MULTIDISCIPLINARY PARTNERSHIP IN RESEARCH FOR LANDSLIDE RISK REDUCTION AND RESILIENCE BUILDING : OPTIONS AND OPPORTUNITIES IN NEPAL

Practical
ACTION

Pic: Corner Reflector- landslide monitoring installed in project districts

Nepal context – Landslide risk

- Nepal is exposed & **affected by multiple hazards**, including **rainfall-triggered landslides and flooding**
- **Flood & Landslide-induced disasters are increasing**: 405 people lost their lives between June 2020 to – August 6, 2021; Melamchi flood-2021 alone took 25 lives (5 death, 20 missing)- destroying nearly 100+ houses, 3 bridges, roads, and other infrastructures
- **Local and provincial government agencies** are demanding technologies for LEWS
- **PA Nepal has worked on LEWS pilot studies before**, but a more rigorous and holistic assessment was needed to understand if it would be feasible to develop a fully operational and sustainable LEWS
- **Conducted a scoping study to review best practice**, evaluate our experience and capacities, map out stakeholders and partners, and develop recommendations for Nepal's LEWS strategy
- **Exploring partnership** and proactive to work with diverse agencies **for LEWS**

Landslides and LEWS in Nepal

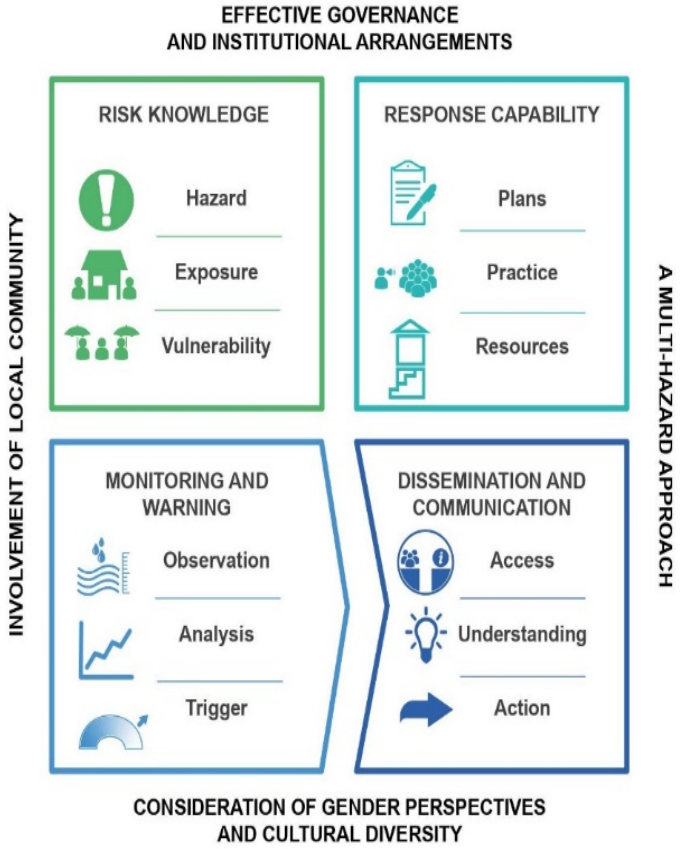
- Common landslide causes = **rainfall**, **earthquakes**, and/or changes to **slope gradient**
- **Anthropogenic activities** also increase likelihood (e.g. improper land use, encroachment into vulnerable slopes and unplanned development activities such as construction of roads and irrigation canals)
- Hilly districts are more susceptible to landslide because of steep **topography** and **fragile ecosystem**
- There have been **many initiatives** to address landslide-related issues but there is **not currently a fully functioning landslide early warning** system in Nepal
- There's a **gap between roles and capacities in government departments**: one is mandated to issues landslide early warning but a separate department (DHM) holds the expertise to link rainfall with landslide risk

