

## Climate change impacts on Chitral-Kabul trans-boundary rivers, Northern Pakistan

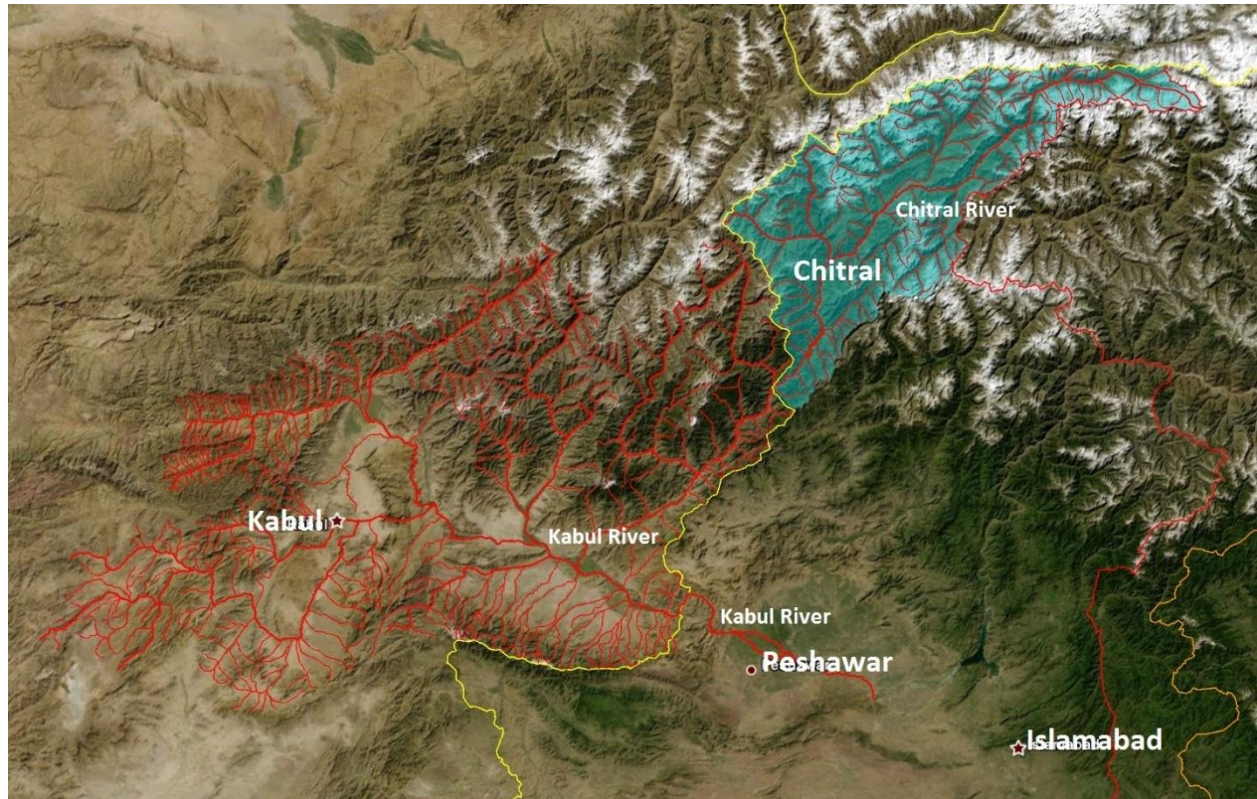
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Climate change presents the most significant environmental challenges and its impacts on water resources is quite uncertain, and can strongly affect the river flows system in many countries. Many rivers and lakes are shared by two or more nations and crosses political borders. Because of economic instability and technological deficiency, a number of developing countries are incapable to take firm policy-decisions for rapid actions to address the environment and climate-related problems. The case study is based on monitoring the impacts of climatic changes on trans-boundary river basin of Chitral in the northern areas of Pakistan. The basin occupies an area of 15,322.4 sq. km out of which the glacier area is about 1,903.7 sq. km (Figure.1). Kabul River flows between two countries specifically Pakistan and Afghanistan. It is considered as a central river of Asia, originates from the Kohi-Baba Mountain in Afghanistan and flows past the valley of Chitral of Hindu Kush Mountains, and Peshawar valley of Himalayas Pakistan. The study area covers a trans-boundary watershed, left part of the watershed lie in northern areas of Pakistan and right part of it wraps the Afghanistan region. The Kabul river water resources are shared between Afghanistan and Pakistan and the river is mostly composed of glacier and snow fed water and naturally flows throughout the year with additional runoff during the monsoon period and playing a vital role in assisting the irrigation and other domestic activities. The trans-boundary watershed and Kabul River are facing climate change impacts via changing pattern of precipitation, temperature and water discharge. Kabul River is a strong water contributing source for Indus River in Pakistan and backbone of the most water based economical activities. The construction of new reservoirs on Kabul River in Afghanistan and variability of water will affect the flow and can cause drought or flood in Pakistan that mainly affect the agriculture sector, especially a fast growing urbanization and industrialization in and around the major cities of Peshawar and Chitral can become a threatening state to the climate as well as groundwater resource system of both valleys.

In this way the water resource system proved to possess more sensitivity towards climate change particularly on conditions like rainfall, flood and water supply to the rivers. The assessment of these impacts is carries importance for an efficient, effective and sustainable planning for water resource. Meteorological data and Landsat Satellite Remote Sensing data were used to observe the effect of climate change indicators on trans-boundary river sites. The variability is measured at gauging station of Chitral and Warsak. Statistics are shown that the temperature and rainfall has increasing pattern for the Chitral and Peshawar valleys, indicating the negative impacts on the future environmental sustainability. The supervised and un-supervised classification and change detection techniques were adopted to assess the land use and land cover features to salvage its class boundaries. The results obtained have shown an increase in both barren land as well as urbanization from 58.168 km<sup>2</sup> to 264.35 km<sup>2</sup> and decreases in the dense areas and as well as light vegetation land from 608.85 km<sup>2</sup> to 411.69 km<sup>2</sup> and 173.25 km<sup>2</sup> to 105.77 km<sup>2</sup> respectively. The accuracy evaluation test was applied for the determination of image of 1985, which reflected the overall accuracy equal to 91.67% while Kappa statistics was calculated as 0.8657. However the user accuracy indicated 92.31%, for rocks while for rocks mix vegetation it was 93.88%, for soil 98.66%. From the result for image of 2011, the assessment reported was 93.65% for rocks, 92.50% for rocks mix vegetation and 83.33% for soil. The overall user accuracy was 91.67% and overall Kappa statistics was given as 0.8682. Our findings are in relation to the facts proved already from the current research that valleys are highly prone to climatic and environmental change.



**Figure 1.** Satellite Image of Chitral-Kabul trans-boundary river.