Environmental vulnerability resolution

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Abstract

In Task 1, the mixed model of principal component analysis and grey prediction is established as an optimization model by analyzing various unstable indexes at home and abroad. Select constants and critical points and calculate whether the defined state is fragile or stable. Climate change has a direct impact on social instability such as temperature, rainfall and indirect impact on the economy, population, etc. In Task 2, we carefully compared the top 10 data on the index of vulnerable countries.In the end, we chose Somalia as a specific research object.Somalia is hot and dry all year round. This severely restricts the growth of plants and animals, thus affecting the normal lives of people and increasing the vulnerability of the country. The data from the model we selected suggest that without this, the state might have improved. In Task 3, we analyzed and chose a country,North Korea, with a vulnerability index that was not in the top 10. The vulnerability of this country is measured in accordance with the criteria referred to above. Using grey prediction, we can know when the country becomes vulnerable and reaches a critical point. In Task 4, we explain the impact of human intervention by using models that demonstrate that interventions driven in a stable state mitigate the risk of climate change and prevent countries from becoming fragile. We calculate the total cost of intervention, as described later. In task 5, we analyzed the practicability and generalization of the model, and found that there are many improvements. For example, whether to consider the cost,the influence of natural factors and social conditions, and so on. We continue to expand the data range and take into account more factors to finish the future work.

Keywords

Principal component analysis; grey prediction; climate change; vulnerability index; human intervention; future work.

1. Introduction

1.1 Backgrounds

The so-called vulnerable countries are states where the state Government is unable or unwilling to provide essential elements for the people. Although the current trend of economic globalization has become mainstream, many countries are still at the stage of vulnerable countries. This is particularly prevalent in developing countries. And those countries are more vulnerable to the effects of climate change because of vulnerability. So how does climate change affect it [1].

- Sea level rise will exacerbate extreme days. The occurrence of gas events makes coastal areas more vulnerable to storms and floods.
- With regard to the impact of climate change on population migration, sea level rise would disrupt the living conditions of coastal populations and increase the likelihood of migration and relocation.
- Affected by climate change, sea level rise and reclamation, the coastal areas of our country face the risk of extreme rainstorm, flooded farmland and collapse of critical infrastructure.

How to assess national vulnerabilities and risks in the context of climate change? What state-driven intervention can mitigate the risk of climate change? What are the effective theoretical frameworks for climate change adaptation analysis? These questions deserve further study and discussion.

1.2 Restatement of questions

In today's world, climate variability, including increased droughts, shrinking glaciers, changes in plant and animal species, and rising sea levels are already being achieved. These climate changes can lead to increased national vulnerability and may also affect the way people live. The increase of vulnerability will lead to a series of problems such as the economic development of the country and the limitation of human existence. Moreover, the vulnerability index of vulnerable countries rose from 2006 to 2017, albeit with fluctuations, but remained stubbornly high.In this state, regional stability is bound to be affected[2].

The principal component Analysis model and grey Prediction model are used to analyze the vulnerability index of selected countries over the years. The vulnerability of future countries can be known through forecasts to prevent risk generation and determine climate impacts, as well as to improve the evaluation of the strengths and weaknesses of selected models. Finally complete all Tasks.

2. Assumption

Assume that climate change is the main cause of national vulnerability, others are secondary. This is more conducive to studying how climate change affects regional in stability.

There is no strong external impact on the country or region in the short term.

There were no accidents in the predicted year that changed the basic structure of the country. Significant accidents, such as disease and war, have a significant impact on national vulnerability, and because of their unpredictability, this paper assumes that there are no accidents in the predicted year. Suppose we use more accurate data.

3. Model

3.1 The Index Set

Given that the accuracy of the model depends on the accuracy of the data, we've collected a lot of reliable data.The data applied below is acquired from literature[1].

- SA(Security Apparatus): National security agencies, reflecting national security.
- FE(Factionalized Elites): The elites of all aspects reflect the national construction cause.
- GG(Group Grievance): Public complaints, reflecting the state of society.
- EC(Economy): National economic development, reflecting national strength.
- UD(Economic Inequality): Economic imbalance, reflecting the confusion of supply and demand of national economy.
- HF(Human Flight and Brain Drain): Talent transfer, reflecting the weakening of the national superstructure.
- SL(State Legitimacy): The legal effect of the state ,reflects whether the state power is reasonable.
- PS(Public Services): Service industry, reflecting the national standard of living.
- HR(Human Rights): Civil rights, reflecting the state of the people's livelihood.
- DP(Demographic Pressure):Population load, reflecting the national population burden.
- RD(Refugees and IDPs): Displaced people, reflecting the National Happiness Index.
- EX(External Intervention): External conditions, reflecting the adaptability and coordination of the country.
- And, of course, the most important data in this case, climate data. Mainly used to study the impact of climate on national vulnerability. As follows:
- National rainfall
- National temperature change

The data will help us build the model next.

