

## **Recent Climate Variability in Kashmir Valley, India and its Impact on Streamflows of the Jhelum River**

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### **Abstract**

Streamflow trend is a robust indicator of the changes in meteorological inputs at a catchment scale and provides vital information about the seasonal and long-term storages of water in soil, snow and glaciers. Due to the mountainous terrain of the Kashmir Himalaya, the network of meteorological observatories is very scanty and inadequate. Therefore, the trends in the observed streamflows, temperature and precipitation shall provide a composite indication of the impact of changing climate at the basin level. Mann-kandall test was used to determine the trends in the annual, seasonal streamflows and meteorological variables (temperature and precipitation) from 1980-2010. Pearson correlation test was used to analyze the relation among the three hydro-meteorological variables. Results from the four observation stations revealed that the Jhelum streamflows have decreased in spite of the increase in the glacier-melt due to the rising temperature. Overall, the precipitation has marginally decreased in the Kashmir valley during the observation period. A good correlation was observed between the winter precipitation (snowfall) and spring streamflows at all the observation stations. The results indicated that the depleting streamflows in the Jhelum river is influenced by the seasonal precipitation and increasing temperature and consequent glacier loss in the Jhelum basin. It is believed that, if, the trend continues, the depleting streamflows will have adverse impact on the water-dependent sector like agriculture, horticulture, and tourism in the Kashmir Himalaya.

**Keywords:** Streamflows, Mann-kandall, Himalaya, Jhelum

### **Introduction**

The high mountains in the Hindu-Kush-Karakoram-Himalayan (HKKH) belt are known as the “Water Tower of Asia” (Viviroli *et al.*, 2007; Immerzeel *et al.*, 2010) due to their important role in feeding a large population of about I billion people living in the major HKKH river basins of the South Asia (Ives and Messerli, 1989). The Himalayan rivers support one of the most heavily irrigated regions in the world in Pakistan and north India (Romshoo, 2012; Tiwari *et al.*, 2009). The economy of the Indus, Ganges and Brahmaputra basins is largely dependent on water resources originating in the Himalayas for irrigation, domestic water supplies and hydropower generation (Karim and Veizer, 2002; Archer *et al.*, 2010). The mountainous Himalayan Kashmir valley is drained by river Jhelum that forms one of the important tributary of Indus River and comprises of 24 watersheds (Meraj *et al.*, 2017). The river is fed by combination of meltwater from glaciers, snow fields, seasonal snow packs and direct runoff from rainfall (Romshoo *et al.*, 2015; Murtaza and Romshoo, 2016). The water resources in the region are vulnerable due to the changing climate and its impacts on snow and ice reserves (Barnett *et al.*, 2005;