

IIT-I study shows climate-driven shift in Ganga flow

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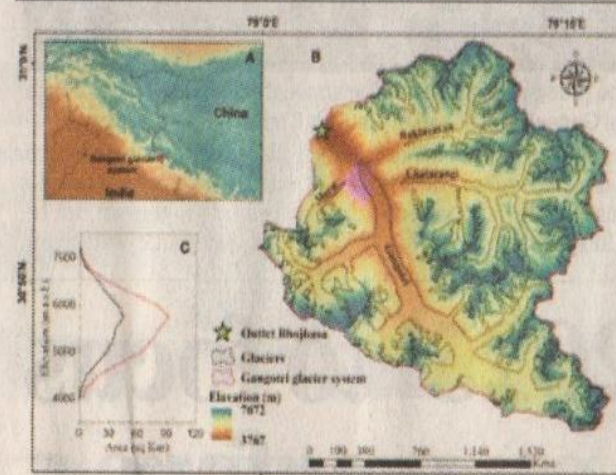
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A new scientific study has revealed that climate change is altering the water composition flowing from the Gangotri Glacier System (GGS), the source of the River Ganga in the central Himalaya. Over the last four decades, researchers say, snowmelt contribution has declined, while rainfall-runoff and baseflow are gradually increasing — a trend that could reshape the river's seasonal flows and impact millions dependent on its

waters.

The study was carried out by the Glaci-Hydro-Climate Lab at IIT Indore and modelled streamflow from 1980 to 2020. Using the high-resolution Spatial Processes in Hydrology (SPHY) model, calibrated with field discharge records, geodetic satellite-based glacier mass balance data and snow cover maps, the researchers offered the most detailed breakdown yet of the glacier-fed river system.

According to the findings, snowmelt continues to dominate the Gangotri



catchment, contributing 64 per cent of annual discharge, followed by glacier melt at 21

per cent, rainfall-runoff at 11 per cent, and baseflow at 4 per cent. But the balance has

shifted over time. Snowmelt has been steadily declining, while rainfall-runoff and baseflow have inched upward.

Lead author Parul Vinze, a PhD scholar at IIT Indore, said the discharge peak shifted from August to July after 1990. "This shift is linked to reduced winter precipitation and earlier summer melting," she explained. The change in peak timing, scientists warn, could upset irrigation cycles and energy production schedules that depend on a predictable water flow.

Earlier research on Himalayan glaciers often relied on shorter time series, coarse climate data or limited calibration. This 41-year study, scientists argue, provides the clearest picture yet of how climate change is reshaping the Gangotri system.

Dr Mohd. Farooq Azam, who supervised the research, said accurate modelling backed by long-term field data is critical. "Predicting future water availability in the Himalaya depends on sustained monitoring.

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We also need to integrate high-resolution climate projections to refine forecasts," said Dr Azam, senior intervention manager at the International Centre for Integrated Mountain Development (ICIMOD) and associate professor at IIT Indore.

A river of faith and livelihood- The Ganga, which originates from the Gangotri Glacier, is not only a lifeline for over 400 million people but also revered as a sacred river in India. From Uttarakhand to West Bengal, it sustains agriculture, provides drinking water, drives industry and powers hydropower plants. At the basin-wide scale, the Ganga is relatively less dependent on glacier melt than rivers such as the Indus. Yet in its upper reaches, especially the Gangotri catchment, meltwater dominates. A disruption in its seasonal rhythm could have cascading effects. Irrigation systems in the plains rely on the timing of glacier-fed flows, while hydropower projects at higher altitudes require steady discharge to operate efficiently.

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