crop yields. This will further aggravate regional instability and make the region more vulnerable[1].
In recent years, a series of studies have been conducted on vulnerability indicators and gradually developed into many fields. There are also different ways. By the model simulation method, a single index method, the layer stack method, the fuzzy matter element evaluation method and the composite index method. Among them, the comprehensive index method is the main research method to quantify the vulnerability of climate change and is widely used [2]. Evaluate the vulnerability of a country so that it can better analyze the current situation and make corresponding measures accordingly.

1.2 Our works

The two factors of climate are precipitation and temperature. When it is linked with human life, they can be roughly expressed in the four aspects of food, fresh water, energy and disasters.
In this paper, the index of vulnerability is divided into the influencing part of the climatic factor and the non-climatic influencing part by referring to the 12 indicators in Fragile States Index.
Climatic factors act on 12 indicators through four aspects of food, fresh water, energy and disasters, and then use analytic hierarchy process to establish the correlation matrix of each factor to calculate the weight, and obtain the proportion of the climatic index and non-climatic index of the vulnerability index How the climate directly or indirectly affects the indicators and thus the national vulnerability.

1.3 Assumption

(1) The impact of climate factors on a country can be summarized by the state of food, fresh water, energy and natural disasters.
(2) The climate has a direct or indirect impact on the twelve indicators of national vulnerability.
(3) National vulnerability indicators consist of climatic and non-climatic factors.
(4) When studying the impact of climate change on national vulnerabilities, it is assumed that the non-climatic factors will not change.
(5) Constructed paired comparison matrices are within reasonable limits.
(6) There are no extreme conditions that affect the result here.

1.4 Variable Definitions

Table 1:Variable Definitions

Variables	Definitions
CFI	The fragility of a country
FSI	Fragile State Index
C/E/P/S(CEPS)	Cohesion/Economy/Political/Social
W_i	The weight of CEPS Indicator
C_i	The sum of CEPS relevance
D_i	The decisive value of CEPS
P_i	The percentage of indicator
TP	The value of a tipping point

