Science for Humanitarian Emergencies & Resilience
SHEAR

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Landslide EVO

Citizen Science for Landslide Risk Reduction and Disaster Resilience Building in Mountain Regions

Landslide EVO brings together experts in environmental hazards, engineering, social science, citizen science, and computational modelling to improve disaster resilience in Western Nepal.

Landslide EVO
environmental virtual observatories

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Summary:

Nepal is one of the most landslide-prone countries in the world.

The remote Karnali river basin in Western Nepal suffers from a complex interplay of natural hazards.

These include hydrologically-induced landslides and cascading hazards, such as flooding.

Citizen science enables the generation of new and higher resolution data, supporting and facilitating better decision making on managing landslide risk.

The use of citizen science and new sensor technology enhances resilience to hydrological hazards at the community level, while also enriching the observational database.

Overall aim

Mountains are hotspots for natural disasters, in particular those related to landslides. Across the developing world, mountains are also hotspots for poverty and underdevelopment. Scientific understanding of natural hazards in these areas is lagging behind because of the complexity of the physical environment and the difficulties it poses for data collection. There is an urgent need to improve our understanding of how natural disasters in mountain regions occur, how they can be mitigated, and how people at risk can become more resilient.

Landslide EVO leverages recent technological and conceptual breakthroughs in environmental data collection, processing, and communication to advance resilience building in data-scarce and under-developed mountain communities in South Asia. Landslide EVO employs a bottom-up participatory, or "citizen science", approach to increasing resilience to hydrologically-induced landslides and flood hazards in mountainous Western Nepal. Landslide EVO leverages advances in in-situ/remote monitoring, vulnerability assessment, and polycentric risk governance to co-generate locally actionable knowledge and tools for disaster risk reduction and resilience building.

Project case studies

The project focuses on the Karnali river basin in Western Nepal, an area affected by a complex interplay of hazards. In recent years, these hazards have caused serious damage to local infrastructure (roads, irrigation canals, houses, and bridges), threatening lives and livelihoods (with 34,760 families affected by the August 2014 flood).

Two study sites in Bajura and Bahjng Districts have been chosen. These sites were chosen to contrast: different settlement density; landslide size, depth, and activity; and exisiting community responses.

In partnership with:
UKaid
NERC SCIENCE OF THE ENVIRONMENT
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Published Papers

Cieslik K., Shakya P., Uprety M., Dewulf A., 2019. Building resilience to chronic landslides through citizen science. Frontiers in Earth Science, in press

Paul J.D., Buytaert W., Allen S., Ballesteros-Canovas J.A., Bhusal J., Cieslik K., Clark J., Dugar S., Hannah D.M., Stoffel M., et al., 2018a. Citizen science for hydrological risk reduction and resilience building. Wiley Interdisciplinary Reviews: Water, 5, e1262

Uprety, M., Ochoa-Tocachi, B.F., Paul, J.D., Regmi, S. Buytaert, W., 2019. Improving water resources management using participatory monitoring in a remote mountainous region of Nepal. Journal of Hydrology: Regional Studies, 23, 100604

Partners:

UK: Imperial College London (Lead), University of Birmingham

Nepal: Practical Action Consulting, Tribhuvan University, SoHAM, Kathmandu Living Labs, Department for Hydrology and Meteorology

Austria: IIASA, Geological Survey of Austria

Switzerland: University of Geneva

Netherlands: Wageningen University

France: UNESCO

Landslide EVO Project

Landslide EVO's focus on citizen science and participatory approaches to knowledge generation embodies the idea that bringing together scientists and stakeholders from the start optimises the (co-)generation of locally relevant and actionable knowledge.

Hydrometeorological characterisation and prediction

Recent advent of low-cost, robust environmental sensors provides an opportunity to be harnessed by citizen science applications in Water Resource Management. The ability to employ such sensors in large quantities may provide valuable information for areas where the spatial variation of a particular hydrological variable (e.g. precipitation or discharge) is high or of particular importance. Such a high spatial coverage network could ideally complement official hydrometric networks operated by national meteorological offices, which focus on long time series.

Over two major field campaigns, Landslide EVO have installed approximately 15 rain gauges and four river level sensors, and are beginning to analyse data from the 2018 Monsoon season. The latter sensors were developed in-house at Imperial College London and have been extensively tested in the laboratory and field.

