The study on evaluation of a fragile state and how climate makes a country more vulnerable

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Abstract. As the effects of climate change become progressively pronounced, numerous countries and regions begin to pay close attention to the question how climate changes influence regional instability. In order to answer the question,by quantifying the six indicators defined by us and the other 12 indicators from the Fragile State Index, we utilize Multiple Linear Regression to get the model and numerous 3D surface charts and finally find out how climate change makes a country a fragile state with the help of the models.

1. Introduction

In recent years, the topic of research on the "fragile countries" that has rapidly emerged in the West has demonstrated the prosperity of the research. It also means the mutual reference and refutation of various viewpoints and research methods [1]. For example, the U.S. Peace Foundation's fragile state index uses a total calculation. The evaluation system has a total of 12 indicators, and each indicator has the same weight [2]. When calculating the overall success, they sum up the scores of the 12 indicators to arrive at a cumulative score. The vulnerability score of the evaluation system ranges from 0 to 120. The smaller the score of a country, the lower the degree of vulnerability; the higher the score, the higher the vulnerability. In addition, there are many different evaluation systems. Furthermore, accompanied by climate change intensifies, the influence has permeated every aspect, even crisis human survival and development [3]. There are many factors contributing to climate change, and the impact of climate change is also varied, such as the urban heat island effect caused by climate change, which makes the urban environment more vulnerable [4]. Meanwhile, extreme weather damages human life and property directly, such as the lack of water resources [5]. It's a chain reaction that has increased the differences of resource environmental bear capacity between different regions, and aggravated the imbalance of economic, social development and international trade between countries and regions, even make weak governance country further deterioration and even lead to the disintegration of social and governmental structures. As a result, unstable governments can lead to fragile states, and the impact of climate change on national vulnerability cannot be underestimated. It has been recognized by governments that climate change must be taken into account in the long-term development of the country. In other words, it's our common challenge to wrestle with climate changes [6].

Through the above we have found it useful to establish a model of how to identify country vulnerabilities and to study how climate change affects national vulnerability. Therefore, we have

established an evaluation model based on the U.S. Peace Foundation's fragile state index [2] and used Congo Democratic Republic as an example to find out how climate change makes it more vulnerable.

2. Model

We consider how to judge a country's vulnerability and build a model from four aspects. Through the background information, we learned that the national vulnerability score [2] is made up of the most vulnerable 120 points to the most stable 0 points.

2.1. Variable Description

First, we simply divided the data into 0-40 points (Stable country), 41-80 points (Fragile states), and 81-120 points (More fragile states). The country with the highest score, the lowest score and the lowest score in each section was nine countries, which is Finland, Malta, Czech, Russia, Tanzania, South Sudan, Germany, Brazil and Nepal.

Second, to evaluate a country's statehood in a highly generalized and quantifiable way, we have adopted an evaluation system of our own design: The highest score is 5, the lowest score is 1, the permeant members of the United Nations Security Council get five points, developed countries get four points, un member states get three points, and non-un members score one. As the chart.

Third, in order to quantify it and make the problem easier to think about, we find out that the climate is measured by the characteristics of cold, warm, dry and wet, it is usually characterized by the average value and deviation value of a period. We also found that the effects of climate change on temperature, precipitation and grain yield [7] were significant. We use GDP indicators instead of economic indicators. It not only reflects the economic performance of a country, but also reflects a country's national strength and wealth. From the change in the Numbers, you can see whether the economy of a country or region is growing or declining. Population indicators are replaced by mortality, because the mortality rate can be found in a region's health habits and medical quality. We have judged the status indicators based on the evaluation system established by ourselves, and through reviewing and summarizing a large number of documents, we know that these factors have high value for assessing vulnerability. Therefore, for simply, we omit the results which are resulted by other factors and only the six second-level indicators were used to build our model, and then, we obtained the data which is needed by us of these countries.