3.2 Data Processing

Because fragile countries all over the world are countless and models should apply to all countries,we choose Somalia and North Korea as the studying samples.

Somalia Annual vulnerability in the world's top 10, more representative.North Korea, though not in the top ten, is equally vulnerable. Both as Task two and Task three are very suitable for the subjects.

3.2.1 Preliminary definition

Before the model is established, we need to define a constant a as a criterion for judging vulnerability and to give clear boundaries. The specific criteria are shown in table I. We use a to represent a vulnerability constant.

Table 1. Standard definition of vulnerability constants

A	>-2.0297	=-2.0297	<-2.0297
class	Strong vulnerability	Moderate vulnerability	Weak vulnerability

Note: When A>-1.8000, countries are extremely vulnerable countries.

3.2.2 Data filtering

Due to the large number of vulnerable countries, we are unable to analyze all national data. So in the following model, we screened the data from 21 countries to calculate the comparison. After the vulnerability constants are obtained, the vulnerability of the selected country is judged, and according to this set of data, we develop a corresponding policy and propose solutions to the vulnerability of future countries. Summing up the above, it can be summarized as:

1) Vulnerable countries need to be representative.

2) Moderate number of data, easy to analyze.

3) Predicted data needs to be realistic and accurate.

4) The solution should be concrete and practical.

3.3 The establishment of the model

This problem we use the principal component Analysis model and the grey Prediction model. Principal component analysis is mainly used to determine the vulnerability of a country and the impact of climate on national vulnerability, while grey forecasting models are used to predict when countries become more vulnerable.

The measurement and judgment criteria for vulnerability are given above (using constant a). For how climate change impacts vulnerability, see Figure 1.[4]

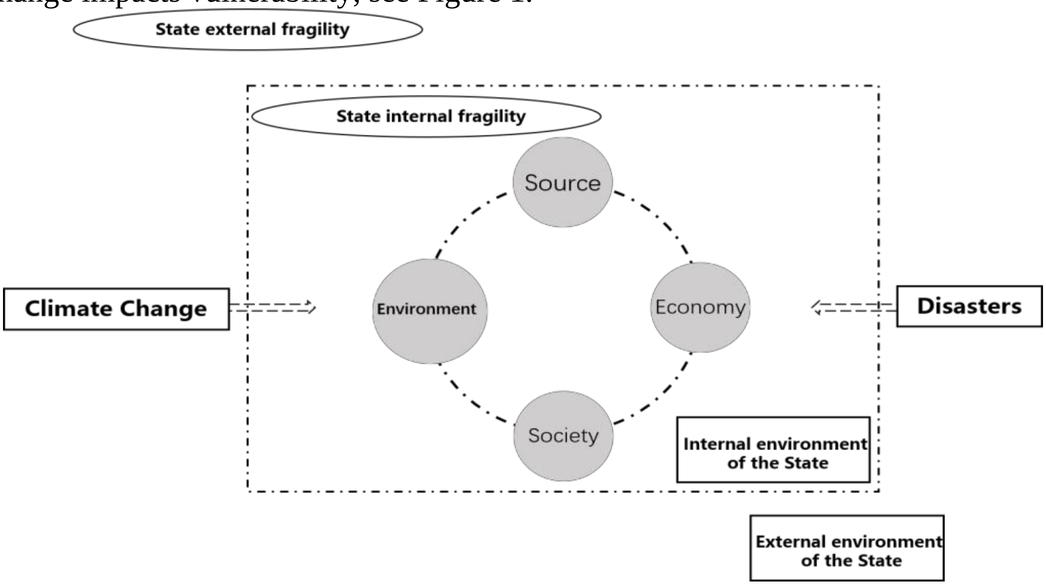

Figure 1. Climate Impact Flow Chart

Principal Component Analysis Model

The main purpose of principal component analysis is to use fewer variables to explain most of the variation in the original data, and to convert many of the highly correlated variables in our hands into variables that are independent or unrelated to each other. It is usually the selection of several new variables that are less than the number of original variables, which explains the variation in most of the data, the so-called principal component, and the comprehensive index used to interpret the data.Its basic ideas and methods are as follows:

Suppose that the index variable of factor analysis has p: $x_1, x_2, \dots, x_p$, there are n evaluation objects, the jth index of the ith one evaluates to the value of x_{ij}. Convert each index value $\widetilde{x}_{ij}$ to standard index ,

$$\widetilde{x}_{ij} = \frac{a_{ij} - \mu_j}{s_j}, \quad (i=1,2,...,n;j=1,2,...,m) \text{.................(Formula 1)}$$

$\mu_j = \frac{1}{n}\sum_{i=1}^{n} a_{ij}$, $S_j = \frac{1}{n-1}\sum_{i=1}^{n}(a_{ij} - \mu_j)^2$,(j=1,2,...,m)that is, the μ_j, s_j is the sample mean and the standard deviation of the jth index.Correspondingly,

$x_i = \frac{x_i - \mu_i}{s_i}$,(i=1,2,...,m)is called a standardized index variable.

