

Large landslides related to earthquakes: a direct and indirect threat to Asian mountain communities

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Large landslides in Asian mountains are often conditioned or triggered by earthquakes. Whilst the direct impact of earthquake-triggered landslides on mountain communities is obvious (casualties, severe damage), the indirect consequences of related processes are sometimes at least as significant. Such can be the earthquake-induced destabilization of slopes, resulting in an increased landslide susceptibility for many years (e.g. the Chi-Chi Earthquake in Taiwan 1999 or the Sichuan Earthquake in the PR China in 2008).

The work presented, however, is focussed on another phenomenon: landslide deposits often block valleys and dam lakes. Such landslide dams may fail suddenly due to internal destruction or by retrogressive erosion, resulting in flood waves downstream. The lakes may also drain stepwise or continuously or persist for a long time. Geomorphic evidence of former landslide-dammed lakes exists in several places. For example, the Pasor Landslide in the Bartang Valley (Pamir, Tajikistan) dammed an 8 km long lake. The patterns of the eroded lake sediments and the deposit downstream indicate sudden drainage of the lake.

Recent examples of lake-damming landslides are Hattian Bala (Pakistan Earthquake, 2005), Tangjiashan (Sichuan Earthquake, 2008), and Attabad (conditioned by at least two earthquakes, 2010). Spillways were constructed in order to reduce the maximum lake level and to control drainage. In the case of Hattian Bala, this mitigation strategy first worked, but the spillway was eroded five years later due to a landslide-induced spillover. The Tangjiashan spillway was eroded immediately. In both cases, destructive flood waves causing major damage were the consequence. The Attabad Lake has not spilled over by May 2010, but a major flood wave far down the valley was expected.

Whilst there are usually no means to prevent the landslides themselves, appropriate mitigation measures include monitoring of suspicious slopes and landslide dams as well as related emergency evacuation plans and activities.