2 Task1

2.1 CFI introduction

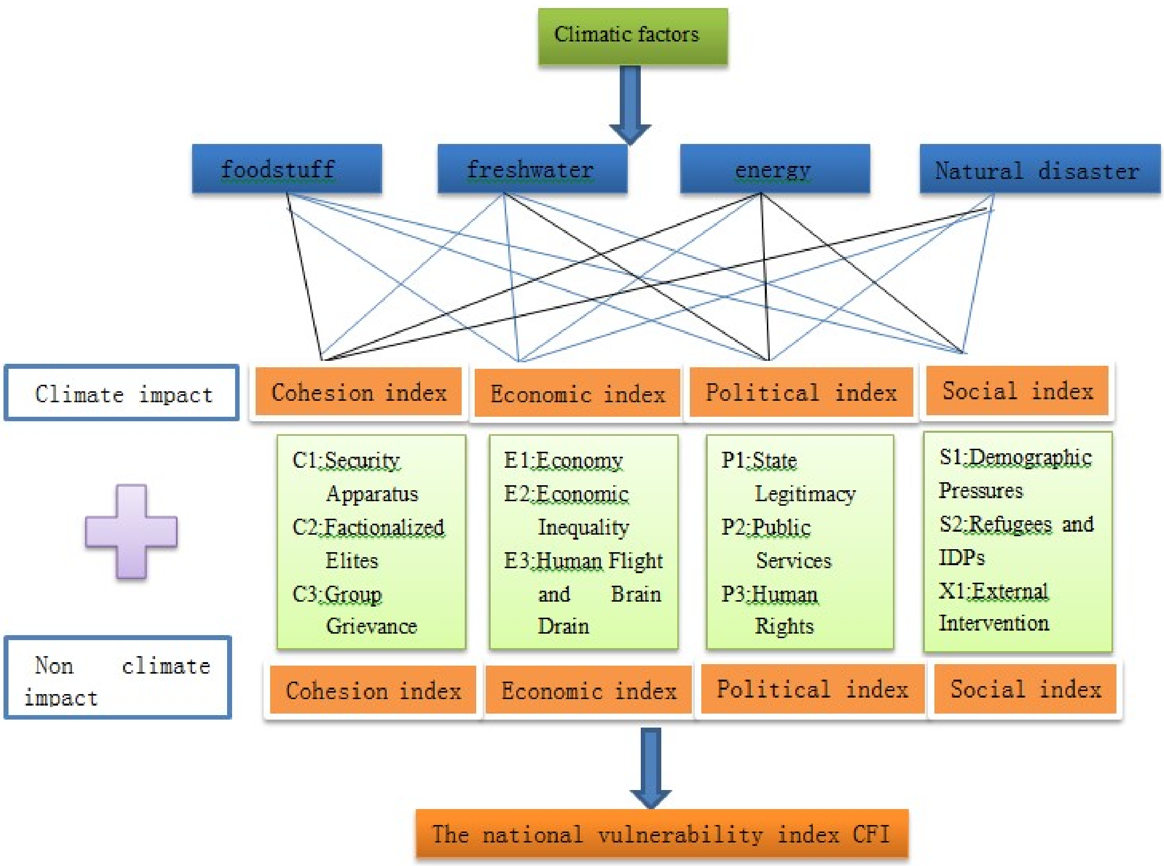

Figure1:Hierarchical analysis diagram

Based on the data collected from many sources, the paper concludes that climate impacts on a country are mainly in four aspects: grain, freshwater, energy and natural disasters.

The 12 indicators of the national vulnerability index CFI are:
(1) Security Apparatus: distribution of internal conflict and non state armed;
(2) Factionalized Elites: Conflict and competition between local and national leaders;
(3) Group Grievance : contradiction between domestic violence and conflict;
(4) Economy: the poverty rate and economic performance;
(5) Economic Inequality: The domestic development differences between different races, different religious groups and different regions;
(6) Human Flight and Brain Drain: migration to other countries, refugees and educated population outflow, and other types of floating population problem;
(7) State Legitimacy: corruption and other measures such as the measure of the level of democracy, government performance and the election process;
(8) public service: Department of education, health care, health services;
(9) Human Rights: human rights and the rule of law on the protection of human rights and promote;
(10) Demographic Pressures: population related issues, such as food shortages, population growth rate and mortality;
(11) Refugees and IDPs :refugee resettlement issues related to refugees and displaced population;
(12) External Intervention: foreign aid and intervention measures, such as sanctions or military invasion.

2.2 CFI Model in Finland

The function of our model is to study the extent of the impact of climate factors on national vulnerability. We build a new model by analogy with the analytic hierarchy process. We analyze the impact of a national climate factor on the vulnerability index by constructing a paired comparison matrix and finding a weight. Here we take Finland as an example to explain the model: The country's access to climate data:
Step1: access to the country's climate and environment information:
Climate: Finland is cold and long in winter and mild and short in summer. The land of 1/3 in the country is in the Arctic Circle, and the rest belongs to the temperate marine climate. From south to north, the average temperature in January was about -4 -16$^{o}C$and the temperature in July was 16-13^{o}C. The annual precipitation of about 400-600 mm (1/3 for graupel and snow).
Food:in 2017, the total population of Finland broke through 5 million 500 thousand, and the annual grain output of Finland reached 3 billion 500 million kg, and the per capita was 636 kilograms, slightly higher than the world average of 400 kilograms.
Freshwater: Finland is known as "the country of thousand lakes". It is the largest country in the world. The area of inland waters accounts for 10% of the total area in the country, up to 338 thousand square kilometers, and the fresh water resources are extremely rich.
Energy: Finland is located in northern Europe, no oil and no coal, and the domestic energy resources are very scarce. At present, 70% of the energy consumption is dependent on imports. The traditional pillar industries in Finland, the forest industry and metallurgical industry, are large energy consumers. Coupled with geographical conditions, the heating period in Finland is very long in winter. The contradiction between supply and demand of energy is very prominent.
Disaster: there is no huge natural disaster in Finland, far away from seismic zones, vol-

canoes and typhoons.
Step2: made of comparison matrix, each taking two factors x_i andx_j. In order to a_{ij}

Table 2:Finland and World Comparison Table

Elements	World average	South Sudan
Fresh water per capita $/m^3$	5919	19592
Per capita food production (grain)/ ton	3.99	67.2
Total electricity consumption per capita / kwh	4271.5	14732.06
Annual average disaster loss / x$10^8$$	306	2.36

Express x_i and x_j. Effect of the ratio of the size of Z, all the results of the comparison matrix $A = (a_{ij})_{n*n}$.Said A is called Z and X between the pairwise comparison judgment matrix (the matrix). In order to know The value of a_{ij}. Saaty use 1-9 and digital reference recommendations as the reciprocal of scale. Table 2 lists the 1-9 scale meaning:

Table 3:Scale meaning

scale	meaning
1	Representing two factors is of equal importance
3	The former is slightly more important than the latter
5	The former is obviously more important than the latter
7	The former is more important than the latter than the latter
9	The former is extremely important than the latter than the latter

