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Ephemeral natural dams in the Nepal Himalaya: types, geomorphic impacts and induced risks.

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In tectonically active mountains such as the Himalaya, valleys are cut by rapidly incising rivers that keep pace with uplift rates. Typically, river valleys display narrow floors with discontinuous patches of aggradational terraces beneath steep rocky or unstable debris-covered hillslopes that are prone to mass wasting. Also, the seasonally contrasting (monsoonal) climate controls soil saturation, slope instability and river regime. In this geomorphic context, ephemeral (less than 24 hours) natural dams are common at all scales; they may even affect powerful rivers such as major tributaries of the Ganga. They develop as a function of slope instability and/or debris laden flows from tributaries. On the basis of field experience gained during the last twenty-five years in Nepal, we present selected examples of ephemeral dams related to debris slides, earth flows and rock slides, together with one example of repeated damming by a tributary river behaving occasionally as a debris flow. These case studies show that such ephemeral dams play a major role in the overall process of sediment transfer, and that their hydro-geomorphic effects are manifold. Upvalley, they force local, temporary aggradation and storage of sediments, and cause rapid backwater flooding, thus threatening and eventually inundating the nearby settlements. Downvalley, dam failure and/or breaching out instantaneously releases huge injections of both coarse and fine solid discharge, in turn increasing the density and competence of the flow and, thus, its morphogenic efficiency. Outbreak flood waves favour and accelerate the removal of sediment stores downstream (constituting material evidence of former, similar events), leading to the erosion of cultivated terraces and villages sites. Where the valley floor widens, changes in both dynamically active river-bed morphology and river channel traces occur at a larger scale, resulting in a complex hillslope-channel coupling, alternating in time and space from one bank to the other. Repeated observations at the

same sites suggest ephemeral dams and their subsequent failure are the most common and efficient mode of erosion and sediment transfer that control sediment fluxes outward from the mountains; the potential impact on human settlements of such failures represent a major threat to local populations along the full length of the river system.