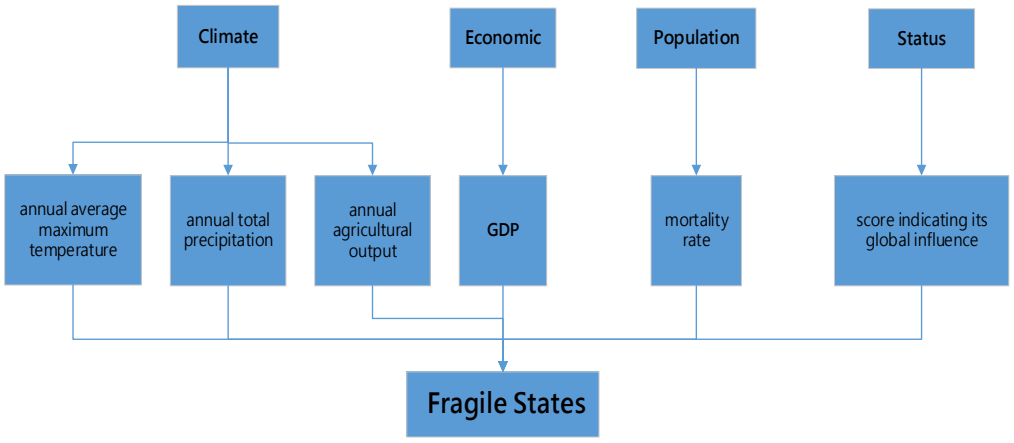

Figure 1. Fragile States

2.2. Basic Model and Assumptions

This method of finishingthe standardization of data is based on the original mean of data and the stand arddeviation. Which measures how many standard deviations are above the fractionof the average of t-he original fraction in the standard deviation unit. Theformula for calculating the variance is as follows:

$$z = (x - \mu) / \sigma \tag{1}$$

Where, μ is arithmetic mean of variables, σ is standard deviation of variables

The standard fraction is kind of numeric value which is not affected by the original measurement. It can not only indicate the location of the original data distribution, but also compare data from different units. This data will not be directly compared in the future. The Z-score normalization method is applicable when the maximum and minimum values of the attribute A are unknown, or when there is an outlier that exceeds the value range.

We use standardized data to perform a linear regression with SPSS, and we get the following results:

$$y = 1.908x_1 + 1.133x_2 - 0.118x_3 - 0.087x_4 - 0.844x_5 + 2.266x_6 \tag{2}$$

Where, y is stand for Country vulnerability score, x1 is stand for Annual mean maximum temperature, x2 is stand for Mean annual precipitation, x3 is stand for Agricultural output, x4 is stand for Score indicating its global influence, x5 is stand for GDP, x6 is stand for Mortality rate.

We find there is a linear relationship between fragile state and the annual average maximum temperature, annual total precipitation, annual agricultural output, GDP, the mortality rate, a score indicating its global influence. In addition, as mentioned above, we use standardized score data as the basis for our final assessment of country vulnerability. The dividing intervals are as follows:

(-1.34,0) -- Stable country

(0,0.57) -- vulnerable country

(0.57,1.62) -- fragile country

And then, in order to simply verify the correctness of our model, we stratify randomly and select Thailand for testing. Through bring Thailand's data into our model, we find it is a vulnerable state which is in accordance with total range (40, 80). Validation of the model is established.

3. The effects of climate change on the Congo Democratic Republic

According to the data in the Fragile State Index we have established the ten most vulnerable countries. Comparison of geographical location, as well as climate change and other factors to consider that Congo Democratic Republic is a better choice to analysis. In order to find out how climate change makes the country a fragile state, we collect the data of twelve indicators from the Fragile State Index [8] and the data regarding the country's annual average maximum temperature, annual total precipitation, and annual agricultural output. Then we use 1 to 12 discrete integer, representing 12 indicators, the specific meaning of the following table l.

Table 1. Fragile State Index.

Number	1	2	3	4	5	6
	C1: Security Apparatus	C2: Factionalized Elites	C3: Group Grievance	E1: Economy	E2: Economic Inequality	E3: Human Flight and Brain Drain

Number	7	8	9	10	11	12
	P1: State Legitimacy	P2: Public Services	P3: Human Rights	S1: Demographic Pressures	S2: Refugees and IDPs	X1: External Intervention

On the basis of these data and MATLAB software we create three 3D surface chart. It is not difficult to find out which indicator changes significantly higher than the other indicators.