1)Calculate the correlation coefficient matrix R

Correlation coefficient matrix $R = (r_{ij})_{m\times m}$

$$r_{ij} = \frac{\sum_{k=1} \widetilde{a}_{ki} \cdot \widetilde{a}_{kj}}{n-1} (i,j=1,2,...,m)\text{.......................(Formula 2)}$$

2)Compute eigenvalues and eigenvectors

Calculation of eigenvalues of correlation coefficient matrix R $\lambda \geq \lambda \geq \dots \geq \lambda$,

and corresponding eigenvector $u_1, u_2, \dots, u_m, u_j = (u_{1j}, u_{2j}, \dots, u_{mj})^T$ m a new ind ex variable composed of eigenvector

$$y_1 = u_{11}\widetilde{x}_1 + u_{21}\widetilde{x}_2 + \dots + u_{m1}\widetilde{x}_m$$

$$y_2 = u_{12}\widetilde{x}_1 + u_{22}\widetilde{x}_2 + \dots + u_{m2}\widetilde{x}_m \quad \text{...............(Formula 3)}$$

....

$$y_m = u_{1m}\widetilde{x}_1 + u_{2m}\widetilde{x}_2 + \dots + u_{mm}\widetilde{x}_m$$

The $\mathbf{y_1}$ is the 1th principal component, the $\mathbf{y_2}$ is the 2nd principal component, ..., the $\mathbf{y_m}$ is the main component of the mth.

4)Select the principal component of p(p≤m) and calculate the comprehensive evaluation value.

①Calculates the information contribution rate and cumulative contribution rate of the eigenvalue λ(j=1,2,..., m).The information contribution rate of y_j is called

$$b_m = \frac{\lambda}{\sum_{k=1} \lambda} \quad (j=1,2,...,m) \text{......................(Formula 5)}$$

as the main component:

$$\alpha \frac{\sum_{k=1}^{p} \lambda}{\sum_{k=1}^{p=m} \lambda_k} \text{......(Formula 6)}$$

the cumulative contribution rate of the main component $y_1, y_2, ..., y_p$. When the α_p is close to 1 (0.85,0.90,0.95), the former p index variable $y_1, y_2, ..., y_p$ as p principal component, instead of the original m index variable, the p principal component can be analyzed synthetically.

② Calculation comprehensive score

$$Z = \sum_{j=1}^{p} b_j y_j \text{............................(Formula 7)}$$

The information contribution rate of b_j as the jth principal component can be evaluated according to the comprehensive score value.

Grey Prediction Model

The main task of the grey System theory modeling is to develop and utilize the explicit and hidden information in the data of the specific grey system, and find the mathematical relationship between factors and factors. The usual approach is to use discrete models to establish a model of time-by-segment analysis.

The basic methods of factor analysis used to adopt regression analysis. There are many deficiencies in the method of regression analysis, such as requiring large amount of data, large computation and possible anomalies. In order to overcome the above disadvantages, this paper uses the method of relational degree analysis to do system analysis.

As a developing and changing system, relevance analysis is actually a quantitative comparative analysis of dynamic process development situation. The so-called development situation is compared, that is, the geometric relationship of statistical data in various periods of the system.

In order to ensure the quality of the modeling and the correct result of the system analysis, the original data collected must be transformed and processed to eliminate the dimension and comparability.

Definition 1 with sequence

$$x=(x(1),x(2),...,x(n))$$

The Mapping

$$f:x\rightarrow y$$

$$f(x(k))=y(k),k=1,2,...,n$$

is called the Data transformation of sequence x to sequence y.

When

$$f(x(k))=\frac{x(k)}{x(1)}=y(k),x(1)\neq 0 \text{ .... (Formula 8)}$$

called f is the initialization transformation.

