The Impact of Climate Change on Rain and Rising Temperatures in Koshi River Basin

By Dr. Santosh Kaini

A double suspension bridge over the Dudh Koshi (a tributary of the Koshi river) on the way to Namche Bazar, Nepal (Photo by Robin Lardon/Shutterstock.com)

The development and management of water resources projects should focus on nature-based solutions and climate resilience.

It is unequivocal that changes in precipitation and temperature patterns are expected due to climate-driven changes, which in turn affect the hydrological regimes of associated river basins. As reported in IPCC's Sixth Assessment Report Working Group I, global surface temperature was nearly 1 degree Celcius higher during 2001-2020 when compared to 1850-1900 and global average precipitation on land has increased significantly since 1950.

These findings are a cause for concern for Nepal - a country that is mostly-mountainous which extends from the Earth's highest peak down to the Terai region. But how does climate change impact this landlocked nation's water resources?

Putting things in the national context, studies show that Nepal's maximum temperatures have increased from 0.06 to 0.12 degrees Celcius in the mountainous areas and 0.03 degrees Celcius per year in the southern plains in the last quarter of the 20th Century. Likewise, Nepal's Ministry of Forest and Environment projects mean temperature rise by 0.9-1.1 degrees Celcius between 2016-2035 and 1.3-1.8 degrees Celcius by 2036-3065 when compared to 1981-2010.

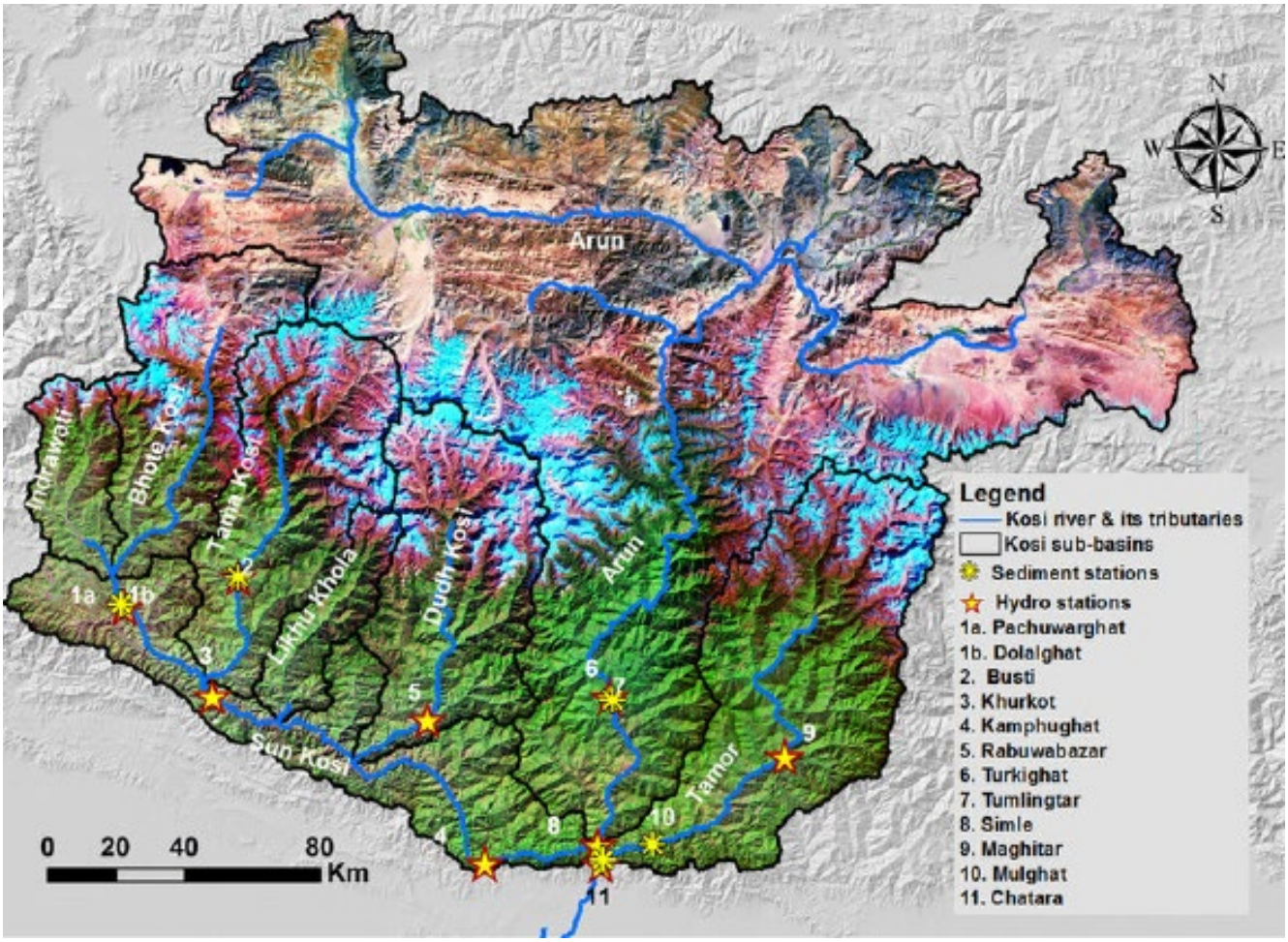
Nepal is expected to get warmer and dryer as its number of rainy days are expected to decrease, but the precipitation intensity of these rainy days are expected to increase in the future. It will rain less frequent but more intense and this will result in a likely increase in water-related hazards such as floods.

