An integrated framework for climate vulnerability, natural hazards & risks assessment at the local scale - and its potential for regional upscaling

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INTRODUCTION

The Indian Himalayan Region (IHR), as many other mountain regions worldwide, is facing important challenges in view of coping with adverse effects of climatic changes. In order to address adaptation needs and reduce the vulnerability of the communities living in potentially affected regions, the Indian Government under its National Mission on Sustaining Himalayan Ecosystem (NMSHE) is targeting an integrated vulnerability, hazard and risk assessment encompassing the 12 Indian Himalayan States. The assessment will serve as an important basis for prioritizing, planning and implementing adaptation measures at state/ sub-national level.

The Indian Himalayas Climate Adaptation Programme (IHCAP) of the Swiss Agency for Development and Cooperation (SDC), being implemented in partnership with Department of Science and Technology (DST), Government of India is actively supporting these efforts through scientific and technical knowledge cooperation between Swiss and Indian scientific institutions. A first step includes the development and implementation of an integrated and comprehensive framework for climate vulnerability and natural hazard and risk assessment in a pilot region of the IHR. Kullu district in Himachal Pradesh, India, has been identified as climate hotspot and as such represents an ideal pilot region, as it has been affected in the recent past by a large suite of natural disasters including floods, flash floods, debris flows, landslides, and snow avalanches.

The framework for Kullu is based on the latest concept of vulnerability, hazards and disaster risks from the Intergovernmental Panel on Climate Change (IPCC; AR5, SREX; see Figure 1). More specifically, a large series of specific joint Indo-Swiss collaborative studies are in the final phase in Kullu district and cover thematic themes as broad as climate, cryosphere, torrential processes, snow avalanches, agriculture, community perception, tourism, forestry, and biodiversity. We demonstrate a common baseline and definition and agreement for a common time window and homogenous datasets (climate, socio-economic, environmental) are fundamental for integrated vulnerability assessments and has thus been chosen for all studies conducted within the framework.

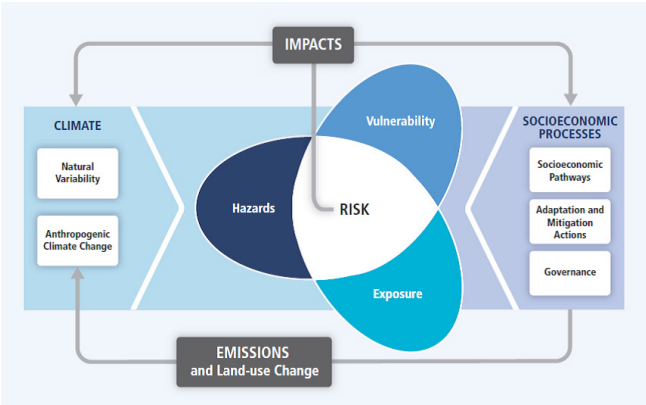

Figure 1. Schematic overview of the revised IPCC concept of disaster risk, showing the interaction between vulnerability, exposure and hydro-meteorological events (modified after IPCC 2012).

PRELIMINARY RESULTS AND INTERPRETATION

In this contribution, we present the framework for the Kullu region, related results from specific thematic studies and discuss in particular the potential and limitations of the upscaling processes towards a common framework for integrated vulnerability, hazards and risks assessment for the IHR. We present a database of past events in Himachal Pradesh based on scientific publications, press and internet sources, and assess of basin disposition to extreme floods based on morphometric indexes, potential hydrological response and

climatic conditions. Analysis includes changes in fluvial systems, both due to natural and anthropogenic forcing based on vegetation and channel changes detection as well as catastrophic floods related to landslide dam outbursts in the Sutlej River basin. In the study we also implemented a broad suite of approaches to assess current and future glacier lake outburst flood (GLOF) hazard, underlying socio-economic vulnerability, exposed communities and infrastructure, and ultimately GLOF risk across Himachal Pradesh. In Kullu district, actual GLOF hazard is highest in Kullu, where potential GLOFs originating in the heavily glaciated Parvati valley can in a worst-case scenario reach the main Kullu Valley. Based on comprehensive mapping of lakes in Kullu district using remotely sensed imagery, a considerable increase in the formation of glacial lakes has been observed, with an increase from 6 (1989) to 33(2011) in Beas basin, from 12 (1989) to 77 (2014) in the Parvati Valley, and 12 (2002)
to 39 (2013) in the Great Himalayan National Park and Seraj catchments, respectively. This increase has been associated with retreat of glaciers during the present era of climatic variations, and these lakes can pose threats to downstream inhabited areas and hydroelectric projects which are operating in the district.

OUTLOOK

The final aim of the present project is to set the basis for the development of a vulnerability and natural hazard and risk assessment tailored for the Kullu Valley (HP) using a concept based on the latest IPCC Fifth Assessment Report (AR5) and the IPCC Special Report on Extremes (SREX). The use of an integrated vulnerability assessment framework is particularly important because the studies for Kullu Valley will involve many different institutions and individuals from various professions (scientists, policy makers, etc.) within different geographical and cultural contexts. Accordingly, the final objectives of the present document are to: (i) ensure a common understanding on concepts and methods that will be used for the vulnerability and natural hazards & risk assessment for Kullu Valley; (ii) develop a single integrated vulnerability and hazards & risk framework tailored to the Kullu Valley in particular, and to IHR in general, and (iii) to propose steps forward for a sustainable development in the Indian Himalayan Region. On the basis of the results from Kullu district, we will also assess the potential for this approach (being implemented locally) to be up- and outscaled to other regions in the Himalayas.

KEYWORDS

climate change, hazards, risks, Indian Himalayas

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