

Morphometry of alluvial fans and its relation to debris flow hazards in Chitral valley, N. Pakistan

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The Chitral district of N. Pakistan lies in the eastern Hindukush Ranges at the south-western limb of the Pamir Syntaxis. The Chitral River traverses across the district as a predominantly U-shaped valley formed in response to Late Quaternary ice-age glaciations. Remnants of landforms formed during these glaciation stages and subsequent fluvial regimes, locally preserved on trunk-valley flanks are superimposed by debris-flow dominated alluvial fans associated with the tributary streams. On one hand these fans are the sites of habitation because of their flatter surfaces, fertile soils and access to water, on the other their proximity to steep valley slopes renders them prone to mass-movement hazards especially the debris flows.

As a part of this study, morphometric analysis of the drainage as well as depositional basins of more than 95 prominent tributary stream fans, stretched along the north-south axis of the Chitral river has been carried out. The morphometric studies including stream attributes like drainage basin area, stream profile, gradient, depositional basin area, stream pattern are measured using Arc GIS 9.2. Based on the morphometric analysis supported by field observations, it is determined that the ephemeral streams i.e., talus cones and debris fans have high hazard potential. These streams having shorter lengths and a limited catchment area, have hyper-concentrated flows resulting in active deposition on fan surface. On the contrary, the high-energy perennial streams, carve through the landforms they traverse including the alluvial fans they formed in their earlier history, leading to an efficient discharge of the debris load into the trunk river rather than on the fan surface. Whereas the ephemeral-stream fans are prone to debris-flow hazards, on average, every three to five years, the landforms associated with the perennial streams face debris flow hazards in exceptionally large events with return periods of recurrence >30 years. The study has utility for quick assessment of vulnerability to debris-flow hazards, based on simple observations about the nature of the feeder tributary stream and its associated alluvial fan.