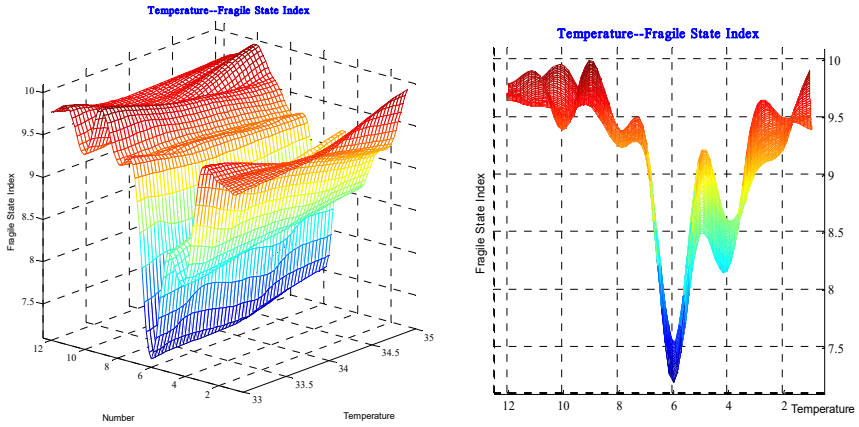

Figure 2. Annual average maximum temperature

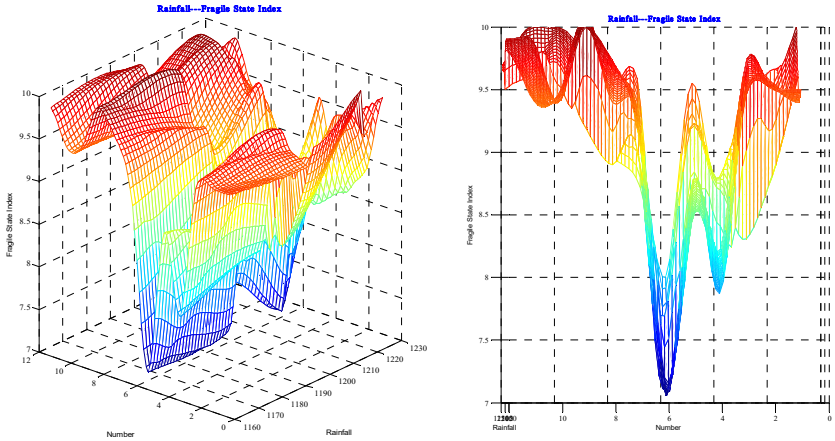

Figure 3. Annual total precipitation

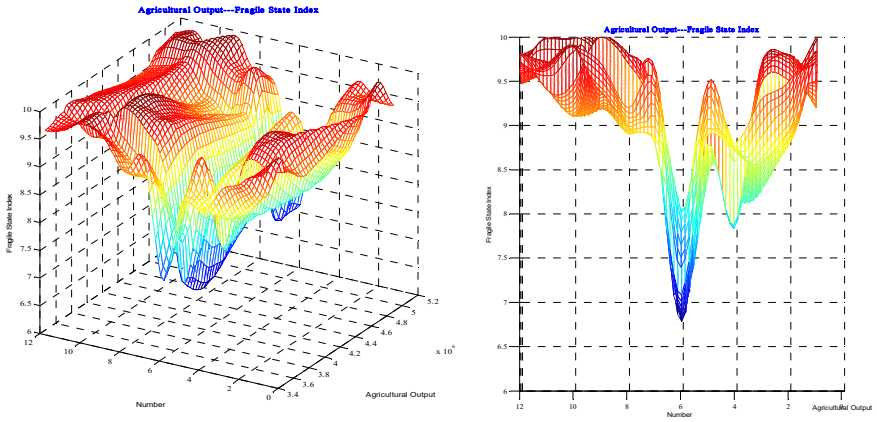

Figure 4. Annual agricultural output

- annual average maximum temperature affects 1, 3, and 9
- annual total precipitation affects 3,5,6,8

• annual agricultural output affects 3, 4, 6, 9, and 10

Not difficult to find that this chart indicates climate changes makes a country a fragile state by influencing its 3, 6, 9.

Then we put the annual average maximum temperature, annual total precipitation, annual agricultural output, GDP, the mortality rate, and a score indicating its global influence of Congo Democratic Republic from 2010 to 2016 to standardize processing data and use our model to get the fragile index. After that, we use the method of controlling variables, assuming that the conditions of each year's climate are unchanged and that the actual data are used for GDP and mortality. Similarly, the six secondary indicators are standardized to obtain the vulnerability index of the Congo Democratic Republic under constant climate change. We plot the data we have processed into a line chart and introduce a trend curve. It is clear that with the change of climate in recent years, the national vulnerability index generally increases and shows an upward trend. On the assumption that climate conditions remain unchanged, the Congo Democratic Republic tends to be stable and even declining.

