Impact of climate change on national vulnerability

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Abstract. The issue of climate change is a topic of close concern to both domestic and foreign society, and it is also an important issue affecting the sustainable development of all mankind. This article explains the impact of climate change on the country in two representative countries: Chad and Afghanistan. To measure a country's vulnerability index and how it is affected by climate change, we identified four main indicators of climate change: temperature, precipitation, forest area, and agricultural land area to analyse the country's vulnerability index. The indirect effects of climate change are measured using the Spearman coefficient matrix.

1. Introduction

The United Nations Intergovernmental Panel on Climate Change (IPCC) illustrated in Comprehensive assessment report that there is no denying about global warming in November 2014. From 1880 to 2012, the average temperature of global surface had approximately increased 0.85℃. Moreover, it was hottest that the northern hemisphere had been in past 30 years from 1983 to 2012[1]. The change already had a severe and common impact within the global.

As a typical global environmental issue, climate change is gradually evolving into a complex issue involving climate science, international politics, world economy, international trade and international environmental legislation. Many scholars at home and abroad have also conducted a lot of research on global climate change and its vulnerability from different subject areas and perspectives [2].

In international politics, scholars mostly judge climate diplomacy from climate politics of different countries. Based on the current situation of power balance and geopolitical benefits, scholars pay more attention to the mutual game between powerful nations. In the economic field, some scholars use the method of microeconomics to study climate change, and specifically analyze the cost and income problems of climate change. These perspectives have always been the attention of researchers, but less on the security benefits of climate change [3].

In view of the shortcomings of the above scheme, we need to obtain the vulnerability of a country and identifies the impact of climate change at the same time. This paper identifies the vulnerability index of each country through various climate indicator data from three countries in the past decade, and proposes measures to mitigate the impact of climate change on the government.

2. Analysis of national vulnerability index

The national vulnerability index analysis process is shown in Fig.1. We take climate change into account to acquire the fragility of a country based on the 12 indicators by the Fragile State Index (FSI) as Table 1. As climate change has not only a direct impact on the fragile country index but also an indirect effect by combining with other factors. We assume that the fragile state index consists of three parts: first,
fragile country index provided by the FSI (W1), twelve indicators affecting the fragile state index by FSI as shown in Table 1; second, the direct impact of climate change (W2); third, the indirect impact of climate change (W3).

\[ W = W_1 + W_2 + W_3 \]  \hspace{1cm} (1)

**Figure 1.** Analysis process.

**Table 1.** Twelve indicators affecting the fragile state index by FSI.

|   | Security Apparatus                | 7   | State Legitimacy          |
|---|-----------------------------------|-----|---------------------------|
| 2 | Factionalized Elites              | 8   | Public Services           |
| 3 | Group Grievance                   | 9   | Human Rights              |
| 4 | Economy                           | 10  | Demographic Pressures     |
| 5 | Economic Inequality               | 11  | Refugees and IDPs         |
| 6 | Human Flight and Brain Drain      | 12  | External Intervention     |

Combine climate change with 12 other factors to determine indirect impact of climate change on fragile country index. When both of the two indicators are considered to be necessary, the score of the two indicators needs to be multiplied [4]:

\[ W_3 = \sum_{i=1}^{12} A_i S_j \]  \hspace{1cm} (2)

\[ K = \frac{\sum_{i=1}^{12} (A_i - \bar{A}) (S_i - \bar{S})}{\sqrt{\sum_{i=1}^{12} (A_i - \bar{A})^2 \sum_{i=1}^{12} (S_i - \bar{S})^2}} \]  \hspace{1cm} (3)
Among (2) and (3), Kij is the Spearman correlation coefficient [5]; Ai is the selected four aspects of climate change performance; Sj is 12 impact indicators provided by FSI.

3. Afghanistan’s national vulnerability index
We obtain the fragile country index of Afghanistan (2015) by the Fragile State Index (FSI) as shown in Table 2.

Table 2. Fragile country index of Afghanistan by FSI.

|                     | Security Apparatus | 10.0 | State Legitimacy | 9.7 |
|---------------------|--------------------|------|-----------------|-----|
| Factionalized Elites| 9.3                |      | Public Services | 9.3 |
| Group Grievance     | 8.9                |      | Human Rights    | 8.6 |
| Economy             | 8.6                |      | Demographic Pressures | 9.3 |
| Economic Inequality | 7.2                |      | Refugees and IDPs | 9.1 |
| Human Flight and Brain Drain | 8.1 |      | External Intervention | 9.8 |

Through the World Bank website, we get data on drought and flood disaster, temperature rise, forest area change and agricultural land area change in Afghanistan from 2006 to 2015. We obtain the Spearman correlation coefficient Kij. Then we get the Indirect effects of climate change as shown in Table 3.

