

# Environmental implications of Pancheshwar dam in Uttarakhand (Central Himalaya), India

S. P. Sati, Shubhra Sharma\*, Naresh Rana, Harsh Dobhal and Navin Juyal

*The present study outlines major concerns and potential environmental consequences of the proposed Pancheshwar high dam in Uttarakhand (Central Himalaya), India. We evaluate the risks associated with the project in the light of environmental impact observed for the Tehri project in the region and the geological understanding developed over the years. Three major factors and their likely impacts analysed relate to (i) sediment mobilization from glacial-paraglacial zones and unstable slopes, (ii) infrastructure development, and (iii) seismicity. We highlight the need to re-assess geo-environmental implications of the project in the ecologically sensitive Kaliganga valley.*

**Keywords:** Environmental impact, Pancheshwar, reservoir draw down effect, sediment flux, seismicity.

THE convergence of Indian and Eurasian plates not only created the world's tallest mountain range – the Hindu Kush Himalayas (HKH), but also led to the rupturing and differential dislocations of rocks along the terrain bounding thrusts. From north to south, these are the South Tibetan Detachment System (STDS), the Main Central Thrust (MCT), the Main Boundary Thrust (MBT) and the Main Frontal Thrust (MFT)<sup>1</sup> (Figure 1). These thrusts also govern the altitudinal variability (mountain topography) and lithological discontinuities in the Himalayan region. The topography dictates the precipitation pattern across the Himalaya with two distinct high rainfall domains located to the south of MBT and MCT.

According to the report of the Ravi Chopra Committee<sup>2</sup> on hydropower projects in Uttarakhand Himalaya, the government plans to harness ~27,000 MW of potential hydropower from its rivers by constructing ~450 hydropower projects. Currently 92 projects with a total installed capacity of ~3624 MW have been commissioned and ~38 projects are under construction. According to a study<sup>3</sup>, if the number of proposed hydropower projects planned on 28 major river valleys becomes a reality, the Indian Himalaya will have one of the highest average dam densities in the world (one dam for every 32 km of a river channel). Further, the feasibility and economics of large storage dams versus the smaller run-of-river

projects are being debated in recent times<sup>4,5</sup>. The run-of-river projects rely on seasonal water availability while the storage dams store large volumes of water to be used when the river discharge diminishes.

If we look into the nature of distribution of the proposed hydropower projects in Uttarakhand, nearly 22 are planned above 3000 m elevation in paraglacial zones (areas vacated by the glaciers), 44 are between 3000 and 2500 m (between paraglacial and winter snow line zone), whereas 54 are proposed between 2500 and 2000 m elevation (around the zone of winter snow line). This implies that the projects would largely populate the higher Himalayan region where the MCT represents a wide zone (5–20 km) of crushed and fractured lithology (mylonitized rocks). It is seismically active with maximum strain build-up and concentration of moderate earthquake epicentres<sup>6,7</sup> (Figure 1). Recent studies on Indian Himalaya based on the geological records of floods extending back to Early Holocene<sup>8–11</sup> suggested that mega floods were predominantly generated in the Higher Himalayan region. This vulnerability and the risk associated with disasters like earthquakes and floods is increased manifold by the construction of mega storage dams with the progression of dam age<sup>12–14</sup>.

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With this backdrop, the present study attempts to assess the potential geo-environmental impact of the Pancheshwar high dam proposed on the Kali river. The study focuses on evaluating the environmental consequences in view of the current understanding of Himalayan rivers with respect to sediment mobilization, infrastructure development and seismicity. We also incorporated our field observations on the commissioned Tehri dam constructed two decades ago on the Bhagirathi river. Here we briefly discuss each of the above factors and their implications followed by a detailed discussion on the Pancheshwar high dam.

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