Correlation analysis

$$\xi_i(k)=\frac{\min_s\min_t|x_0(t)-x_s(t)|+\rho\max_s\max_t|x_0(t)-x_s(t)|}{|x_0(t)-x_i(t)|+\rho\max_s\max_t|x_0(t)-x_s(t)|} \text{ ...(Formula 9)}$$

This is called the correlation coefficient of the comparison sequence x_i to the reference sequence x_0 in the k-time. $\rho\in[0,1]$ is the resolution coefficient.Generally speaking, the higher the resolution coefficient, the greater the resolutions, and the smaller the less the resolution. $r_i=\frac{1}{n}\sum_{k=1}^{n}\xi_i(k)$ is called the correlation degree of reference of x_0 to x_i.

Grey prediction refers to the use of GM model to predict the development and change of the behavior characteristics of the system, at the same time, it can estimate the time of abnormal behavior, and make a study on the future distribution of events in a particular time zone. In essence, the "stochastic process" is regarded as "grey process", "random variable" as "Grey variable", and is mainly processed by the GM (1,1) model in grey system theory.

Build a model

Forecast value $\hat{x}^{(1)}(k+1)=(x^{(0)}(1)-\frac{b}{a})e^{-ak}+\frac{b}{a}, k=0,1,...,n-1,...$

and $\hat{x}^{(0)}(k+1)=\hat{x}^{(1)}(k+1)-\hat{x}^{(1)}(k), k=1,2,...,n-1,$ ....(Formula 10)

Forecast

Based on the predicted value of the specified time zone obtained by model GM (1,1), the corresponding forecast is given according to the actual problems.

Somalia Data Processing

Upon completion of the model, we data processing the Somalia in the top 10 of the selected vulnerabilities to determine the impact of climate on vulnerability and to assess national vulnerability.See the Table 2[3].

Table 2.Data sheet of some national vulnerability indicators

	SA	FE	GG	EC	UD	HF	SL	PS	HR	DP	RD	EX
South Sudan	10	9.7	9.7	10	8.9	6.4	10	10	9.5	9.9	10	9.8
Somalia	9.4	10	8.9	8.9	9.3	9.8	9.3	9.0	9.5	10	10	9.3
Central African Republic	9.0	9.7	9.1	9.1	10	7.5	9.7	10	9.7	9.0	10	9.8
Yemen	9.8	9.5	9.3	9.3	8.2	7.3	9.7	9.6	9.7	9.3	9.4	10
Sudan	9.0	9.8	10	8.4	8.4	6.6	9.6	9.5	9.8	9.4	10	9.5
Syria	9.8	9.9	9.8	8.1	7.7	8.4	9.9	9.2	9.8	8.2	9.8	10
Congo Democratic Republic	9.0	9.8	10	8.4	8.4	6.6	9.6	9.5	9.8	9.4	10	9.5
Chad	9.4	9.8	8.0	8.5	9.1	8.8	9.1	9.7	9.1	10	9.6	8.3
Afghanistan	10	8.6	8.4	8.3	7.5	8.2	9.1	9.7	9.1	10	9.6	8.3
Iraq	10	9.6	9.6	6.6	7.3	7.7	9.5	8.2	8.7	8.6	9.9	9.7
Haiti	7.7	9.6	6.5	8.7	9.6	8.8	9.7	9.7	7.6	9.5	7.7	10
Guinea	8.8	9.6	8.6	9.2	7.7	7.4	9.6	9.5	7.7	8.7	8.2	7.4
Nigeria	9.2	9.6	9.2	8.0	8.6	7.2	8.6	9.2	8.9	9.1	7.5	6.5
Zimbabwe	8.1	9.8	7.3	8.6	8.6	7.9	9.2	8.9	8.2	9.1	8.5	7.5
Ethiopia	8.4	8.7	9.1	7.0	6.5	7.6	8.2	8.8	9.0	9.8	9.3	8.7
Guinea Bissau	8.9	9.6	5.2	8.3	9.1	8.1	9.2	9.4	7.5	8.6	7.3	8.3
Burundi	8.8	8.2	7.9	8.0	7.2	6.3	8.8	8.0	8.8	9.3	8.6	9.0
Pakistan	9.1	8.9	10	6.9	6.5	7.2	8.1	7.7	8.0	8.4	8.7	9.4
Eritrea	7.2	8.1	7.1	8.1	7.8	8.3	9.3	8.4	9.0	8.8	8.3	7.7
Niger	8.7	8.9	8.0	7.5	8.6	7.6	7.3	9.5	6.5	9.0	7.9	8.1
Cote d'Ivoire	7.7	9.1	8.1	6.6	8.0	7.3	7.9	8.7	7.9	8.2	7.8	9.2
Angola	6.5	7.2	7.5	6.4	9.9	6.6	8.6	9.1	7.3	9.5	7.1	5.4

The principal component analysis of 10 evaluation indexes was carried out by using MATLAB software, the first several characteristic roots and the contribution rate of the correlation coefficient matrix were as table 3.