Our work on LEWS: objective and partnership

Landslide-EVO Project, FCDO/NERC, 2017 - 2022

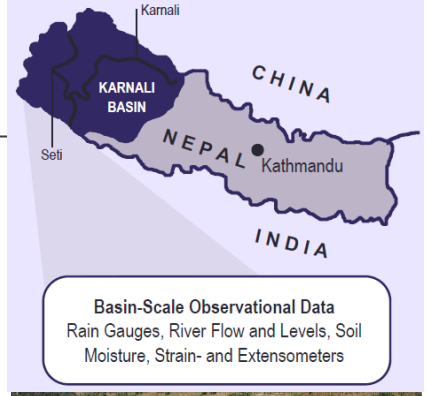
Objectives

- Strengthen resilience to hydro-meteorological disasters in the mountain region of Nepal by utilizing scientific information generated in collaboration with local citizens
- Bridge the gap between and among researchers, practitioners, and policymakers(research into impact)
- Use of research generated outcomes to inform and influence policy and practice
- Both social science and physical science fusion in methodology/multiple partners:
    - Imperial College London, UK (Lead)
    - Practical Action Consulting Nepal
    - University of Birmingham, UK
    - University of Wageningen, Netherlands
    - Tribhuvan University (Department of Geology), Nepal
    - Society of Hydrologists and Meteorologists, Nepal
    - University of Geneva, Switzerland
    - IIASA, Austria
    - Geological Survey of Austria
    - Lancaster University
    - UNESCO
    - Many local partners (NGOs, government,)



Geographical Scope and Scale

Study Site




Sunkuda Landlside, Bajhang

Sunkuda Landslide- Bajhang
Bajhedi Landslide - Bajura


Sunkhola Landslide, Dadeldhura

Work Packages, Methods and approach for Landslide EVO

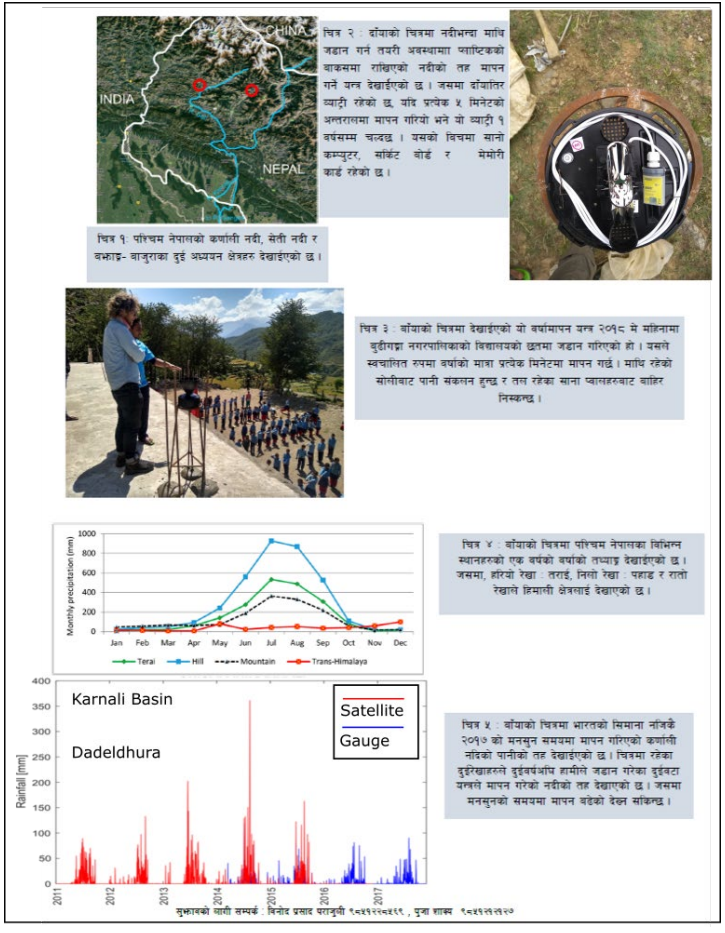
WP1: Hydro meteorological characterisation and prediction (Imperial, DHM, Tribhuvan, SOHAM, Lancaster, PA)
(Participatory monitoring and citizen science; Data merging and hydro meteorological modelling; Hydro meteorological forecasting and prediction)

