World Development 112 (2018) 88–118

Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

# In harm's way: Climate security vulnerability in Asia ☆

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ARTICLE INFO

*Article history:*
Accepted 20 July 2018

*Keywords:*
Climate change
Vulnerability
Adaptation
Asia

ABSTRACT

Asian countries have among the highest numbers of people exposed to the impacts of climate-related hazards and, thus, at greatest risk of mass death. Floods, droughts, and storms have always tested civilian governments and international humanitarian aid agencies. However, climate change threatens to make the problem worse by increasing the intensity and possibly the frequency of climate-related hazards. Humanitarian emergencies potentially upend and reverse progress on development priorities, making improved spatial awareness of likely hot spots a priority for adaptation and preparedness. This article presents the findings of the effort to map sub-national "climate security vulnerability" in 11 countries in South and Southeast Asia. Climate security vulnerability is defined as areas where large numbers of people are at risk of death due to exposure to climate-related hazards and the follow-on consequences of exposure, including but not limited to conflict. The Asian Climate Security Vulnerability Model Version 1 (ACSV V1) found that Bangladesh, parts of southern and western Myanmar (the Ayeyarwady region and Rakhine state), and parts of southern and northwest Pakistan (Sindh and Khyber Pakhtunkhwa provinces) were the most vulnerable from a climate security perspective. In terms of absolute numbers, the largest numbers of people who are exposed to climate hazards are in India followed by Bangladesh. Model results are compared with a geo-referenced version of the EM-DAT Disaster Database and by creating alternative model specifications informed by a survey of 18 regional experts.



In May 2008, a major cyclone devastated the Ayeyarwady Delta in Myanmar and left 700,000 homeless. Three quarters of the delta's livestock were killed. Half of the fishing fleet sank, and a million acres of rice paddies were inundated with saltwater (The New York Times, 2009). Myanmar's authoritarian regime did not request nor permit significant foreign aid. The U.S. Navy, having made fifteen unsuccessful attempts to receive authorization to deliver aid, ultimately ordered its ships to depart in early June (The New York Times, 2008). In the end, some 140,000 people died (Zarni & Taneja, 2015).

In July 2010, Pakistan faced its own climate-related emergency, with floods in the Indus River basin affecting as many as 20 million people. Like Myanmar, Pakistan's government was criticized for its slow response to the crisis, its president blamed for proceeding with an overseas European trip as the floods unfolded (Shah, 2010). Ultimately, 2000 people lost their lives and 11 million were left homeless. However, unlike Myanmar, the Pakistani government was more open to relief efforts. Donors ultimately pledged in excess of $2.5 billion to help Pakistan respond to the floods (UNOCHA, 2016).

In 1999, a devastating category five cyclone smashed into Odisha state in eastern India on the Bay of Bengal. 10,000 people were killed. In 2013, another category five hurricane struck the same state. In this instance, 50 people died, as the country evacuated more than 500,000 people from low-lying areas, the largest such evacuation in more than 23 years (Press Trust of India, 2013). While donors like the U.S. Agency for International Development (USAID) worked with India on early warning systems and disaster preparedness, India did not rely much on disaster aid for preparedness or recovery (Konyndyk, 2013).

As a densely populated region with many people living along rivers and low-elevation coastal zones, Asia has among the highest numbers of people exposed to the impacts of climate-related hazards in the world (IPCC, 2012, 240, 254). By one count, as many as 17 of 26 megacities – cities with populations in excess of ten

☆ This material is based upon work supported by, or in part by, the U.S. Army Research Laboratory and the U.S. Army Research Office via the U.S. Department of Defense's Minerva Initiative under grant number W911NF-14-1-0528.

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https://doi.org/10.1016/j.worlddev.2018.07.007
0305-750X/

million people – are located in Asia (Cox, 2012). While floods, droughts, and storms have always tested civilian governments and international humanitarian aid agencies, climate change threatens to make the problem worse by increasing the intensity and possibly the frequency of climate-related hazards (IPCC, 2012). From 2000 to 2012, of the 2.74 billion people killed and affected by climate-related disasters worldwide,[1] 89% were located in Southeast, Southern, and Eastern Asia.[2]

However, as the examples that opened this article show, whether exposure to climate hazards translates into large-scale loss of life in specific places hinges crucially on other social factors and the relationship between citizens and their governments. Some governments in the region such as India and Bangladesh have over time improved their capacity and willingness to protect their citizens, at least from the catastrophic impacts of such hazards. Other governments, such as Myanmar and Pakistan, by contrast, have been less able and/or less responsive to climate-related hazards. Climate-related humanitarian emergencies have the potential to upend and reverse progress on development priorities. At a time of scarce resources for humanitarian and development assistance, climate-related disasters impose major demands on governments and aid providers, forcing them to put off long-run investments to deal with unfolding emergencies. While there is a vigorous academic debate about whether disasters affect long-run country GDP, unnecessary suffering and death are not positive development outcomes (Shabnam, 2014; Bergholt & Lujala, 2012; Cavallo, Galiani, Noy, & Pantano, 2013). Even if countries historically have rebounded after disasters, climate change may worsen their future economic impact.