Table 3.Principal Component Analysis method

	Characteristic root	Contribution rate	Accumulate contribution rate
1	4.6603	38.8359	38.8359
2	2.5478	21.2318	60.0677
3	1.3033	10.8612	70.9289
4	0.9545	7.9544	78.8833
5	0.7184	5.9866	84.8699
6	0.5172	4.3101	89.18

We can see that the cumulative contribution rate of the first two characteristic roots is over 90%, and the principal component analysis is very good. The following selection of the first four main (cumulative contribution rate reached 98%) for comprehensive evaluation. The eigenvector corresponding to the first four eigenvalues is shown in table 4.

Table 4.The eigenvector corresponding to the first 4 principal components of a normalized variable

	~x1	~x 2	~x 3	~x 4	~x 5	~x 6	~x 7	~x 8	~x 9	~x10	~x11	~x12
First eigenvector	0.3523	0.3374	0.2576	0.3271	0.0435	0.0613	0.3371	0.2221	0.3764	0.1512	0.3395	0.3098
Second eigenvector	-0.1798	0.0822	-0.3941	0.3138	0.5344	0.2183	0.1708	0.4352	-0.1407	0.2410	-0.1994	-0.1942
Third eigenvector	0.1047	0.4181	-0.2601	-0.0187	-0.0614	0.5375	0.0395	-0.1634	-0.2082	-0.5264	-0.1187	0.3013
The four eigenvector	0.0456	-0.1814	-0.119	-0.1559	-0.158	0.6694	-0.2010	-0.1936	0.1138	0.5583	0.2221	-0.0403

Four principal components can be

$$y_1 = 0.3523\,\tilde{x}_1 + 0.3374\,\tilde{x}_2 + \dots + 0.3098\,\tilde{x}_{12}$$

$$y_2 = -0.1798\,\tilde{x}_1 + 0.0822\,\tilde{x}_2 + \dots - 0.1942\,\tilde{x}_{12}$$

$$y_3 = 0.1047\,\tilde{x}_1 + 0.4181\,\tilde{x}_2 + \dots + 0.3013\,\tilde{x}_{12}$$

$$y_4 = 0.0456\,\tilde{x}_1 - 0.1814\,\tilde{x}_2 + \dots - 0.0403\,\tilde{x}_{12}$$

From the coefficient of principal component, it can be seen that the first principal component mainly reflects six indicators, including national security, social complaint, economic situation, civil rights, refugee status and external intervention.The second principal component mainly reflects the uneven distribution of economy and the

State of public service.The third main component mainly reflects the situation of facti on elites.The fourth main component mainly reflects the brain drain, state legality and population pressure status.The four principal component values of each country can be obtained by substituting the standardized data of the original 12 indicators of each country into four principal component expressions.

Based on the contribution rate of four principal components, the main component comprehensive evaluation model was constructed:

$$A = 0.4660\, y_1 + 0.2548\, y_2 + 0.1303\, y_3 + 0.0955\, y_4 \quad \ldots\ldots\text{(Formula 11)}$$

By substituting the four principal component values in each country, a comprehensive evaluation of the vulnerability of countries and the results of their ranking can be obtained, as shown in table 5.The table clearly reflects the comprehensive evaluation of the regions and makes a comparison.

Table 5.Rankings and some comprehensive evaluation results

Country	Somalia	South Sudan	Central African Republic	Sudan	Chad	Syria	Afghanistan	Yemen
Rank	1	2	3	4	5	6	7	8
Comprehensive evaluation Value	1.3735	1.2260	1.1009	0.9746	0.8458	0.7063	0.6535	0.5289
Country	Iraq	Zimbabwe	Congo Democratic Republic	Nigeria	Ethiopia	Guinea	Burundi	Haiti
Rank	9	10	11	12	13	14	15	16
Comprehensive evaluation Value	0.5289	0.4004	0.0079	-0.0041	-0.0228	-0.1931	-0.4001	-0.6981
Country	Eritrea	Code d’Ivoire	Guinea Bissau	Pakistan	Niger	Angola		
Rank	17	18	19	20	21	22		
Comprehensive evaluation Value	-0.7082	-0.9277	-0.9801	-1.2513	-1.3163	-1.8448		

It can be seen from the graph that the Somalia Comprehensive evaluation Index is more than -2.0297, and it is in the first place, which shows its fragility is very strong, and its fragility is characterized by the indicators in the above table. The climate we are studying is the impact of vulnerability by influencing indicators.

