Debris flow modelling of Uchar Stream through Geophysical and Remote sensing technique

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The Uchar Nullah, or Uchar stream, represents a tributary of the Indus River, akin to numerous other watercourses that contribute to the Indus River's flow, characterized by a considerable topographic gradient. The region spanning from Besham to the northernmost reaches of the country has been structurally influenced by historical tectonic activities, resulting in a surface configuration such that each stream exhibits a higher risk of transporting debris to the River Indus. Currently, two major dams are under construction in the Dasu hydel power project (HPP) and Diamer Basha dam areas. The existence of these substantial reservoirs necessitates a comprehensive assessment of debris modeling for each stream to accurately quantify its capacity for its debris transport to the River Indus. The Uchar Nullah conjoins the Indus River at an elevation of approximately 800 meters above mean sea level (MAMSL), originating at an altitude of around 4500 meters MAMSL, covering a total length of 17 km. The Uchar stream is characterized by a steep gradient towards the Indus, and its surrounding mountain ranges exhibit pronounced slopes towards the stream's center. Loose debris accumulations are evident along the banks and various depositional centers at different elevations. The primary dam of the Dasu Hydro Power Project (HPP), which is currently under construction, is situated 1.5 kilometers downstream from the confluence point of Uchar and the Indus River. In July 2022, severe monsoonal rains triggered flash floods that transported one million cubic meters of debris into the Indus River. This event not only destroyed the bridge at Karakorum Highway (KKH) but also completely demolished the contractor camp of the HPP, leading to a temporary cessation of construction activities due to the adverse effects of the transported debris. A collaborative investigation, conducted by a Joint Investigation Team from WAPDA and Bacha Khan University, aimed to model the debris transport characteristics of the Uchar Nullah, considering both its geophysical and geological aspects. This study endeavors to integrate all assessments conducted on the Uchar Nullah, including remote-sensing evaluations, to model the volume and transport characteristics of its debris. The topography of the entire Uchar catchment is modeled through a Digital Elevation Model (DEM), and the accretion and erosion rates of the Nullah are evaluated through temporal assessments of debris area. Recommendations and suggestions are provided to mitigate the debris transport characteristics and enhance the resilience of the Hydro Power Project (HPP).

Keywords: Debris flow; Uchar Nullah; DEM; WAPDA; catchment; Indus River