Avalanches around Kedarnath

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In September 2022 avalanche activity was observed repeatedly in the mountains to the north of Kedarnath in Rudraprayag district of Uttarakhand. Presence of pilgrims and others in large numbers facilitated pictographic and video records of these, and stories projecting these as posing a major hazard to the township and pilgrims became viral on social media.

A multi-institutional team was thus quickly constituted by Uttarakhand SDMA to ascertain the causes of recurring avalanche activity assess the risk and accordingly suggest mitigation measures. After field investigations on October 3, 2022 the Committee ruled out major avalanche risk to the temple township and described the avalanches as being routine geomorphic activity.

Kedarnath

The temple township, abode of Lord Shiva, is highly revered by Hindus. It is located at the western extremity of the Central Himalaya in a glacier-modified U-shaped valley of Mandakini river that has a catchment area of ~67 sq km (upto Rambara), of which 23% is covered with glaciers.

The township is situated on the outwash plains of Chorabari and Companion glaciers. The channels of Mandakini and Saraswati rivers encircle this outwash plain that ends to the south of the temple where the two channels meet. These streams are observed to actively erode their banks.

The temple township can be accessed by road upto Gaurikund that is at a distance of 224 km from the nearest airport at Jollygrant in Dehradun and from there one has to trek for 16 km. Helicopter service is also available for Kedarnath from Phata and Guptkashi, but one has to book the tickets well in advance to avoid inconvenience.

Avalanche

Simply speaking avalanche is nothing but downslope movement of snow and ice under the impact of gravity. Law of Inertia however precludes any movement of the material, in howsoever unstable condition, either in the form of a landslide or an avalanche, unless acted upon by an external force.

In the case of avalanches, this trigger is often provided by thermodynamic changes following variations in physical conditions such as the temperature of the air. Wind velocity, gradient of slope on which the snow accumulates, mass of accumulating snow, and seismogenic shaking together with mechanical or anthropogenic ground shaking could be other triggers for avalanche initiation. The avalanche probability increases with slope gradient and with increasing ice mass the magnitude of the forces acting in the downslope direction tends to increase.

The Committee consisting of officials of WIHG, IIRS and USDMA accepts avalanche as being a major threat in the high altitude regions of the state and cites previous incidences of February 7, 2021(causing Dhauliganga floods and killing 207 persons), April 23, 2021 (killing 18 persons around Sumna in Girthiganga valley), October 2, 2021 (killing 07 mountaineers), October 1998 (killing 27 persons), and June 23, 2008 (injuring 20 persons).

Observations of the Committee

- The avalanche initiated ~6 km uphill of the Kedarnath temple from the peaks of Companion Glacier that flows parallel to Chorabari Glacier.
- Companion Glacier is 4.5 km long, has an area of around 3.5 sq km and shows altitudinal variation from 3810 and 4250 m.
- Absence of a well-defined accumulation zone and presence of several avalanche chutes in the accumulation zone of Companion Glacier clearly suggest that the glacier is mainly avalanche-fed and avalanches are common for that glacier.
- The avalanches have initiated from the accumulation zone of the Companion Glacier at an elevation of 4800-5800 m asl.
- Run-out and deposition zones of these avalanches are located ~5 km uphill of the Kedarnath temple. The avalanche activity thus poses little or no threat to the temple township.
- The Committee considers snow avalanche as being a common geomorphic process in the glacial terrain during early summer, late summer and winters.

- According to the Committee avalanche activity is a function of snowfall intensity and temperature variability.
- Appreciable snowfall was experienced over high-altitude areas of Uttarakhand in September, 2022 and presence of fresh snow is clearly seen in satellite imageries.
- The present avalanche activity is attributed to the snowfall during September, 2022.
- From the Glaciologists' perspective the Committee deduces that the avalanche activity is good for overall health and wellbeing of Companion Glacier.

Recommendations

Slope modification: Benching of the slope at different elevations along the steep gradients of snow drift or channels to the north of Kedarnath temple to reduce overall slope angle and retard the velocity of downward movement of snow and debris mass.

Structural control: Construction of concrete wedges along the mid-slope of avalanche chutes to prevent and divert the force of descending ice mass.

Mounds: Construction of mounds to arrest and break the momentum of the decelerating avalanche mass and bring the moving ice mass to rest at a short distance, thereby protecting the facilities at the far end of the run out zone of avalanche slope.

Ban on construction: Complete ban is recommended on the construction of building or any form of shelters over the highly unstable and active debris slope that include scree fans, as the same results in the change in the angle of repose of the unconsolidated material.

Mass awareness: Accumulation of snow, either directly through solid precipitation or indirectly by avalanches, being common in a glacial regime, the Committee recommends of media and mass sensitisation so that they refrain from rumour mongering.