



## Operational assessment of landslide risks in the sprawling city of Bukavu (DR Congo)

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The expansion of informal and uncontrolled urban landscapes commonly overlooks the natural constraints from the environment. This is particularly true for urban environments affected by landslides. Landslide risk assessment relevant for urban planning and disaster risk reduction (DRR) strategy requires highly spatially-resolved datasets and approaches. It also requires that both physical and social local aspects of risk are studied in an interdisciplinary manner. Such assessment of hazard risk remains challenging and under-researched in many regions, especially in low- and lower-middle-income countries in the tropics, as it usually requires large and diverse datasets that are frequently unavailable or unreliable. In addition, specifically in urban contexts, human-induced environmental change impacts slope stability. Under these conditions of data-scarcity and land transformation, reliable and detailed landslide risk assessment encompassing the physical and societal aspects in an operational approach strongly relies on expert knowledge.

In this research, we assess the risks associated with landslides in Bukavu, a city located in the eastern DR Congo where urban sprawling is high and the problem of landsliding is particularly acute. Firstly, we compiled a comprehensive multi-temporal landslide inventory covering several decades using remote sensing, archives, field survey and interviews with key informants. From this inventory, we derived three hazard zonations with multiple scenarios that allow to consider the interactions between various landslide processes and the role of human activities. Secondly, we obtained detailed socio-economic data from a sample population survey in morphological areas determined by remote sensing. Within two months, 10 specifically-trained local interviewers counted and located nearly 44,000 inhabitants living in about 6,580 households, and collected socio-economic baseline data over 10,880 people from 1,614 households. These demographic data were used to determine the variations in population density (exposure) in the city. These data were also key for the vulnerability assessment. For this, we designed a contextualised vulnerability index capturing the various dimensions of vulnerability with a set of selected indicators aimed at facilitating understanding, replicability and updating of the data collection. By combining hazard, exposure and vulnerability, we produced three risk zonation maps at a very high spatial resolution

with the potential to be used operationally: one for shallow landslides, another for deformation within landslides and one for reactivation of deep-seated landslides. The development of these maps, as well as the collection of field-based information were carried out in close interaction with the city authorities and various stakeholders (e.g. civil protection, local community leaders) involved in DRR. A specific effort of awareness raising was also made through the organisation of dedicated workshops and radio programmes, and the implementation of a disaster risk information centre in Bukavu.