2, 4, 6, 8 represent the intermediate values of the above adjacent judgments

As mentioned above, according to the degree of restriction of climate, climate, climate and food in Finland, fresh water, energy and natural disasters, a team comparison matrix A can be made as follows:

$$\begin{array}{ccccc} & Food & FreshWater & Energy & Disaster \\ Food & 1 & 3 & \frac{1}{4} & 3 \\ FreshWater & \frac{1}{3} & 1 & \frac{1}{5} & 1 \\ Energy & 4 & 5 & 1 & 5 \\ Disaster & \frac{1}{3} & 1 & \frac{1}{5} & 1 \end{array}$$

Calculate the proportion of consistency $CR = \frac{CI}{RI}$.CR <0.10, the pairing matrix A passed the consistency test, and the weight vector Q of each vector is:

$$Q_a = (0.2261, 0.0922, 0.5896, 0.0922)$$

Step3: Next, through the influence of food factors on cohesion, economy, politics and society, 0.245 also establish a paired comparison matrix as:

$$
\begin{array}{ccccc}
 & Cohesion & Economy & Political & Social \\
Cohesion & 1 & \frac{1}{3} & 3 & \frac{1}{4} \\
Economy & 3 & 1 & 8 & \frac{1}{2} \\
Political & \frac{1}{3} & \frac{1}{8} & 1 & \frac{1}{8} \\
Social & 4 & 2 & 8 & 1
\end{array}
$$

CR <0.10, paired comparison matrix through the consistency test, find the weight. The same method to calculate freshwater, energy and natural disasters, and get their respective weight vectors of cohesion, economy, politics, society and other indicators

The weights of CEPS obtained through calculation are respectively as follows:

$$w_i = (0.145173, 0.385316, 0.136888, 0.332709)$$

Table 4:The weight of indicators btweent climate and CEPS

Indicator	Cohesion	Economy	Political	Social
Food	0.1235	0.3279	0.0474	0.5011
Fresh Water	0.2475	0.1310	0.1105	0.5110
Energy	0.1436	0.4588	0.1716	0.2260
Disaster	0.1059	0.3101	0.1606	0.4235

Step4: Calculated for the cohesion, the proportion of climate impact is:

$$W_i = Q1_i * Qa_1 + Q2_i * Qa_2 + Q3_i * Qa_3 + Q4_i * Qa_4$$

Step5: According to the proportion of the twelve indicators of the climatic and non-climatic factors calculated distribution

In this model, we only need to understand the environment and climate condition of a country and set up pairwise comparison matrix, after model operation, we can get the proportion of climate impact. We can clearly see how climate factors affect national vulnerability. Therefore, we can better characterize the vulnerability index CFI of a country. Through consulting papers, sampling and builting models for fragile countries and stable countries, we can roughly determine the classification of national vulnerability index CFI.

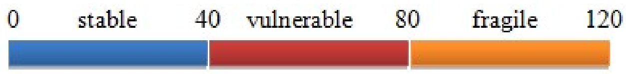

Figure2:Hierarchical figure

Table 5:CFI model results of Finland

Component	Total	climate: 27.35%	non-climate 72.47%
Total	18.7	5.1477554	13.5522446
C1: Security Apparatus	1.7	0.2467941	1.4532059
C2: Factionalized Elites	1.1	0.1596903	0.9403097
C3: Group Grievance	1.8	0.2613114	1.5386886
E1: Economy	3.5	1.34806	2.1519400
E2: Economic Inequality	1.0	0.38516	0.6148400
E3: Human Flight and Brain Drain	2.3	0.885868	1.4141320
P1: State Legitimacy	0.9	0.123192	0.7768080
P2: Public Services	1.0	0.13688	0.8631200
P3: Human Rights	1.0	0.13688	0.8631200
S1: Demographic Pressures	1.1	0.3659799	0.7340201
S2: Refugees and IDPs	2.3	0.7652307	1.5347693
X1: External Intervention	1.0	0.332709	0.6672910

We can judge the effect by the weight of the index: we use the climate conditions in Finland as an example, Finland is a country with rich fresh water resources and few natural disasters. The constraints of Finland's national vulnerability are energy, the lack of energy have a direct impact on the economy, so the ratio of climate factors in the economy should be great; and other aspects such as politics, energy has indirect effect,The proportion should be small. This results are in agreement with the results calculated by the model.

3 Task 2

3.1 CFI model in South Sudan

3.1.1 Background information

Southern Sultan is known as one of the least developed countries in the world, and its civil war has lasted for 5 years. The continuous war has made the most serious humanitarian disasters and refugee crises on the continent. South Sultan's vulnerability index has been at the top of the list in recent years. A large part of the reason is the perennial violent conflict in the region. Environmental pressure itself does not necessarily cause violent conflict, but there is evidence that when it is combined with weak governance and social division, it will lead to violent conflict, [3].