Table 2. Congo's model of standardization in climate change

Year	Annual average maximum temperature	Annual total precipitation	Annual agricultural output	Score	GDP	Mortality rate	Y
2016	0.84602	0.6357	-0.44545	-0.26739	-0.45646	-0.79063	1.003965
2015	0.74514	0.56245	-0.40836	-0.26739	-0.45579	-0.79063	0.723552
2014	0.74514	0.6155	-0.45322	-0.26739	-0.45064	-0.78268	0.802619
2013	0.84602	0.61297	-0.40406	-0.26739	-0.45073	-0.78268	0.986506
2012	0.64425	0.5574	-0.39646	-0.26739	-0.4511	-0.78268	0.537984
2011	0.74514	0.47405	-0.4441	-0.26739	-0.45036	-0.78666	0.632025
2010	0.74514	0.6155	-0.43484	-0.26739	-0.45259	-0.79063	0.784081

Table 3. Congo's model of standardization in no change of climate

Year	Annual average maximum temperature	Annual total precipitation	Annual agricultural output	Score	GDP	Mortality rate	Y
2016	0.71076	0.57777	-0.46902	-0.26739	-0.45646	-0.79063	0.683035
2015	0.71076	0.57777	-0.46902	-0.26739	-0.45579	-0.79063	0.68247
2014	0.71076	0.57777	-0.46902	-0.26739	-0.45064	-0.78268	0.696138
2013	0.71076	0.57777	-0.46902	-0.26739	-0.45073	-0.78268	0.696214
2012	0.71076	0.57777	-0.46902	-0.26739	-0.4511	-0.78268	0.696526
2011	0.71076	0.57777	-0.46902	-0.26739	-0.45036	-0.78666	0.686883
2010	0.71076	0.57777	-0.46902	-0.26739	-0.45259	-0.79063	0.679769

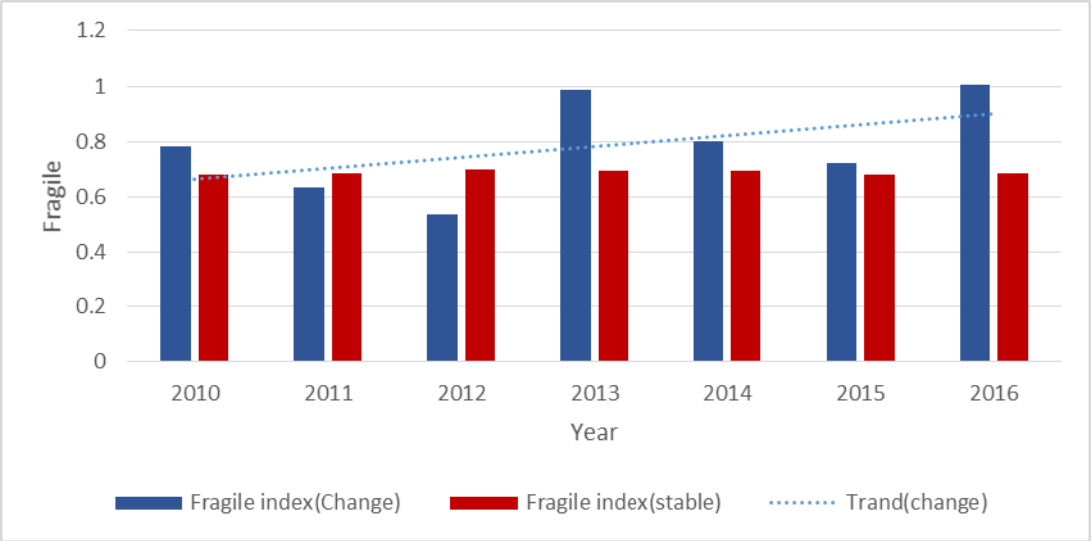

Figure 5. Fragile index of Congo Democratic Republic

4. Conclusion

By quantifying the six indicators defined by us and the other 12 indicators from the Fragile State Index, we create one model and numerous 3D surface charts and finally find out how climate change makes a country a fragile state with the help of the models. For a fragile state, climate change will affect the country's Group Grievance Human Flight and Brain Drain and Human Rights indicators.

Acknowledgments

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