The effects of climate-related emergencies are also more than humanitarian and development challenges. An emergent discussion in policy circles and among academics links climate change and security (Barnett, 2003; Salehyan, 2008; Gleditsch, 2012; Scheffran, Brzoska, Jasmin Kominek, Link, & Schilling, 2012; Salehyan, 2014). While there are diverse ways climate change can affect security outcomes and contested understandings of security, the loss of life from exposure to extreme weather events is identified as a core security concern in the IPCC Fifth Assessment Report chapter on human security (Adger et al., 2014, 762). Climate change may also indirectly lead to loss-of-life by contributing to conflict, though this relationship, as the IPCC notes, remains "contested." That said, the IPCC concluded that climate change likely has an impact on factors such as low per capita incomes, economic contraction, and weak state institutions that are strongly associated with the incidence of violent conflict (Adger et al., 2014, 758).

Where will the consequences of climate change be concentrated in Asia? Current data availability makes this a difficult question to answer with geographic precision and high confidence. Asia is a diverse and large region; thus, the impacts are likely to vary significantly by location. Regional projections of future climate change impacts are increasingly fine-grained, but there is still much scientific uncertainty about specific effects in particular places.

To the extent that early warning and vulnerability analysis can help limit the need for expensive emergency mobilization, improved spatial awareness of likely hot spots can help prioritize climate adaptation and disaster preparedness (Barrett, 2014). However, while vulnerability mapping holds some promise as a tool for decision-makers, it is not without complications, given the heterogeneity of definitions of vulnerability and approaches to modeling it (Preston, Yuen, & Westaway, 2011; Cardona et al., 2012). As de Sherbinin notes, the assumptions that go into modeling risk reifying concepts like vulnerability and resilience at the expense of local contextual knowledge and power relations (de Sherbinin, 2014, 34; see also Ribot, 2014).

These concerns notwithstanding, this article provides a portrait of regional vulnerabilities or hot spots by mapping sub-national "climate security vulnerability" for 11 countries in South and Southeast Asia. Study countries include six countries in South Asia – Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka – and five countries in Southeast Asia – Cambodia, Laos, Myanmar, Thailand, and Vietnam.[3] Climate security vulnerability is defined as the risk in a particular location that large numbers of people could die from either direct exposure to a natural hazard or the follow-on consequences of instability and conflict that the hazard might generate (Busby, Smith, & Krishnan, 2014, Busby, Smith, White, & Strange 2013).

To map hot spots, physical, demographic, social, and governance indicators are combined in a composite index, the Asian Climate Security Vulnerability Model Version 1 (ACSV V1). Our approach is anchored at the intersection of studies of development, disasters, and security. We emphasize security, distinguishing this model from other accounts of climate vulnerability that tend to focus on livelihoods.

The ACSV V1 findings suggest that much of Bangladesh, parts of southern and western Myanmar (the Ayeyarwady region and Rakhine state), and parts of southern and northwest Pakistan (Sindh and Khyber Pakhtunkhwa) are the most vulnerable locations from a climate security perspective. In terms of absolute numbers, the largest numbers of people who are exposed to climate hazards are in India followed by Bangladesh. The article subjects the model to sensitivity tests (1) by comparing the results with work by Germanwatch and a geo-referenced version of the EM-DAT International Disaster Database, (2) by providing alternative specifications of the model, and (3) by surveying 18 regional experts and building alternative maps based on their responses.

This article unfolds in six parts. In the first, we explain the concept of climate security vulnerability and anchor our approach in the wider literature. In the second, we discuss the methodology. In the third, we present our results. In the fourth section, we compare our results to work by Germanwatch and a geo-referenced version of the EM-DAT International Disaster Database. In the fifth, we present sensitivity analysis of our model using different functional forms and model weights drawn from a survey of eighteen regional experts. In the final section, we discuss our research agenda going forward.

## 1. Defining climate security vulnerability

There is a rich literature on vulnerability and climate change, but there is no unified definition of vulnerability across different disciplines, making comparisons between studies animated by different assumptions and definitions problematic (Füssel, 2007; IPCC Working Group II Report, 2014, 6; IPCC, 2012; O'Brien, Eriksen, Nygaard, & Schjolden, 2007; Cutter et al., 2008). Consequently, researchers must be clear about their meaning of vulnerability and its operationalization.

[1] Climate-related disasters include storms, floods, wet mass movements, extreme temperatures, droughts, and wildfires (CRED, 2012). The average was 228 million a year over this time period.

[2] These numbers are estimates derived from the EM-DAT International Disaster Database, the main dataset that compiles information and statistics on disasters. Southern Asia encompasses Afghanistan, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka. Southeast Asia includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, and Vietnam. Eastern Asia thus encompasses China, Hong Kong, Macao, North Korea, Japan, Mongolia, and South Korea. United Nations Statistics Division, http://unstats.un.org/unsd/methods/m49/m49regin.htm.

[3] The choice of these specific Asian countries was determined by the funder of the research.