We have reviewed the relevant information about Somalia, especially the climatic conditions, and have found many discoveries.Somalia year of high temperature and drought, the annual average temperature can reach 28~30℃.Bad weather has affected people's health and economic situation, and also increased the number of refugees.We use the correlation degree to analyze the correlation of climatic conditions,as shown in table 6.

Table 6. Correlation degree of climatic conditions

Climatic indicators	Annual average temperature	Rainfall
Correlation coefficient	0.5737	0.5784

The rainfall figures in recent years are shown in Figure 2.[5]According to UN standards, annual rainfall below 200mm is called drought.A year is into dry and rainy seasons.Data show that rainy season is becoming more and more concentrated.

So,climate change causes extreme weather to become more frequent.On the other hand,the public services in Somalia is very fragile.The state can not deal with climate change well.Consequently，Somalia becomes more fragile year by year.

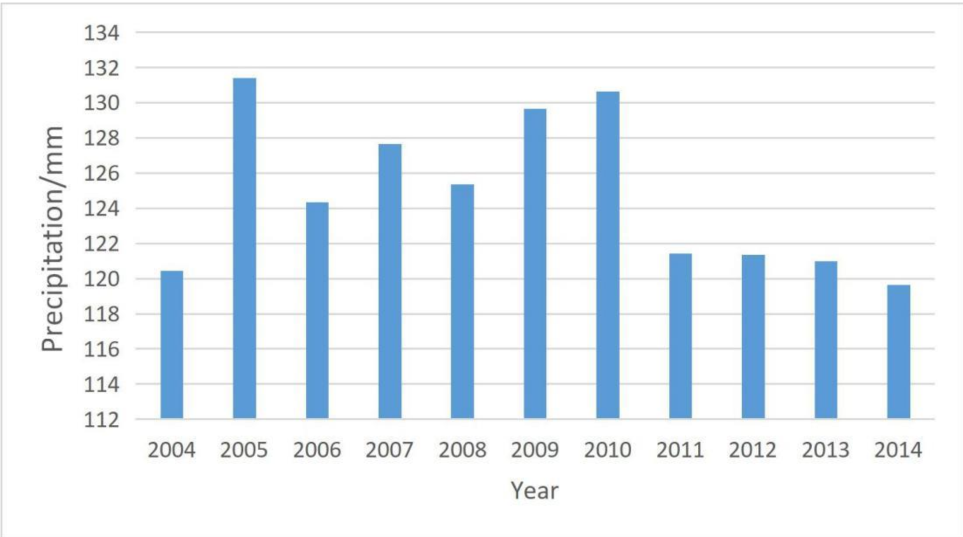

Figure 2. Somalia Annual Rainfall

The above figures and graphs show the specific ways in which climate conditions can increase national vulnerability. Without the effects of drought, the state would not be so vulnerable.

Angola Data Processing

Although Angola's vulnerability is not at the top 10, the data from table 2 can be seen to be rather fragile. From table 5, the index of vulnerability comprehensive evaluation is -1.8448.We also collected climate information on Angola and found a significant correlation with vulnerability.

Generally speaking, the north of Angola more precipitation, inland areas than the same latitude of the coastal plain wetter, and with the increase in latitude, annual precipitation growth. Angola has a clear dry and rainy season, the northern region every year September to the next April is the rainy season here, of which January and February, the rain is relatively weak; The southern rainy season began in November each year and lasted until the following February, the hot weather and the humid air. The dry season in the north is May to August every year, the southern dry season is longer, from March to October, because every morning is foggy, and is called Angola "fog season", the climate is cool, the average temperature of about 24 degrees, although it is called the dry season, but not dry, humid air, but no rain. July and August are the coolest season of the year, there will also be frost at high latitudes and high-altitude areas, and in some areas the rainy season will be linked with torrential rains, which can easily cause floods. The Congo River basin is a typical tropical rainforest climate zone, with lush forests and heavy rains throughout the year.[6]

It should be noted that the Kwanzaa River River basin in Angola is hot and humid, prone to the hot and humid conditions of endemic and contagious diseases such as malaria, which has been plagued by many endemic and infectious diseases. Heavy rains have encouraged the breeding of malaria mosquitoes, making the "vicious fever" of malaria a "super endemic" here. This has, to some extent, prevented the integration of Angolan peoples and cultures.

We then use the grey Prediction model to predict when it will become more vulnerable. The critical point of the definition is shown in table 1.