South Sultan is a tropical grassland climate, over 95% are moist and semi humid areas with high humidity and a large amount of rain. 5-10 months of the year is the rainy season, the temperature is 20-40, the 11-4 month is dry season, and the temperature is 30-50[4]. The climatic characteristics are all year after year, and the precipitation season is very different.

Fresh water: Although the rainfall is rich, the per capita fresh water resources are far below the world average.

Food: due to the low area of cultivated land and the clear season of high temperature and precipitation, and the backwardness of its own agriculture. At present, 50% of the total demand for things in southern Sultan needs to be imported. There are still 4 million 800 thousand people in the country facing serious food security threats, 1 million 400 thousand more than the same period last year.
Energy sources: South Sultan is rich in energy, but it has not been fully exploited because of technology and other problems. The average level of electricity consumption per capita is 0.013 times the world average, which is far from meeting the national demand.
Disaster: Except to man-made disasters, natural disasters in South Sultan (including floods and droughts, etc.) reached 42.6billion dollars in 2017, accounting for 1/7 of global total losses in 2017. The specific data are as follows:

Table 6:South Sudan and World Comparison Table

Elements	World average	South Sudan
Fresh water per capita $/m^3$	5919	2255
Per capita food production(maize) / ton	1395	87
Total electricity consumption per capita / kwh	4271.5	55.4
Annual average disaster loss / x10^8\$	306	42.6

3.1.2 Model application

Based on the climatological information of south Sudan, the paired comparison matrix was established:

$$\begin{array}{ccccc} & Food & FreshWater & Energy & Disaster \\ Food & 1 & 6 & 4 & 3 \\ FreshWater & \frac{1}{6} & 1 & \frac{1}{2} & \frac{1}{2} \\ Energy & \frac{1}{2} & 2 & 1 & 1 \\ Disaster & \frac{1}{3} & \frac{1}{4} & 1 & 1 \end{array}$$

By calculating

$$Q_a = (0.5964, 0.0919, 0.1716, 0.1412)$$

Then we got

$$W_i = (0.1359, 0.3297, 0.0904, 0.4442)$$

And The CFI model results are as follows.

The above models can be used to calculateW_C, W_E, W_P andW_S. We can see that the greatest impact of climate on Southern Sultan vulnerability is the aspects of social and economic. Here's a model to see how climate change can make a country's vulnerability increase.

Table 7:CFI model results of South Sudan

Component	Total	climate: 24.75%	nonclimate 75.25%
Total	113.9	28.1923015	85.70769849
C1: Security Apparatus	10	1.3585189	8.6414811
C2: Factionalized Elites	9.7	1.31776333	8.382236667
C3: Group Grievance	9.7	1.31776333	8.382236667
E1: Economy	10	3.2965586	6.7034414
E2: Economic Inequality	8.9	2.9339371	5.966062846
E3: Human Flight and Brain Drain	6.4	2.1097975	4.290202496
P1: State Legitimacy	10	0.9037599	9.0962401
P2: Public Services	10	0.9037599	9.0962401
P3: Human Rights	9.5	0.85857191	8.641428095
S1: Demographic Pressures	9.9	4.39729033	5.502709674
S2: Refugees and IDPs	10	4.4417074	5.5582926
X1: External Intervention	9.8	4.35287325	5.447126748

3.2 Model analysis

Through the calculation of weight matrix Q_a, it can be seen that the southern Sultan food factors accounted for 0.5964, indicating that the food is the restricti factors of southern Sultan climate; we can see the food factors impact on cohesion, economy, politics, social indicators through weight vector:

$$Q_1 = (0.1235, 0.3279, 0.0474, 0.5011)$$

We can see that the largest proportion is social 0.5011 and economy 0.3279Showing that the most direct and maximum increase in the social and economic vulnerability of South Sultan is the food shortage, this is the most important way for climate to affect the CFI index in South Sultan, the grain is the decisive factor in the climate factors, and the other ways are indirect ways, which are consistent with the national conditions.

If there is no impact on the climate, CFI will obviously reduce, The following is the main approach to climate impactfood as an example: If a good climate suitable for crop growth, grain yield will, grain proportion will reduce in the climate factors, the decisive factors influencing the vulnerability is no longer obvious, which makes the economic vulnerability index and social vulnerability index decreased, so that the total number of CFI decreased.

Model of the actual argument: establishing new pairwise comparison matrix, it will be substituted into the model of computation, we can get the new W_C, W_E, W_P, W_S, the proportion of the new allocation table will be made as well (ignoring), the climatic factors was 22.63%, non climatic factors was 77.27%, Assuming that the non climate influence factors are constant, the new$CFI = 110.92$ is calculated according to the ratio, and the vulnerability is obviously reduced.