Landslide EVO aim to use these data to:

i) calibrate satellite precipitation products
ii) perform weather nowcasting
iii) make flood risk maps

Landslide EVO will also simulate large-scale surface hydrological processes in the Karnali Basin and beyond (using the JULES model).

Landslide characterization, risk mapping, and prediction

The project has developed tools aimed at local and regional decision-makers including detailed district- and village-scale landslide maps, which show the likelihood of landslides based on past frequency. The team is looking into adding a layer of information on district social vulnerability. Landslide maps based on Google maps have been created by Practical Action to be shared with the local communities and governments.

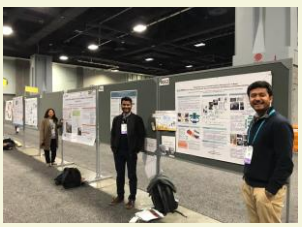
Project partners at Geological Survey of Austria have been carrying out detailed field surveys of the landslides at both case study sites (May 2018 and 2019), employing diverse techniques (such as DGPS, UAV mapping, and geoelectric and PS-InSAR surveys). The goal is to elucidate the disposition of a landslide, its water content, and potential future displacement.

There is also synergy with Landslide EVO hydrometeorological work in terms of developing rainfall (intensity and duration) thresholds, which will be used to quantify the likelihood of landslides taking place. This process requires both detailed landslide maps, histories of past landslide occurrence (from dendrochronological analyses), and ultra-high-resolution precipitation time series.

Key Events

May 2018: Conclusion of Landslide EVO first-year project inception meeting, Kathmandu.

November 2019: Community vulnerability mapping in Bajura. Understanding local perceptions of risk is key in disaster risk and resilience planning.



December 2018: American Geophysical Union Autumn Meeting, Washington DC. Landslide EVO convened two sessions: on citizen science and natural hazards, and sensor networks in hydrology.

May 2019: Rain gauge installation on secondary school roof, Bajura, part of our citizen science in schools programme.

Knowledge co-generation and polycentric risk governance

Meteorological forecasting and landscape dynamics components of the Early Warning System were combined to develop a rainfall-induced landslide forecasting model, applicable over daily to seasonal time scales. The model is now running on a daily basis and data starting from July 2018 have been processed to analyse past events (hindcasting).

The landslide forecasts will be combined with other decision support tools to create a bulletin of information to be provided to District authorities.

The model and its components are being tested and validated and will be re-tuned over the upcoming monsoon seasons in both case study areas. This will be done through a structured and systematic data collection including field surveys and social media sources.

We are also integrating local secondary schoolchildren and teachers into the project by teaching basic hydrology, geology, and geography, while also setting up 'science clubs' for citizen science (e.g. supporting pupil managed rain gauges).

Operational disaster risk reduction and resilience building

Current activities focus on extending the functionality and reach of existing Flood Early Warning Systems, combined with livelihood training activities that build local people's capacity to cope with and adapt to with natural hazards. Lessons drawn from working with 74 communities in the lower part of the river catchment will be used to expand existing local (or informal) early warning systems towards communities further upstream in the Karnali basin.

At the national level, project partners like Practical Action and IIASA are linking with national policy discussions, such collaboration with the Asian Development Bank Institute and the National Planning Commission of Nepal to co-organize a policy dialogue on disaster risk management.

At sub-national level (in newly federalised Nepal) Landslide EVO have organised two municipal workshops, disseminating project outcomes, and ensuring our scientific work informs policy and practice. Data and other scientific information have been translated into a locally understandable form, and are being shared with the municipality and ward chairpersons, to build understanding of landslide-related risk. To date, this initiative has been met with strong positive feedback from local government at the study sites.

Science for Humanitarian Emergencies and Resilience (SHEAR) is an interdisciplinary, international research programme jointly funded for five years by the UK's Department for International Development (DFID) and the Natural Environmental Research Council (NERC).

It aims to support improved disaster resilience and humanitarian response by advancing monitoring, assessment and prediction of natural hazards and risks across sub-Saharan Africa and South Asia. SHEAR is working with stakeholders to co-produce demand-led, people-centred science and solutions to improve risk assessment, preparedness, early action and resilience to natural hazards.