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**Title:** Dynamics of Himalayan Glaciers and their Response to Climate Change: A Case Study of Kolahoi Glacier

### **ABSTRACT**

Kolahoi Glacier is located in the North Western part of Liddar Valley and lies between  $34^{\circ} 09' 29''$  to  $34^{\circ} 10' 57''$  North latitude and  $75^{\circ} 18' 46''$  to  $75^{\circ} 20' 11''$  East longitude. The melt water stream emanating from the Kolahoi Glacier is known as the West Liddar River, which joins the East Liddar River at Pahalgam (35 km from the snout). The Glacier headwall is located at an altitude of 5425 meters in Kolahoi Mountain. The present research endeavor is based on the assessment of the impact of climate change on Kolahoi Glacier based on the findings of satellite data, meteorological data, GIS analysis and ground surveys. The remotely sensed information has been validated through field verification and the identification of various features for geomorphological mapping of an area and monitoring of a snout. Morphometric analysis of West Liddar Valley revealed that there are 1471 streams grooved with each other from 1<sup>st</sup> to 6<sup>th</sup> order and are sprawled over an area of 393 Km<sup>2</sup>. Detailed study gave us useful information about surface runoff which helps in the management of its water resources. Morphometric analysis of West Liddar Valley clearly shows the expressions of surface configuration and the presence of drainage network. The change in the slope of West Liddar River from the snout of Kolahoi Glacier to its confluence with East Liddar River at Pahalgam reveals the dynamic nature of the West Liddar Valley. This also portrays the picture of its vulnerability to natural hazards like erosion, landslides and avalanches. To recognize the impact of changing climate on the Kolahoi Glacier, temperature and precipitation data of Pahalgam meteorological station of IMD Srinagar was analyzed from 1979 to 2010. The average temperature showed the increasing trend which

has a negative impact on the Kolahoi Glacier. Precipitation data of Pahalgam, when analyzed, revealed that the average annual precipitation showed decreasing trend from 1979 to 2010. The behavior of Kolahoi Glacier and its response to climatic conditions in different time periods was analyzed in length. Imagery analysis shows that there is a linear decrease in an overall extent of the Kolahoi Glacier from 1962 to 2010 although the rate of retreat has not been the same during this period. The area of Kolahoi Glacier shrunk from 12.21 km<sup>2</sup> in 1962 to 11.61 km<sup>2</sup> in 2010 i.e. decrease of 0.6 km<sup>2</sup> (6,00,000 m<sup>2</sup>). The snout of Kolahoi Glacier has undergone marked change and has also retreated by about 575 meters from 1962 to 2010 at an average retreat rate of 11.97 meters/year and the retreat of the snout was also different during different periods. The climatic parameters have shown a negative impact on Kolahoi Glacier. The impact of warmer temperatures and reduced winter precipitation in West Liddar has lead to substantial retreat and thinning of Kolahoi Glacier. This retreat of Kolahoi Glacier has been accelerating. This has lead to greater runoff in the West Liddar River with high sediment yield. If the present situation continues, the perennial West Liddar River will be changed to a seasonal stream, which in turn will lead to water scarcity in the lower areas. The investigations revealed that there is no evidence that Kolahoi Glacier is anywhere close to equilibrium and its retreating trend indicates that it will continue to recede and no point of equilibrium will be achieved with the present scenario of climate. Therefore, it is unlikely for the Kolahoi Glacier to survive for long under the present conditions.