4 Task 3

In order to solve Task 3 we choose Japan for analysis.
Reasons: Japan fluctuated between the stable and Vulnerable ranks in the FIS in 2006-2017. It will not change dramatically due to the stability of climate change. So choose Japan, we can more easily study the law of its critical change.

4.1 CFI Model in Japan

4.1.1 Background information

Japan is an island nation composed of four large islands and more than 7,200 small islands. At the same time, it is a highly developed capitalist country, one of the industrial powers and the third largest economy in the world. But it is a natural disaster-prone country, while its lack of resources is extremely dependent on imports.
Japan is dominated by temperate and subtropical monsoon climate, hot and rainy in summer, cold and dry in winter and distinct in four seasons. North-South temperature difference is very significant. At the same time, Japan is the area with more precipitation in the world.
Food: Compared to the world average, Japan's per capita food production is below the world average
and its food self-sufficiency rate has been consistently the lowest among developed countries.
Fresh water: Japan is rich in water resources but freshwater resources are scarce, with per capita freshwater resources accounting for three-fifths of the world's average water resources.
Energy: energy is relatively scarce, per capita energy consumption is higher than the world average.
Disaster: Japan is a country with multiple natural disasters and accounts for about one-third of the total losses in the world at average annual disaster losses. It can be seen that the disaster in Japan is the most influential climatic factor. Below is a list of climatic factors:

Table 8:Japan and World Comparison Table

Elements	World average	South Sudan
Fresh water per capita /m^3	5919	3378
Per capita food production(grain) / ton	3.99	0.013
Total electricity consumption per capita / kwh	4271.5	7371.62
Annual average disaster loss / x10^8\$	306	134.3

4.1.2 Model Analysis

Analysis of Japan using the CFI model yielded

$$W_i = (0.12774539, 0.340185, 0.145102, 0.387007)$$

Table 9:CFI model results of Japan

Component	Total	climate: 27.97%	non-climate 72.03%
Total	37.4	28.1923015	85.70769849
C1: Security Apparatus	1.6	10.46099196	26.93900804
C2: Factionalized Elites	2.6	0.204392624	1.395607376
C3: Group Grievance	3.7	0.332138014	2.267861986
E1: Economy	4.1	0.472657943	3.227342057
E2: Economic Inequality	1.6	1.394758746	2.705241254
E3: Human Flight and Brain Drain	3.2	0.544296096	1.055703904
P1: State Legitimacy	1.2	1.088592192	2.111407808
P2: Public Services	2.2	0.174122964	1.025877036
P3: Human Rights	3	0.319225434	1.880774566
S1: Demographic Pressures	6	0.43530741	2.56469259
S2: Refugees and IDPs	4.4	2.32204248	3.67795752
X1: External Intervention	3.8	1.7028311524	2.329373096

Climatic factors accounted for 27.97%, non-climatic factors accounted for 72.03%, in the CFI classification within a stable stage. According to the analysis of Japan's situation, Japan is a country where natural disasters occur frequently. The climate performance of the country's vulnerability mainly depends on natural disasters. The S indicator has the largest share of the C P E S indicators. Because of the direct impact of natural disasters on the S index led to its relatively maximum weight. Therefore, the establishment of this model can be the most important factor for national analysis in order to formulate appropriate measures.

4.2 Definitive indicators

In order to analyze the decisive factor in the CFI model, we use gray relational analysis to find the correlation between 12 indicators and vulnerability index. Then, the relevancy of the second-level indicators of the CEPS index including 12 indicators is summed up respectively. The weight of the climatic factor found in the CFI model is multiplied by the sum of the correlations. So get the maximum value is the decisive factor. Which can also be analyzed under the CEPS indicators contained the most relevant secondary indicators, further understanding of the decisive indicators of refinement.

Step1: The establishment of gray correlation analysis model, the specific steps are as follows:

(1) Determine the data sequence

According to the indicators in 2006-2017, we establish the data of each indicator. (http: fundforpeace.org/fsi/data/) The data sequence $X_1^{,} = \{x_1^{,}(1), x_2^{,}(1), \ldots, x_n^{,}(1)\}$, the n data sequences form the following matrix:

$$(X_1^{,}, X_2^{,} \ldots, X_n^{,}) = \begin{pmatrix} x_1^{,}(1) & x_2^{,}(1) & \ldots & x_n^{,}(1) \\ x_1^{,}(2) & x_2^{,}(2) & \ldots & x_n^{,}(2) \\ \vdots & \vdots & \vdots & \vdots \\ x_1^{,}(m) & x_2^{,}(m) & \ldots & x_n^{,}(m) \end{pmatrix}$$

M is the number of elements.

