

National Vulnerability Assessment System: Part1 Model Theory

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Abstract. In recent years, the impact of climate change on national vulnerabilities has become increasingly evident. Therefore, it is of crucial importance to propose a sound evaluation system to measure the impact of national vulnerabilities and climate change. In this paper, we focus on how to develop a comprehensive national vulnerability assessment system that takes into account climate change. Based on analysis from Fragile States Index, we build the NVAS (National Vulnerability Assessment System) which includes SA (Social aspects), EA (Economic aspects) and PA (Political aspects) and we divide the four dimensions of judging national vulnerabilities. Each contains three first class indicators and different quantities of second-class indicators. We choose temperature and precipitation as indicators of climate change. By analyzing the influence of temperature and precipitation on the four second-level indicators, the indirect impact of climate change on the national vulnerability is obtained.

Keywords: Climate change, NVAS, grey relational analysis, regression analysis.

1. Introduction

In recent years, with the global climate change, a series of vulnerability events such as glacier melting, sea level rise, drought, floods and the reduction of biological species have emerged. Relevant departments believe that many of these effects will change human lifestyles and may lead to the weakening and collapse of social and government structures and may even result in the country's vulnerability.

At the same time, the fragile state has increased the pressure of the national population in the face of climate shock such as natural disasters, arable land reduction and rising temperatures, which may further aggravate the weak governance of the country. At present, the study on the national vulnerabilities has become a basic core topic when the academic circles discuss the issue of world development.

2. Assumptions and Justifications

To simplify the problem, we have the following assumptions properly justified.

The government policy will not change in the short term.

Climate change is measured only by precipitation and temperature.

Neglect the explosive changes when forecasting over the few decades.

Only consider four second class indicators of climate change.

The second class indicators that are not affected by the climate at the time of fore-casting remain stable.

3. Variable Description

4. National Vulnerability Assessment System (Nvas)

In combination with FRAGILE STATES INDEX (FSI) [1], we select nine first class indicators and twenty-one second class indicators in social, economic and political aspects. Among them, we focus on the impact of climate change on some of these secondary indicators and their impact on the country's vulnerability.

Table 1. Variable Description

SA	The metric to measure the social aspects
EA	The metric to measure the economic aspects
PA	The metric to measure the political aspects
NV	The metric to measure the national vulnerability
SA_{ij}	The j th second class indicator of the i th first class indicator for SA
EA_{ij}	The j th second class indicator of the i th first class indicator for EA
PA_{ij}	The j th second class indicator of the i th first class indicator for PA
γ_{ij}	The grey rational coefficient for the j th second class indicator of the i th first class indicator
s_{ij}	The j th country observation on the i th indicator
δ_i	The rational grade of the i th first class indicator
x	Precipitation
y	Temperature
t	Time

4.1 Aspects of Social

4.1.1 First Class Indicators of Social Aspects

Social aspects consist of three components, respectively are population pressure, refugees and internally displaced persons and groups complain.

Population pressure. It considers pressures upon the state deriving from the population itself or the environment around it.

Refugees and internally displaced persons. It measures the pressure upon states caused by the forced displacement of large communities as a result of social, political, environmental or other causes.

Groups complain. It focuses on divisions and schisms between different groups in society C particularly divisions based on social or political characteristics C and their role in access to services or resources, and inclusion in the political process.

4.1.2 The Sa Metric System

Based on the above analysis, we develop a metric called SA to describe the impact of social factors on national vulnerabilities. The metric includes three first class indicators and eight second class indicators.

Table 2. Indicators in Sa (Social Aspects) Metric System

	Indicators	Notation	Indicators	Notation	Target
SA	Population pressure	SA_1	Per capita water	SA_{11}	↓
			Per capita arable land	SA_{12}	↓
			Population density	SA_{13}	↑
	Refugees and internally displaced persons	SA_2	Refugees	SA_{21}	↑
			Displaced persons	SA_{22}	↑
	Groups complain	SA_3	Crime index	SA_{31}	↑
			Religious conflicts	SA_{32}	↑
			Armed conflicts	SA_{33}	↑

The target \uparrow (\downarrow) means that the increase in this indicator will lead to an increase (decrease) in the country's vulnerability. In all, the metric of SA can be finally expressed by a function of SA_1 , SA_2 and SA_3 as $SA = f(SA_1, SA_2, SA_3)$.

