A methodological framework for assessing the impacts of climate risk on food security through a vulnerability index

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Extended Abstract

This article describes an experimental method for the development of a Hunger and Climate Vulnerability Index that shows the relative vulnerability of food insecure populations to climate risks at country level through a vulnerability model. It is proposed that the Hunger and Climate Vulnerability Index can be used as a tool for better understanding the risks to food security presented by climate change. The analysis goes beyond the impact of climate change on crop yields and provides a multidimensional analysis of food security vulnerability under climate change.

The index is based on the vulnerability framework proposed by the Intergovernmental Panel on Climate Change in the context of food security which suggests that vulnerability is a function of exposure (the magnitude and duration of climate-related events that affect food security), sensitivity (the degree to which food security responds to climatic events) and adaptive capacity (the ability of populations to withstand or adjust to climate events).

In order to develop the index, data from socioeconomic and environmental indicators were analysed and tested against a proxy for hunger (undernourishment). The most relevant indicators were aggregated using a composite index of sixteen indicators to compare differential vulnerabilities. Indicators were chosen through a rigorous three-tier selection process based on (1) an extensive literature review, (2) a statistical analysis to determine the relationship between an indicator and hunger risk, and (3) a further analysis to eliminate factors that were auto-correlated.

Indicators were normalised and expressed as a fraction of the maximum value for each. Adaptive capacity contributed negatively to vulnerability, so the inverse value (1-*x*) was used for the model. Vulnerability was therefore calculated using the following equation:

$$\text{Vulnerability} = \sum_{i=1}^{m} \frac{Exposure_{indicator_m}}{m} \times \sum_{j=1}^{n} \frac{Sensitivity_{indicator_n}}{n} \times \sum_{k=1}^{p} \frac{AdaptiveCapacity_{indicator_p}}{p}$$

where *m*, *n*, and *p* are the number of exposure, sensitivity and adaptive capacity indicators respectively. The index scores were also normalised with 1 being the highest value.

The results were mapped alongside undernourishment data (www.faostat.fao.org) to highlight the relationship between climate risk and hunger (Figure 1). The analysis shows a high correlation between hunger and climate risk. Indeed, the index highlights that the most vulnerable regions are West Africa, Eastern Africa and South Asia where most of the current food security problems persist.

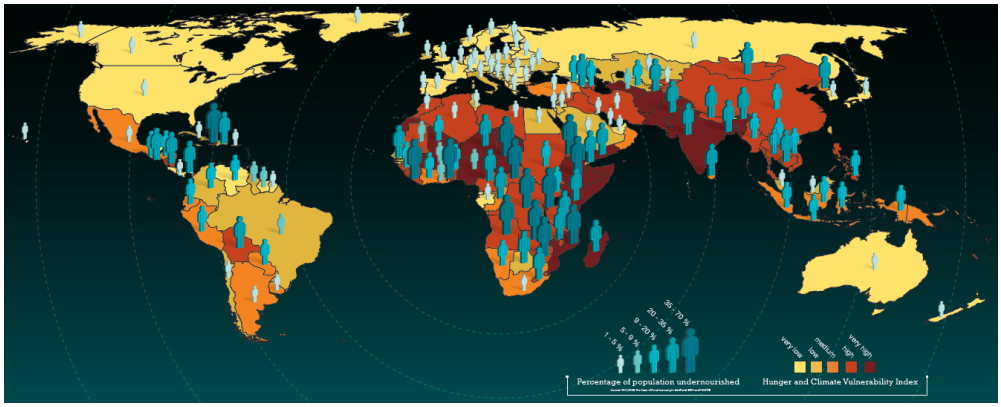

FIGURE 1. VULNERABILITY MAP HIGHLIGHTING FOOD INSECURITY AND CLIMATE RISK.

The study demonstrates the critical role that adaptive capacity has in influencing vulnerability to climate risks, corroborating findings from other vulnerability assessments. It is found that sensitivity is the component with the second highest contribution to vulnerability in the context of food security under climate change. Finally, exposure can be better captured in overall vulnerability by enhancing hazard reporting and monitoring capacities in some countries. Further assessments of hazard impacts in these countries could enhance the explanatory value of the index.

Visual tools are used to complement the results of the index. Spider diagrams are used to illustrate the relative contribution of each of the vulnerability indicators. The use of such tools can inform policymaking by highlighting the interventions with the highest potential benefits for climate change adaptation and food security.

The method presented here is replicable at different spatial and temporal scales to provide a robust planning tool for policy makers. Replication is likely to provide different indices that illustrate the contexts in which specific exposure rates, sensitivities and adaptive capacities interact to increase (or reduce) vulnerability in different countries. This approach can also be used to monitor vulnerability, evaluate potential effectiveness of programmes, and/or examine plausible impacts of climate change by introducing scenarios into the vulnerability model.

Keywords: *Vulnerability, Index, Hunger, Food security, Climate change, Adaptation*