When a>-2.0297, the country is a vulnerable country;

When a<-2.0297 the country as a stable country;

When a>=-1.8000, the country is extremely vulnerable

Table 7.Angola 2011-2017 Comprehensive evaluation form

Year	2011	2012	2013	2014	2015	2016	2017
Rank(k)	1	2	3	4	5	6	7
Vulnerability constants	-1.8781	-1.8759	-1.7557	-2.0279	-1.9808	-1.6135	-1.8448

Write out the initial sequence

$$x^{(0)} = (-1.8781, -1.8759, -1.7557, -2.0279, -1.9808, -1.6135, -1.8448)$$

Because $x^{(0)}(i)$ is a critical value to satisfy $x^{(0)}(i) \geq -1.8000$,The index of easy lower bound is listed as

$$x_{\varsigma}^{0} = (-1.7557, -1.6135)$$

The corresponding number of times is listed as

$$t = (3,6)$$

To add a sequence t to 1 times,

$$t^{(1)} = (3,9)$$

The establishment of the GM (1,1) model is

$$u\hat{} = (a,b)^{T} = (-1,0)$$

$$\hat{i}^{(1)}(k+1) = 3e^{k} \qquad \text{(Formula 12)}$$

Through (Formula 12), the prediction to the 3rd data is

$$t^{(0)}(3) = 14.0123$$

Since 14.0123 differs from 7 by 7.0123, this indicates that extreme vulnerability will occur after seven years, that is, 2024.

3.4 Solutions and Expenses

3.4.1 Coping strategies

After collating the data, we have basically identified the country's vulnerability. At this point, we should consider ways to address or weaken national vulnerabilities [7].Comprehensive consideration, only by the regulation of the laws of nature is not enough, there must be human intervention to mitigate the risk of climate change and prevent countries from becoming vulnerable countries.How can we implement it[8]?

First, to improve urban resilience to climate change and natural disaster. We should strengthen the medium and short term and meticulous forecast of extreme climate change and major climatic phenomena and their impacts, improve the accuracy and timeliness of major meteorological disaster forecast, and form a nationwide, multi-level and reasonably-arranged meteorological monitoring and forecasting network to realize the early warning analysis and risk analysis of disastrous climatic events.

Second, to strengthen urban response capacity for climate change and natural disaster. Set up different level natural disaster emergency disposal system and response system, set up the vertical organization commanding system of grading response and territorial management, construct the horizontal department cooperation system of information sharing and division cooperation, and set up the disaster emergency disposal system which the Government, enterprise and the masses respond together.

Third, accelerating urban resilience to climate change and natural disaster recovery. To give full play to the government's important role in post-disaster reconstruction, the government should do a good job in reconstruction and recovery after the disaster from the aspects of organizational leadership, safeguard measures, responsibility implementation and policy measures. The Government strengthens the fund and the material management, strengthens the supervision, manages the post-disaster reconstruction and completes the daily work relations, guarantees the post-disaster recovery reconstruction work solid advancement[9].

3.4.2 Cost overhead

From these strategies, we need to invest about 100 million funds, including network construction, department building and post-disaster Reconstruction. At the same time, we need a lot of human input, including government, citizen and society. and medical standards, public services and other infrastructure construction needs to be valued.

3.5 Further Discussion about the Model

3.5.1 Difference in the type of regions

The principal component Analysis model and grey Prediction model are used to solve this problem effectively. However, the applicability of the model is also affected by the difference between the range size and other characteristics. This shows that our model works in smaller cities or larger continents, and requires a good tuning path.

3.5.2 Model Improvement Method

In view of the above characteristics and analysis, we have discussed and obtained the improved method. To construct a path analysis of cities and continents adapting to climate change[10]:

First of all, to clarify the global, national and regional climate characteristics, climate change trends, especially extreme weather phenomena, clear the human economic and social system and climate change, such as the interrelationship between human economic activities to reduce and mitigate its impact on climate change.

Therefore, we should strengthen the formulation and construction of the Special Plan for climate change, and fully utilize the sketchy function of the planning to coordinate the action of various departments (regions) to deal with climate change. On the basis of planning, we should strengthen the legislation on climate change at the national level, regulate the economic and social activities of the whole society by law, define their responsibilities and obligations, and realize the climate security of sustainable development.

Secondly, we should give full play to the supporting role of science and technology to climate change. Through the use of science and technology to increase climate change law research, climate change trend prediction, climate change impact analysis, improve climate change predictability, to enhance the response to climate change, effectiveness and scientific, to mitigate the existing or possible climate change on the human economic and social negative impact. Finally, we should improve the ability of climate change adaptability city to prevent and reduce disasters.

Third, the ability to cope with climate change and to prevent extreme climatic disasters is an important aspect that embodies the level of harmonious society construction and national comprehensive strength in the next 20 years, and should integrate the response of climate change and disaster prevention and mitigation into the national security system, mobilize the whole society to enhance the ability of disaster prevention and mitigation and Reduce the risk of climate change, improve agricultural production, water resources security, public health and other areas to adapt to climate change capacity.