4.2 Aspects of Economic

4.2.1 First Class Indicators of Economic Aspects

Economic aspects consist of three components, respectively are economic imbalance, economic decline and talent loss.

Economic imbalance. The indicator looks at structural inequality that is based on group or education, economic status, or region.

Economic decline. It considers factors related to economic decline within a country. For example, it looks at GDP per capita and unemployment rate.

Talent loss. It considers the economic impact of human displacement and the consequences this may have on a country's development.

4.2.2 The Ea Metric System

We develop a metric called EA to describe the impact of economic factors. The metric includes three first class indicators and seven second class indicators.

Table 3. Indicators in Ea (Economic Aspects) Metric System

	Indicators	Notation	Indicators	Notation	Target
<i>EA</i>	Economic imbalance	EA_1	The gap between rich and poor	EA_{11}	\uparrow
			Slums	EA_{12}	\uparrow
			Education level	EA_{13}	\downarrow
	Economic decline	EA_2	GDP per capita	EA_{21}	\downarrow
			Unemployment rate	EA_{22}	\uparrow
	Talent loss	EA_3	Expatriate ratio	EA_{31}	\uparrow
			Overseas remittances	EA_{32}	\downarrow

The metric of EA can be finally expressed by a function of EA_1 , EA_2 and EA_3 as $EA = f(EA_1, EA_2, EA_3)$.

4.3 Aspects of Political

4.3.1 First Class Indicators of Economic Aspects

Political aspects consist of three components, respectively are national legitimacy, public service and human rights and nomocracy.

National legitimacy. It considers the representativeness and openness of government and its relationship with its citizenry.

Public service. It refers to the presence of basic state functions that serve the people. It may include the provision of essential services and the state's ability to protect its citizens through perceived effective policing.

Human rights and nomocracy. It considers the relationship between the state and its population insofar as fundamental human rights are protected and freedoms are observed and respected.

4.3.2 The Pa Metric System

We develop a metric called PA to describe the impact of political factors. The metric includes three first class indicators and six second class indicators.

Table 4. Indicators in Pa (Political Aspects) Metric System

	Indicators	Notation	Indicators	Notation	Target
<i>PA</i>	National legitimacy	PA_1	Corruption rate	PA_{11}	↑
			Democratic level	PA_{12}	↓
	Public service	PA_2	Infrastructure	PA_{21}	↓
			Security forces	PA_{22}	↓
	Human rights and nomocracy	PA_3	Free citizens	PA_{31}	↓
			Law popularity	PA_{32}	↓

The metric of PA can be finally expressed by a function of PA_1 , PA_2 and PA_3 as $PA = f(PA_1, PA_2, PA_3)$.

4.4 Metric of NV

Now that we have constructed the metric of SA, EA and PA, we can construct metric of NV by integrating them. We assign weights (0.4, 0.3, 0.3) to SA, EA and PA based on consideration that the impact of climate change on social, economic and political aspects. So NV is expressed as follows.

$$NV = \theta_1 SA + \theta_2 EA + \theta_3 PA = 0.4SA + 0.3EA + 0.3PA \quad (1)$$

4.5 Impact of Climate Change

We use the temperature, precipitation two indicators to measure on the climate. And we selected four of the twenty-one secondary indicators that are more affected by climate change as the targets of attention.

Per capita water resources. It is an indicator to measure the available water resources. Global climate change exacerbates the frequency and intensity of droughts, floods and other disasters, increases the government's pressure to deal with water-related issues and even leads to the weakening of the government structure and the increase of national vulnerability. [2]

Crime index. It is a measure of national harmony. The negative impacts of climate change on agriculture and economy have led to increased pressure on people's lives, lack of confidence in life and even crime. In addition, the hot weather will affect people's physiological functions, increase human aggression, crime index rises, increasing the national vulnerability. [3]

GDP per capita. At the maximum speed GDP per capita growth there is a golden temperature: about 13 degrees Celsius (55 degrees Fahrenheit). Anything below or above this temperature can have a negative impact on economic growth. [4] Climate change affects economic development, which in turn affects national vulnerabilities.

Infrastructure. It is a measure of the country's ability to serve people. Climate change affects infrastructure improvements that affect people's satisfaction with the country and affect the country's vulnerability.

We will later use regression analysis to establish the relationship between climate change and the above four indicators.

References

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