A living example of these climate trends can be witnessed in the Koshi River Basin - one of the largest tributaries of the Ganga River and the largest river basin in Nepal. Studies report both rising temperatures and precipitation which will most likely follow an increasing trajectory in the basin.

The 2020 International Journal of Climatology published one of my co-authored studies projecting an increase in both the minimum and maximum temperatures in the basin, which means that both winter and monsoon seasons will be warmer.

Specifically, the northern part of the basin (originating in the Northern Himalayan region) is particularly more sensitive to climate change given its snowy and glacier character, where absolute temperatures are expected to rise by 1.2 degrees in Representative Concentration Pathway (RCP) 4.5 and 1.6 degrees Celsius for RCP8.5 by 2030.

On the other hand, monsoon precipitation is expected to increase for all RCP scenarios; post monsoon precipitation is also expected to increase in the future, but winter precipitation is projected to decrease. The pre-monsoon precipitation is also expected to decrease in the coming decades. Based on the ensemble mean of average annual precipitation, Lower Himalaya and High Himalaya regions are sensitive to climate change considering precipitation. Higher absolute increases in precipitation are expected in the Lower Himalaya



The Upper Koshi River Basin and the major tributaries (Figure by Mishra et al., 2019)

region during 2016-2045 (231 mm for climate change scenario RCP4.5 and 270 mm for RCP8.5) and in the High Himalaya region during 2036-2065 (291 mm for RCP4.5 and 419 mm for RCP8.5) and 2071-2100 (391 mm for RCP4.5 and 922 mm for RCP8.5) compared to the base period (1981-2010).

In contrast, Lower Himalaya and High Himalaya regions are sensitive to changes in precipitation in the coming decades. The spatial and temporal variation in temperature and precipitation will have a direct impact on water resource availability in the rivers and crop irrigation requirements in the region.

In another one of my co-authored studies published in the 2020 International Journal of Water Resources Development, we projected the changes in river water availability in the Koshi River based on the above-mentioned changes in temperature and precipitation for short-term, mid-century, and end-of-century periods considering RCPs 4.5 and 8.5.

Within this context, prevailing design considerations for water-related infrastructures such as hydropower dams, bridges, canals, etc., should be reviewed considering climate change impacts on the hydrological regimes of the river systems resulting from changes in precipitation and temperature. It is also suggested that the development and management of water resources projects should focus on climate-resilient infrastructure and nature-based solutions.

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