Only if this path is implemented perfectly will our model apply to smaller cities or larger continents and to make the model truly available for most and even all regions, with pervasive effects.

3.6 Conclusion

From the data analysis process, climate change will have a greater impact on all aspects such as economic conditions, population, social status and political aspects. Through principal component analysis and grey Prediction model, we understand the influence of each component and get the concrete method to solve this problem. The concrete path is given from the macroscopic angle of the national social government and the microcosmic angle of the citizen.At this point, the task has been completed one to five, as shown in Figure 3[11]:

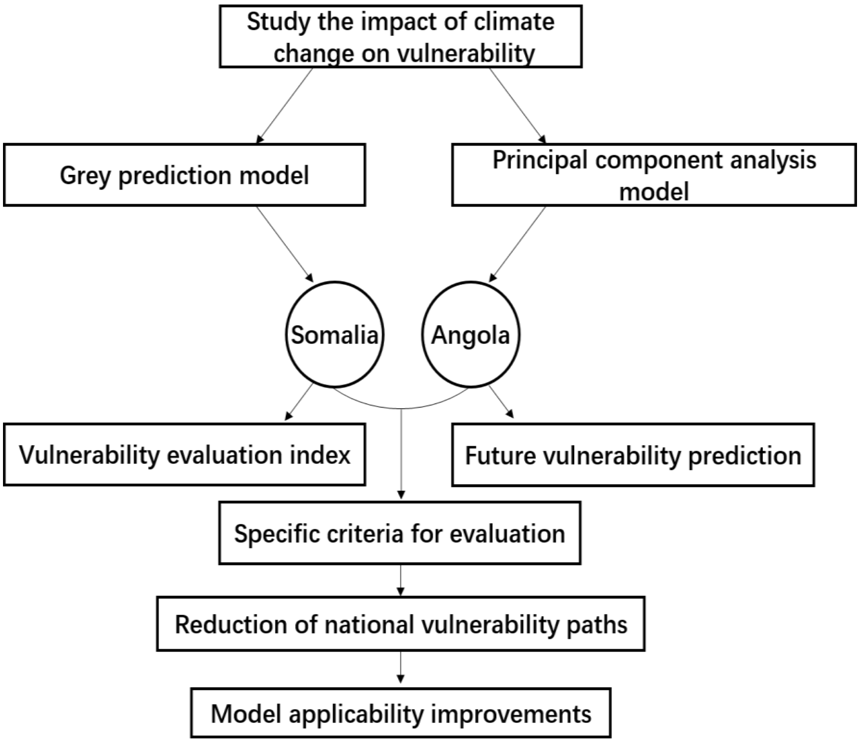

Figure 3.Task flowchart

This flowchart describes the tasks performed and the selected countries, and so on, concise and clear.The research model and the concrete method have been demonstrated. The internal clues of the whole article are briefly summarized. The main conclusions of this case are drawn, and the specific impact of climate on national vulnerability.

4. Strengths and Weaknesses

4.1 Strengths

This is a good solution to the problem and complete the task, thanks to the selection of the model's many advantages[12]:

Principal component Analysis Model:

- Eliminate the correlation between evaluation indicators
- Reduce the workload of the selection of indicators for other evaluation methods
- When the rating index is more, it can be used to replace the original index with a few comprehensive indexes while reserving the most information.
- In the comprehensive evaluation function, the weighting of each principal component is its contribution rate, it reflects the proportion of the total amount of information that the principal component contains the original data, so it is objective and reasonable to determine the weights, which overcomes the defects of determining weights in some evaluation methods.
- The calculation of this method is more standard, easy to realize on the computer, but also can use specialized software.

Grey Prediction Model:

- Do not need a large number of samples.
- Samples do not need to be regularly distributed.
- Small computational workload.
- Quantitative analysis results and qualitative analysis results will not be consistent.
- Can be used for recent, short-term, medium and long-term forecasts.

- High accuracy of grey prediction.

4.2 Weaknesses

Of course, any model is flawed. Principal component Analysis Model:

- In principal component analysis, we should first ensure that the information of variable dimensionality reduction should be kept at a higher level, and then the main components extracted must be able to give an explanation of the actual background and meaning.
- The main components of the interpretation of the general meaning of how much with a point of ambiguity, unlike the original variable meaning so clear and precise.

Grey Prediction Model:

- It is necessary to determine the optimal value of each index, and the subjectivity is too strong.
- The optimal value of some indices is difficult to determine.

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