Landslide mapping in Nepal: the impacts of the 2015 Gorkha earthquake and the subsequent monsoon

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The Gorkha earthquake (M 7.8) on 25 April 2015 and later aftershocks strongly hit the central part of Nepal and induced numerous numbers of landslides. The Japan Government requested rapid and frequent advice from the Japan Landslide Society in collaboration with Ministry of Land, Infrastructure, Transport and Tourism, Japan and a team supported by J-Rapid of JST on the impacts of the earthquake-induced landslides. As a first step to underpin the advice, the members utilized optical satellite images provided by archive of Digital Globe Co. Ltd., Google Earth, JAXA, and NASA to produce landslide inventory with mapped landslides as polygons. The type of landslides included in this inventory were disrupted rock and debris slides, rockfalls, and debris avalanches and they are either newly formed landslides or enlarged old landslides. The inventory was verified through limited field check in corporation with researchers in Nepal in the catchments of Trisuli River and Bhote Kosi River. We mapped 3594 landslides and significant landslide concentrations were highest to the east of the epicenter (in Gorkha, Dhading, Nuwakot, Rasuwa, Sindhupalchok and Dolakha districts) than to the west. The field survey suggested majority of landslides tend to occur along the slope break that confined the fluvially debuttressed steep valley slopes (>35°) and steep scarp slopes (>35°), which are located against the direction of the dip of the strata, of mountain ridges. These suggest that the landslide distribution might be controlled by fault rupture direction and topographic and litho-structural conditions.
The field survey in late October 2015 after the monsoon season also allowed the observation of development of new landslides as well as the reactivation of pre-existing landslides prompted by the subsequent rainfall. Some newer head scarps tend to develop retreating upward from pre-existing landslide scarps formed in weathered or the earthquake loosen rocks of about 10-20 m in thickness. In addition, a rainfall-induced debris flow was observed with debris served from a debris avalanche in the upper slope which transported into a gully eroding gully deposits.
We are now working on verification of the inventory sine the existing inventory was created by different persons. The results are being used as based data for further hazard evaluation and shared with the government of Nepal.
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