(2) Determine the reference data
The 2006-2017 Fragile Indicator value is used as a reference data column and is recorded as $X_0^{'} = \{x_0^{'}(1), x_0^{'}(2), \ldots, x_0^{'}(m)\}$
(3)btained gray correlation coefficient
Since the data sequence itself has the same magnitude, there is no need to dimensionless. Directly gray correlation coefficient calculation, find the reference series and comparison series gray correlation coefficient ξ the formula is:

$$\xi_{oi} = \frac{\Delta(min) + \rho\Delta(max)}{\Delta_{oi}(k) + \rho\Delta(max)}$$

Where ξ is the resolution coefficient, generally between 0 and 1, and usually takes 0.5; Δ_{min} is the minimum difference between the two levels; Δ_{max} is the maximum difference between the two levels; and each point on the Xi curve of each comparison series is compared with the X_0 curve on the reference series The absolute difference of each point, denoted as $\Delta_{oi}(k)$.
(4) Find the degree of correlation r_i

$$r_i = \frac{1}{N}\sum_{k=1}^{n} \xi_i(k)$$

The closer the value is to 1, the better the correlation.
Calculated correlation values of the indicators as shown below

Table 10:Relevance of each indicator value

Indicator	Correlation
C1: Security Apparatus	0.8095
C2: Factionalized Elites	0.7845
C3: Group Grievance	0.9062
E1: Economy	0.9129
E2: Economic Inequality	0.8527
E3: Human Flight and Brain Drain	0.9214
P1: State Legitimacy	0.917
P2: Public Services	0.7554
P3: Human Rights	0.9144
S1: Demographic Pressures	0.937
S2: Refugees and IDPs	0.7039
X1: External Intervention	0.874

Step2: Respectively, including 12 indicators of the four aspects of the degree of correlation obtained.

$$C_i = C_{i1} + C_{i2} + C_{i3}$$

C_i ndicates the degree of association of each of the four aspects, C_{i1}, etc. indicates the degree of relevance of the indicators included in each aspect.
Step3: By multiplying the weight of the climatic factors found in the CFI model with the

sum of the degree of relevance, the maximum value is the decisive factor.

$$D_i = W_i \times C_i$$

$D_i$represents the decisive value of each of the four dimensions, W_i being the weight of each. D_C= 0.32, D_E = 0.91, D_P = 0.38, D_S = 0.97, D_S> D_E> D_C> D_P.
From this, it can be concluded that the decisive indicators of national vulnerability are mainly S and E indicators, of which S1: Demographic Pressures and E3: Human Flight and Brain Drain are the most relevant in S and E indicators. It can be seen that S1 and E3 are the more important and decisive indicators.

4.3 A tipping point

In Section 4.2, we have calculated that the proportion of climatic factors in Japanś Vulnerability Index is 27.97% and the nonclimatic factor is 72.03%. Japan's vulnerability index is known to be 37.4 in 2017 and is in a stable state. Japan is likely to become relatively vulnerable as climate change worsens its vulnerability. The threshold for relative fragility and steady state is 40. To study how Japan reaches the critical value of 40, we establish the following function:

$$T_P = FSI(P_C/P_C^{'} + P_U/P_U^{'})$$

Where TP is the critical value, FSI is the current national vulnerability index, P_C refers to the proportion of climate factors, $P_C^{'}$ is the proportion of climate factors after climate change. P_U is the proportion of non-climate factors, $P_U^{'}$is the proportion of non-climate factors.
Knowing $Japan's$ climate change its critical value can not directly reach the standard value of 40, only greater than it. The calculated critical value is 42.45. The proportion of climatic factors is 28.09% and that of nonclimatic factors is 71.91%. By analyzing the 2006-2017 data, we know that the vulnerability index of Japan was 43.5 in 2012, which is mainly related to the earthquake in Japan in 2012. According to the corresponding situation in Japan, the impact of natural disasters on the CEPS index further increased the vulnerability index , Making the country more vulnerable.