WP2: Landslide and flood risk mapping and prediction (Geneva, GBA, Tribhuvan, PA)
Data collection using classic and participatory approaches ; Baseline dataset development; Catchment scale modelling and landslide early warning

WP3: Knowledge co-generation & polycentric risk governance (IIASA, Wageningen, B'ham, PA)
Participatory disaster risk mapping and monitoring; Community disaster resilience assessment ; Assessment and design of risk governance arrangements

WP4: Operational disaster risk reduction and resilience building (PA)
Risk information collection and knowledge dissemination tools; Data processing and models; Technologies for participatory monitoring; Training and capacity building

Citizen Science in School



Collaborative Mapping with citizen scientists

20 mappers

3 days

Attributes mapped

Roads, rivers, buildings, forest area , trails, open spaces and streams

43 participants from Bajhang and Bajura attended training in OSM mapping

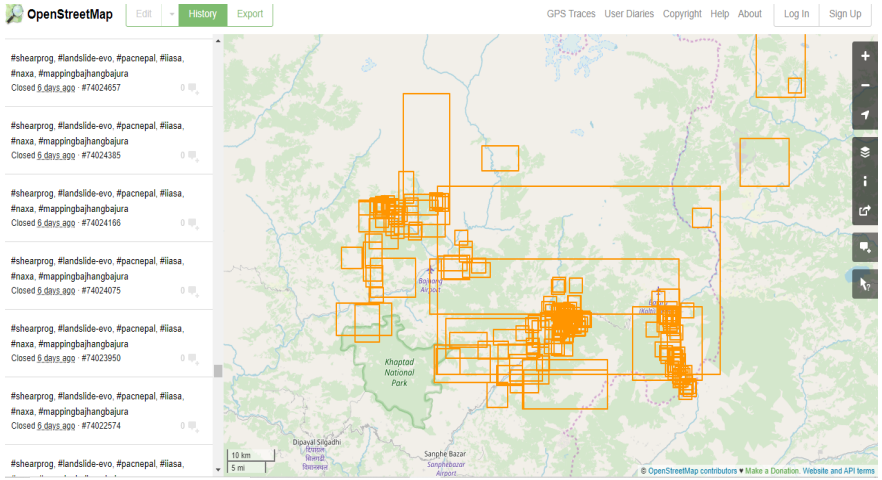


Figure: Snapshot of changes in Open Street map after remote mapping

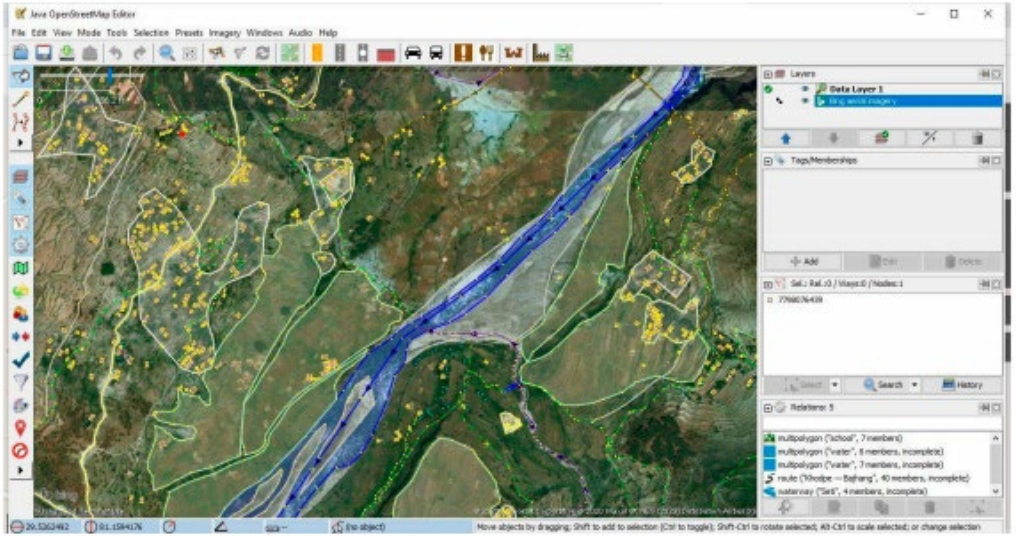
Ground based mapping of key landmarks and facilities of two local government and uploaded in the Open street map

