

Chapter 14

Geomorphic Changes Related to Anthropogenic Interference Along the Ganga River From Rishikesh to Haridwar, Uttarakhand, India: Geomorphic Response of the Ganga to Tehri Dam

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ABSTRACT

The authors, in this study, have quantified the changes in the geomorphic activity of the Ganga River between Rishikesh and Haridwar by using Survey of India (SOI) 1:5000 scale topographic sheets, satellite data, digital elevation model (DEM), and hydrological data from published resources. They have also correlated the change in settlement area in Haridwar and Rishikesh and connected it to the changing geomorphic features in the downstream reach of the Tehri dam site. The study finds that the change in geomorphology of the river in the studied reach of the Ganga River is attributable to reduced water and sediment supply. The study area being in the active tectonic zone, bound between MCT in the north and HFT in the south, may have experienced offsetting of the reduction in sediment supply by dam in the post dam era (after 2006) due to massive earthquakes delivering sediment directly delivered to streams through enhanced landslide and other mass wasting processes.

INTRODUCTION

Topography and landforms act as the memory of factors that sculpted them. Understanding and quantifying the linkage between landforms and their control factors is and has always been of utmost importance to geomorphologists. Climate, tectonics, base level change (local as well as local), anthropogenic changes and biotic controls are the chief factors of denudation responsible for constructing, modifying, and destructing landforms (Pandey, 2014; Aman *et al.*, 2018; Arora *et al.*, 2019; Pandey, *et al.*, 2020). Changes in climate, tectonics and base level and their effects on topographic forms and the processes thereof have got comprehensive research exposure to earth science community since long but the biotic controls and their role in construction/modification landform by changing the rate of water and sediment flux rate including hydrogeomorphic response have started a little late. Biotic controls include both plants and animals. From among the animal kingdom, humans have lately been identified as one of the intensely active controlling factors of topography at different scales (Robock and Liu, 1994; Gedney *et al.*, 2006; Braje and Erlandson, 2013; Anthony *et al.*, 2014; BalaSundareshwaran *et al.*, 2019; Gomez *et al.*, 2019; Wilkinson and McElroy, 2007).

The construction of dams across the river courses result in change of the water and sediment supply regimes downstream of these structures (Ranasinghe *et al.*, 2019; Stähly *et al.*, 2019; Warrick *et al.*, 2019; Binh *et al.*, 2020; Brenna *et al.*, 2020; De Rego *et al.*, 2020). Dams also change the ecological balance in the upstream and downstream reaches (Kingsford, 2000; BEDNAREK, 2001; Bednarek and Hart, 2005; Richter and Thomas, 2007; Maavara *et al.*, 2020). Overall, the imbalance between

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