5 Task 4

5.1 Intervention measures

(1) The ecological natural: Finland ẗhe conservation and sustainable use of biodiversity action planïs also regulation measures for considering the effects of climate change, and adapt to these measures in terms of biodiversity conservation. To adapt to climate change request to strengthen the knowledge base and monitoring, ecological function and abundant nature reserve system, strengthen the link between these areas, including proper consideration in land use planning of green and blue infrastructure.
(2) Economic health: climate change will lead to cost, because the related events, such as flood, drought, increased incidence of pests, environmental damage, and have led to an

increased incidence of hot weather, etc., may need to change, including loss of income or additional fees.
(3) Urban construction: adapt to climate change through green urban areas. The ürban greenïs also conducive to mitigating climate change, maintaining and forming carbon reserves and reducing the leaching of nutrients. This also enhances the ecological environment and ecological diversity of the builtup area.
(4) Water resources management: the water resources management plan currently under preparation is also considering different regions.The impact of change and appropriate consideration of adaptation measures. Adaptive capacity can be enhanced by improving water and nutrient retention, such as buffer zones, wetlands, and erosion reduction.
(5) Agricultural management: multiple projects will cooperate with national and local organizations. The techniques include drip irrigation, roof rainwater collection, protects agriculture, farmland forestry and pest management[5].

5.2 Model validation

Practical demonstration of the model: After applying the intervention measures, the grain output will increase accordingly. The planning and utilization of fresh water will be more reasonable; "Urban greenc̈an save energy and reduce emissions and improve energy efficiency; Ecosystems tend to be stable and biodiversity increases; Losses from natural disasters are reduced. According to the new environmental climate state, a pair comparison matrix was established, and the operation of the model was replaced by the consistency test.
Conclusions: W_C=0.1867, W_E=0.3046, W_P=0.2147, W_S=0.2940 The new factor proportional distribution table (process strategy), climate impact factor was 25.39%, and non-climatic factors were 74.61%. Assuming that the nonclimate impact factor does not change to 13.55, the new CFI=13.55/74.61%=18.16< 18.7, obviously, the vulnerability decreases.Therefore, it can be seen that the intervention measures taken by the state can mitigate the risks of climate change and prevent a country from becoming a f̈ragile stateänd the intervention effect is more obvious.

5.3 Cost prediction of intervention measures

(1)through consulting and analyzing data, this paper selects the most important interventions in Finland: establishing nature reserve system, building flood control works, soil and water conservation and new agricultural technology. The cost of Nature reserve is related to its area, the cost of flood control engineering is related to its quantity, the cost of soil and water conservation engineering is related to its size, the cost of agricultural new technology is related to its technological content, we can predict the total cost of the interventions by appling the appropriate correction factor.
(2)we can learn about the changing trends of the cost of climate interventions in Finland in the last decade by accessing to information.This is a small sample data, the information we know is limited, we only know the value of the cost over the years .Without knowing its influencing factors, grey prediction can be carried out, and the total cost is calculated by MATLAB. Then, according to its policy changes and climate change trends,

the results are revised.

6 Task 5

The reason for selecting urumqi in China is that the city has a vulnerability assessment system, which can be verified with this model.

6.1 CFI Model in Urumqi

Referring to the environmental and climatic conditions in Urumqi, we can get the following information by referring to the database of Urumqi environmental statistics bulletin, Xinjiang statistical yearbook, environmental quality bulletin and so on.
Climate and crop status: Urumqi is the most distant city in the world. It is a continental dry climate in the middle temperate zone. The hottest is 7 and August, the average temperature is 25.7^oC. The coldest season is January. The average temperature is -15.2^oC, the temperature difference between day and night is large, and the crops are abundant.
The status of freshwater resources: in 2012, the total water resources in Urumqi amounted to 996 million 900 thousand cubic meters, of which 919 million 800 thousand cubic meters of surface water resources and 77 million 100 thousand cubic meters of groundwater resources. But there is a problem of structural water shortage.
Energy situation: Urumqi North West Zhundong oilfield, Karamay oilfield, South Tarim Oilfield, East Turpan Hami oilfield, and is located in Junggar coal with coal coal reserves in central area amounted to 100 tons, known as the "sea of coal city". In addition, it is also rich in various colored and rare mineral resources. Energy is not rich.
We got:

$$W_C = 0.1224, W_E = 0.4862, , W_P = 0.0663, W_S = 0.3251$$

It can be seen that the climate has a great impact on the economy, while economic indicators have contributed a lot to the overall vulnerability.
Forecast: the annual average temperature of urumqi shows a significant increase trend, and annual precipitation is also increasing significantly, with an average increase of 9.2mm every 10 years. Xinjiang climate presents the trend of wet of extreme weather and climate events at the same time also showed a trend of multiple, retransmission and at the same time, urumqi and take a series of measures to resist the negative impact of the climate through the model calculation, it is concluded that the climate factors affecting the proportion and there is no obvious change.