Approximately 40km of ground based mapping done

Data cleaning and uploaded to the OSM platform done by citizen scientists

Figure : Citizen scientists collecting field based data

Attributes	Edits
Building (number)	24,704
Road (km)	209.9
Total (number)	25,899



remote mapping in JOSM

Work in Progress with local stakeholders

- Open Source Mapping
- Citizen Science in School in data collection, landslide risk monitoring
- Orientation on mainstreaming landslides risk in municipal plans
- Sharing of research data, maps in simple communication approach-with Nepali translation
- Household survey to understand landslide risk perception - involving students from Far Western University
- Risk Sensitive Land use planning – to validate and inform
- Orientation to Municipal and community representatives on EWS jointly with DHM
- **Monitoring devices installed** (e.g. Corner Reflector (CR), and rainfall monitoring stations, ground sensor devices-soil saturation level link with precipitation
- Municipal level display board (under progress)
- Data analysis, and threshold determination (soil moisture, soil saturation level link with level of precipitation) in progress

Stakeholder in landslide risk reduction

Department	Roles and Responsibilities
Department of Hydrology and Meteorology	Issuing warnings (floods and landslides)
Department of Mine and Geology	Landslide expertise, data collection, hazard and susceptibility mapping
Ministry of Home affairs/NEOC	Disaster rescue and relief, mobilize Police personnel in disaster rescue operation
National Disaster Risk Reduction Management Authority	Disaster preparedness, rescue and relief
Ministry of Energy, Water Resources and Irrigation: Landslide Study and Management Division	Landslide research, management and training
Ministry of Forests and Environment	Land use and landslide mitigation, forest management, watershed management, and wild life conservation
Department of Soil Conservation and Watershed Management	Soil conservation and watershed management including landslide mitigation works
Department of Water Induced Disaster Management	To mitigate water induced disasters including landslides throughout the country. Focal agency for all water induced disaster mitigation works in Nepal

Stakeholder mapping….

- There are number of initiatives but there are significant gaps: lack of continuity, different methods, not holistic
- **No long term strategy and sustainability considered**

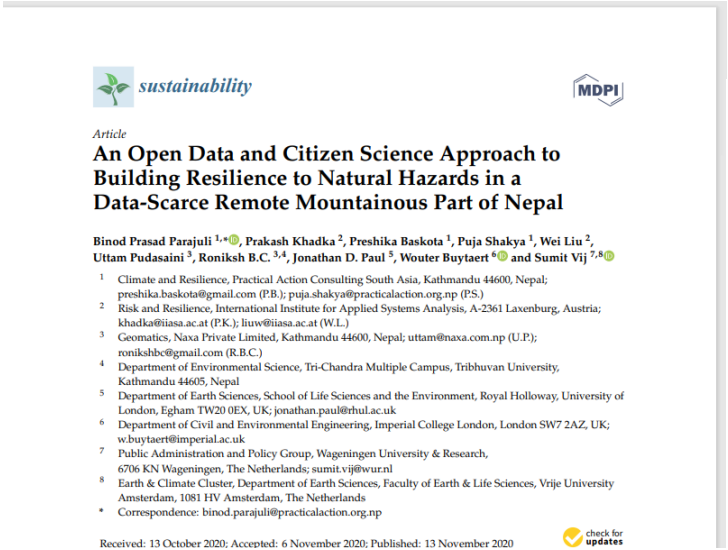
Researchers

- **Universities**: Tribhuvan University, Durham University & the International Landslide Centre, Imperial College, Northumbria University, Heriot-Watt University, University of Edinburgh
- **British Geological Survey**: mapping landslides and developing susceptibility maps
- **UK Met Office**: ARCCC project - working with Nepal government to link weather forecasts with likely impacts (focusing on landslides), to produce forecast products and information that can be used by stakeholders to take action.
- **ICIMOD-SERVIER-HKH programme** in partnership with **USAID and NASA**-Earth observation based landslide monitoring

