# Formation and Failure Mechanism of Pre-Historic and Historical Landslide Dams in Astore Valley (NW Himalaya, Pakistan)

Niaz Muhammad[1], Sajid Ali[2], and Shibiao Bai[1,3*]

[1]*School of Marine Science and Engineering, Jiangsu Center for Collaborative Innovation in Geographical Information Resource Development and Application, Nanjing Normal University, Nanjing 210023, China;*

[2]*Department of Earth Sciences, COMSATS University Islamabad Abbottabad Campus 22010, Pakistan;*

[3]*China-Pakistan Joint Research Center on Earth Sciences, Institute of Mountain Hazards and Environment, CAS, Chengdu 610299, China*

[*]*Email: niaz8122@gmail.com*

A landslide dam is a type of natural dam that forms when an earth mass or rock mass enters a river channel and results in its partial or complete blockage. When a river or channel is blocked by a sliding landslide, a landslide dam forms, creating a natural reservoir that overflows with water and/or sediments. The Astore valley has the characteristic feature of a narrow, steep landscape surrounded by high, uneven mountains with a high probability of landslide dams. The area is associated with the base of Nanga Parbat Haramosh syntaxes. Furthermore, the presence of active Raikot Fault is the diagnostic feature of the area. Four major formations of study area are Nanga Parbat Gneisses, Kohistan Batholith Kamila Amphibolite and Quaternary deposits. Landslide dams having differences in their construction, features and durability. Landslides dams occurred majorly in those regions which are seismically active zone, have volcanic activity and are glacially overstepped slope areas. Historical landslide dams identifying through satellite imagery and ASTER Digital Elevation Model (DEM) different geomorphic and topographic features like (Knick points, Thalweg, hummocky surface, bending river and balance of the stream passage along a valley) were recognizing through Arc GIS 10.5. For detailed investigation, we selected six landslide dams in the valley. Among the selected landslides the largest area was covered by the Gorikot landslide, which is 11.6 $Km^2$ area and the smallest one are Harcho landslide, which covers 1.2 $Km^2$ area. Several geomorphic parameters including total volume of the rockslide ($Mm^3$), volume of the rockslide dam, lake size ($Mm^3$), Drainage area of the rockslide in

kilometer2, and height of the maximum crest height of the rockslide, relief upstream of the point of blockage (HR=Emax−[Emin − HD]) (m), describes the rockslide dam and extreme altitude point in subsidizing catchment area (m), altitude of the rockslide dam (crest) (m), thickness of the dammed valley (m), local lengthwise slope of the waterway bed (°) were all studied during the construction of rockslide dams. A range of criteria were employed to define the stability or instability of landslide dams throughout time. II=log(VD/VL) and BI=log(VD/AC) are these indices, DBI=log (ACHD/VD), Basin index IA=log(HD2/AC), Back-stow index IS=log(HD3/VL), and Relief index IR=(HD/HR) Hydromorphic dam stability in one Log(VD/ACS) equals HDSI. Based on these indices Dion, Dashkin, Harcho, Darley landslides are unstable while Rattu and Gorikot are uncertain due to some indices and due to all others parameters were found unstable. Those factors which involves mainly in the instability of landslide dams are overtopping, pipe collapse, and slope failure are the three primary ways that enhance landslide dams failure.