6.2 Model verification

In urumqi, the existing urban vulnerability evaluation system on the basis of a comprehensive, scientific, such as the principle, draw lessons from the related research results, from the ecological environment vulnerability, economic vulnerability and social vulnerability evaluation index, the three aspects of selecting 34 urumqi urban vulnerability evaluation index system is constructed.The proportion of each factor is as follows:

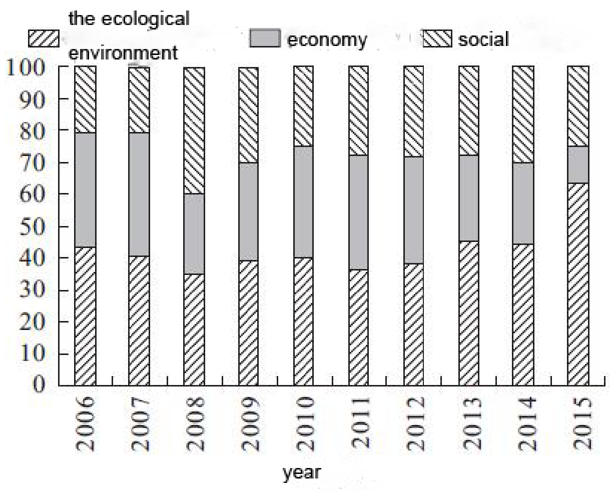

Figure3:The contribution rate of the vulnerability

It can be seen that the vulnerability of urumqi was high before 2010, and after 2010, the overall situation gradually stabilized. From the contribution analysis, urumqi social vulnerability and economic vulnerability are varying degrees of decline, but the ecological environment vulnerability growing, showing that in urumqi by economic dominant vulnerability to the urban ecological environment vulnerability city transformation. Urumqi city peopleś living standards continue to improve, has gone from a welloff gradually into the relatively rich stage, this is mainly thanks to urumqi city hightech zone is established, began the business again, in addition, as the capital city of urumqi, the state-owned collective economy is given priority to, a variety of ownership economy common development pattern has been formed, promote the development of the economy[6]. This is consistent with the conclusion of the model that the climate plays a dominant role in the economy.

6.3 Model improvement

Then the model is applied to smaller cities, before we take the four influences indexes :cohesion index, economic, political and social indicators has not appropriate, cohesion and political indicators, for example, a city basic will not have this kind of problem, so if continue to use the model, will inevitably cause description of deviation. We need to choose better characterization for urban vulnerability index, through access to information in many ways, the portrait of a city, the application of ecological environment vulnerability (including the ecological vulnerability and environmental vulnerability), economic vulnerability (including economic structure vulnerability, economic vulnerability and vulnerability of economic innovation), the social vulnerability (including the vulnerability of human development, infrastructure, brittleness and the social environment vulnerability) three indicators more appropriate.

7 Conclusion

7.1 Conclusion and promotion

The impact of climate change makes the region unstable, and its impact changes the country's vulnerability indicators. This model helps us further understand the mechanism of climate impact on national vulnerability, and help us to make targeted rectification. This will not only stabilize the region as soon as possible, but also reduce our investment in policies and measures. This paper further promotes the model, and establishes a more suitable model for the use of small countries or cities. The model has the characteristics of simple, practical and sensitive. If it is popularized, it can provide convenience for the government to find the solution quickly.

7.2 Strengths and weaknesses

7.2.1 Strengths

(1) According to Fragile States Index, this article established the CFI model. Based on the Fragile States Index, the model divides the climatic and non climatic factors in 12 indicators. When climate changes, changes in CFI can be clearly observed. At the same time, it can be observed how climate change directly or indirectly affects the outcome.
(2) The model determines the weight of each layer through AHP, and systematically analyzes the interrelationship of 12 indicators. Qualitative and quantitative combination of the difficult to quantify the problem into a multilevel singlegoal problem.
(3)CFI model is calculated and available on the data available for analysis and calculation, the model is simple. In the meantime, this model is also applicable to different climates in different countries. It can only be obtained by importing the data of food, freshwater, disasters and energy according to the local climatic conditions. It has universal promotion and local conditions.

7.2.2 Weaknesses

(1) The CFI model uses a composite index approach to analyze national vulnerabilities. However, the reasons for the formation of vulnerability and performance characteristics vary in space and time. Therefore, it is very complicated to set up crossregional and interperiod indicators. At the same time, the validity of the evaluation results obtained by the index system evaluation method is rarely confirmed [7]. The 12 conflict risk indicators of the "CAST" conflict assessment framework are adopted directly, yet these 12 indicators do not fully reflect the vulnerability of a country.
(2) The 12 indicators are classified as cohesion, economic, political, social four aspects, in determining the climate of food, fresh water, energy, disasters on the above four aspects of the relative weight of a certain subjectivity.
(3) This model has less quantitative data, more qualitative components, limitations, not easily convincing. Even in a simple system or region, it is difficult to fully consider all the variables and interference factors [8].

8 References

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