NGOs

- **IFRC** and **Nepal Red Cross Society**: conduct rapid assessments and provide relief services after heavy rainfall and landslides occur.
- **Nepal Risk Reduction Consortium** (FCDO, ADB, World Bank, WHO, GoN etc.): flooding and earthquakes
- **Several local, pilot landslide early warning projects in Nepal. Not many are operational post-project funding (e.g. DIPECHO or Mission East Pilot LEWS)**
- People in Need-EU funded landslide risk reduction project

Some publications



sustainability

MDPI

Article

An Open Data and Citizen Science Approach to Building Resilience to Natural Hazards in a Data-Scarce Remote Mountainous Part of Nepal

Binod Prasad Parajuli [1,*], Prakash Khadka [2], Preshika Baskota [1], Puja Shakya [1], Wei Liu [2], Uttam Pudasaini [3], Roniksh B.C. [3,4], Jonathan D. Paul [5], Wouter Buytaert [6] and Sumit Vij [7,8]

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Received: 13 October 2020; Accepted: 6 November 2020; Published: 13 November 2020

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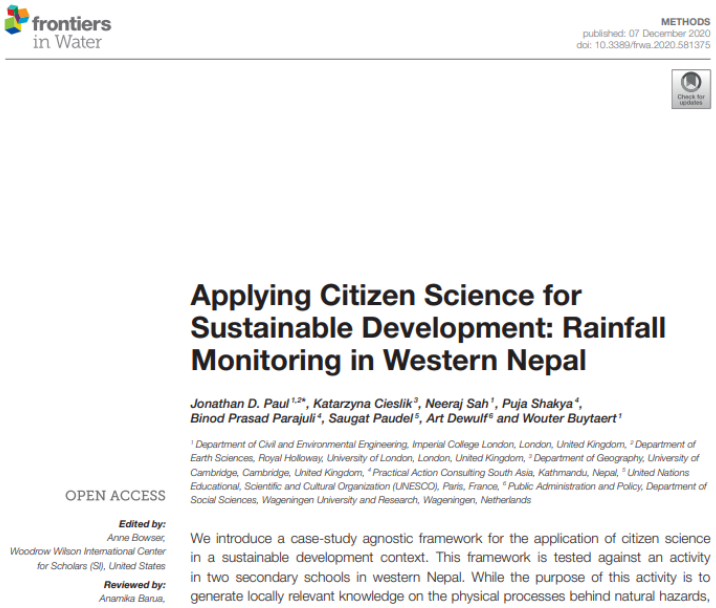

frontiers in Water

METHODS

published: 07 December 2020
doi: 10.3389/frwa.2020.581375

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Applying Citizen Science for Sustainable Development: Rainfall Monitoring in Western Nepal

Jonathan D. Paul [1,2], Katarzyna Cieslik [3], Neeraj Sah [1], Puja Shakya [4], Binod Prasad Parajuli [4], Saugat Paudel [5], Art Dewulf [6] and Wouter Buytaert [1]*

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OPEN ACCESS

Edited by:
Anne Bowser, Woodrow Wilson International Center for Scholars (SI), United States

Reviewed by:
Anamika Barua,

We introduce a case-study agnostic framework for the application of citizen science in a sustainable development context. This framework is tested against an activity in two secondary schools in western Nepal. While the purpose of this activity is to generate locally relevant knowledge on the physical processes behind natural hazards,

Ways forward for landslide EWS in Nepal (future plan)

Where does Practical Action fit in?

- Extensive experience of assessing EWS and risk information for practical application purposes
- Provide a bridge to municipal government to facilitate the development, uptake and use of existing and new hazard and susceptibility maps and products.
- Strong, long-term relationships at local and municipal level
- Understanding of holistic approaches and expertise in data collection, governance, and user-centred communication of complex forecast information, as well as on piloting projects with a focus on legacy and sustainability.
- Advise on potential appropriate governance structures
- Experience with citizen science approaches, data collection, and collaborative working across communities, NGOs and government authorities
- Collaboration for monitoring methods and community education and outreach
- Partnership with agencies to operationalize LEWS

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Thank YOU