Policy Brief #5

How can we communicate anthropogenic factors that contribute to natural disasters? ---Transdisciplinary approaches enhance cooperation among different stakeholders

Preamble

The ISC GeoUnions Standing Committee for DRR seeks to strengthen the long-standing International Science Council (ISC) leadership in advancing Disaster Risk Reduction. The International Council of Scientific Union (the predecessor to ISC) coordinated and represented the science and technology communities in preparation for the 3rd World Conference, where the Sendai Framework for Disaster Risk Reduction was presented. The ISC and the UN Office on Disaster Risk Reduction co-sponsored the 'Sendai Hazard Definition and Classification Review', which aims to further refine the Sendai Framework by introducing a consistent terminology, clarifying actions, and increasing awareness of the Framework, with the overall purpose of improving societal well-being.

Context

The major recent and ongoing environmental changes frequently manifest themselves in the form of abnormal weather. Locally occurring heavy rains can induce floods, landslides or debris flows. At the same time, human interactions with the geological environment can increase the susceptibility to these kinds of disasters. While natural events of this kind are inevitable, we need to reduce their impacts, thereby saving human lives and sustaining human well-being. However, we should also assess and reduce the impact of anthropogenic factors that can exacerbate the drivers of such natural disasters and make them more likely to occur.

Impacts

After three days of continuous heavy rain beneath a linear precipitation zone associated with a monsoonal front, a highspeed debris flow took place in Atami City, Shizuoka Prefecture (Japan) on the morning of July 3, 2021. Cumulative precipitation exceeded 400 mm in three days. Such a large precipitation is unprecedented since meteorological records began 100 years ago. A dense mass of muddy debris rushed down a steeply sloping valley, and swept away over

130 houses, causing 27 fatalities. It is believed that heavy precipitation was the proximal cause of the debris flow and that the city authorities had failed to issue an evacuation warning. However, although it remains under investigation, it appears that a number of anthropogenic factors also contributed to the debris flow disaster. One factor was that more than 50,000 tons of soil material, deposited at the head of Ohshogawa Creek in order to form an artificial embankment, had collapsed as a result of being saturated with water. Changes in land utilizations by urban land developers may also have played a role. We propose that the disaster at Atami should be comprehensively analyzed using a transdisciplinary approach involving multiple stakeholders.

Policy Advise to National Governments

1. Develop models for linear and heavy precipitation mechanisms and rainfall thresholds. Abnormal weather due to global warming introduces an unexpected amount of precipitation. This meteorological phenomenon has been observed in Germany, China and other areas of the world. It is important for scientists to develop high precision, short term meteorological models/forecasts and provide them to governments and citizens.

2. Monitor and control artificial embankments. Town building generates surplus soil that can be used to construct artificial embankments. These have different physical properties compared to bedrocks and create slippery land surfaces. As a result, they can easily fail and generate sudden debris flows or landslides if not designed and constructed properly, e.g. by applying adequate compaction and drainage. Artificial embankments should therefore be monitored with open access, high resolution topographic data obtained using various forms of edge-cutting altimetry.

3. Monitor and control vegetation along the slopes facing settlements and streams. The ability of vegetation to regulate water runoff and sediment flows depends on the interaction between the kind of vegetation and the soil in which the vegetation is rooted. The management of the vegetation cover should prevent the accumulation of necromass and debris on the surface, which increases the detrital flow of streams.

4. Develop maps showing transdisciplinary data and records relevant to rainfall-induced natural hazards. Information on the physical properties of rocks and soils, together with land utilization and other topographic information, is important for understanding the mechanisms behind the destabilization of slopes and urban residential developments. For example, the topography of the Izusan village area is characterized by wide valleys with steep riverbeds and fragile volcanic soils, which provide ideal conditions for landslides leading to debris flows. In order to prevent slope failures, local peoples have constructing terraced fields and planted orchards on the steep slopes. This information can be incorporated by scientists into susceptibility or hazard maps that serve as a communication medium for planners and decision

makers. Communities that have lived in the area for centuries have accumulated a considerable body of local historical knowledge about how the steeply-sloped topography has been modified by the planting of orchards and by modern urbanization. Interestingly, local wisdom has shown us that historical shrines, temples and even old orchards were free from damage, a lesson we must learn from history and deliver to the next generation within the framework of Disaster Risk Reduction.

5. Dialogue among multiple stakeholders from a transdisciplinary perspective. It should be recognized that debris flows, such as the one that impacted Izusan village, are complex phenomena that have anthropogenic as well as natural causes. To prevent such complex disasters, risk communication should be embedded into disaster reduction schemes. Such schemes should involve multiple stakeholders, including central and local governments, industries involved in earthworks and tourism, scientists from different fields (not only from civil engineering but also earth sciences, landscape ecology, among others) and local citizens. Different ideas and experiences will generate diverse solutions for DRR, including ecosystem-based DRR.

Action Advise to ISC GeoUnions members and expert panels.

Geounion Members are asked to support these policy briefs by distributing them to expert panel groups and disseminate them to Governments and NGOs.

Involvement of Global Stakeholders to Disseminate This Policy Brief

The International Science Council, IAP Global Network of Science Academies, WMO, National Meteorological Agencies, and Geo-Unions should all play a role in disseminating the Brief.

Lead Author: Hiroshi Kitazato (IUGS)
Additional external expertise: Yuri Oki (social sciences*)
Contributing Authors: Anika Braun (INQUA), Edoardo Costantini (IUSS)

* DLab, Tokyo Institute of Technology, Ookayama, Meguro-ku, Tokyo, JAPAN

AUGUST 2021