Table 3. Indirect effects of climate change combined with the original factors.

| Drought and Flood Disaster | Temperature Rise | Forest Area Change | Agricultural Land Area Change |
|----------------------------|------------------|--------------------|-------------------------------|
| 1.1161                     | -0.0011          | 0                  | 0                             |
| -0.2434                    | 0.0004           | 0                  | 0                             |
| 2.4945                     | 0.0010           | 0                  | 0                             |
| -0.8955                    | -0.0036          | 0                  | 0                             |
| 0.1457                     | 0.0021           | 0                  | 0                             |
| 1.2201                     | 0.0005           | 0                  | 0                             |
| 0.4140                     | -0.0028          | 0                  | 0                             |
| 1.1715                     | -0.0005          | 0                  | 0                             |
| 1.8698                     | -0.0003          | 0                  | 0                             |
| 1.1668                     | -0.0016          | 0                  | 0                             |
| 2.1757                     | 0.0024           | 0                  | 0                             |
| 0.7244                     | -0.0028          | 0                  | 0                             |

Above all, \( W = W_1 + W_2 + W_3 = 118.52 \)

The inclusion of climate change in the fragile index system has led to an increase in the fragile index in Afghanistan, indicating that climate change has a certain impact on the fragile national index.

4. Chad’s national vulnerability index
We chose the Chad, ranked eighth, as the target country to determine the impact of climate change on its vulnerability. The Chad’s vulnerability index is 108.4, without considering the climatic factors. So W1=108.4.

The four factors of climate change, respectively, combined with the 12 factors identified by the FSI, have the following effects on the vulnerability index as shown in Table 4:
Table 4. Indirect effects of climate change to Chad

| Drought and Flood Disaster | Temperature Rise | Forest Area Change | Agricultural Land Area Change |
|----------------------------|------------------|--------------------|-------------------------------|
| 17.6282                    | -0.0102          | -0.0373            | 0                             |
| 0.5746                     | 0.0010           | -0.0138            | 0                             |
| 29.7006                    | 0.0083           | -0.0046            | 0                             |
| -12.1330                   | -0.0294          | -0.0772            | 0                             |
| -2.8327                    | 0.0230           | 0.0052             | 0                             |
| 22.9843                    | 0.0050           | -0.0375            | 0                             |
| 5.8038                     | -0.0273          | -0.0449            | 0                             |
| 22.2275                    | -0.0057          | -0.0264            | 0                             |
| 27.2563                    | -0.0046          | -0.0148            | 0                             |
| 17.8707                    | -0.0166          | -0.0406            | 0                             |
| 38.5753                    | 0.0227           | -0.0384            | 0                             |
| 8.1951                     | -0.0225          | -0.0635            | 0                             |

To sum up, the direct and indirect impacts of climate change increased Chad's Fragile Nation Index by 17.6 and 174.9, respectively, resulting in a dramatic increase in Chad's Fragile Country Index, from 108.4 to 300.9.

5. Government measures

In order to prevent a country from becoming a "fragile state," the state should reduce its Vulnerability Index by targeting measures that are deterministic.

Therefore, countries should take measures to reduce the Vulnerability Index according to these decisive factors.

- Promote the reform of household registration system.
- Improve the social security system for migrant workers [6].
- Collect data on internally displaced groups.
- Support training for the rights of internally displaced persons.
- Establish a legal framework for the protection of the rights of internally displaced persons [7].
- Enhance cooperation with the international community.
- Designate a body to deal with the problem of internally displaced persons.
- Allocate adequate resources to address the issue of internal displacement.
- Popularize education about human rights awareness of government officials [8].

6. Conclusion

There is no denying fact that climate change affects national security both directly and indirectly. Through theoretical analysis and case calculation, the conclusion is as follows:

1. On the one hand, climate change will threaten the key assets and personnel of various countries, especially in its coastal areas. The military will also be directly affected by climate change.

2. On the other hand, the mechanism by which climate change causes security problems is indirect. As a "threat multiplier," it can exacerbate a resource crisis through a variety of paths, intensify potential tensions, trigger a humanitarian disaster and lead to unrest and conflicts. These issues undoubtedly enhance the vulnerability of fragile countries.

3. Countries should take interventions to relieve the risk of climate change in order to prevent a country from becoming "vulnerable".

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