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Topography, climate change: Behind heavy rains in Himalayas

Extreme rainfall or cloudbursts have led to landslides, mudslides, flash floods, and swollen riverbanks, resulting in large-scale destruction, loss of life, and communication disruptions.

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Extreme rainfall has triggered landslides at several regions in Uttarakhand in the past few days. PTI

Dehradun and several other districts in Uttarakhand have experienced very heavy rainfall over the past few days, triggering landslides in multiple areas and causing rivers to swell to dangerous levels. At least 15 people have reportedly died in the region due to landslides.

A series of such incidents has occurred in Uttarakhand and Himachal Pradesh over the past month. Extreme rainfall or cloudbursts have led to landslides, mudslides, flash floods, and swollen riverbanks, resulting in large-scale destruction, loss of life, and communication disruptions.

While these types of events in the two states are not uncommon during the monsoon, the increase in their frequency and intensity over recent years has become a significant cause for concern.

Why do hilly regions receive more rainfall?

The monsoon has been quite active this season. The northwestern region of the country has been quite wet, especially in the last month and a half (see box).

During this time, consecutive rain-bearing low-pressure systems — formed in the Bay of Bengal — have travelled farther north than normal, causing intense rainfall in the region.

As a result, the northwestern region recorded 34% surplus rainfall in August. For the season (June-September) so far, the region has received more than 30% surplus rainfall. During the first half of September, rainfall has been more than 67% above normal.

The impact of extreme rainfall varies according to geography. For instance, 300 mm or more of rainfall over 24 hours is not unusual for some places in Goa, Konkan, coastal Karnataka, Kerala, or Meghalaya. However, rainfall of this magnitude is a recipe for disaster in the Himalayas, especially the western Himalayas spanning Jammu and Kashmir, Uttarakhand, and Himachal Pradesh.

In mountainous regions, favourable conditions can help the air rise swiftly, which leads to the formation of massive clouds with steep heights. These overgrown, rain-bearing clouds can, in turn, cause higher-than-normal precipitation locally over the hilly region. This represents the typical climate pattern of these mountainous areas.

For instance, Udhampur in Jammu and Kashmir recorded 630 mm of rainfall (in 24 hours) on August 27. This is equivalent to an entire year's rainfall in Rajkot, Gujarat. Leh in Ladakh received 59 mm in 48 hours between August 24 and August 26, a record since 1973. Leh usually receives just about 0 to 5 mm in August, with the highest 24-hour rainfall of 16 mm (August 8, 2018) and 12.8 mm (August 4, 2015).

Why are hilly regions more vulnerable to disasters?

Over the plains, such intense rainfall can drain out into rivers or locally available water sources. However, in mountainous regions, extreme rainfall can trigger landslides, mudslides and flash floods as the descending rainwater carries along with itself mud, loose soil, gravel, and all materials in its pathway. This happened across Mandi, Kullu, Dharali, Tharali, and Jammu over the past two weeks.

Also, when major river streams are choked, gushing water and/or mudslides and landslides are forced to enter settlements, cutting through roads and bridges, which can cause larger disasters.

However, not all cloudburst-like events lead to disasters. Several conditions have to come together to cause disasters. For example, if extreme rainfall occurs on a side of a hill that is not prone to landslides, or if debris does not fall into any river, the results are very different.

What is the role of climate change?

An emerging and worrisome meteorological observation in recent years has been the southward shifting of large-scale weather systems — in this case, western disturbances.

Originating in the Mediterranean Sea, western disturbances are streams of eastward-propagating wind bands that cause precipitation (rain or snow) along their route. Western disturbances have a pronounced impact on India, particularly northern regions, during the winter months.

However, the southward shift of western disturbances and their interaction with massive southwest monsoonal systems is adding another layer of complexity to rainfall prediction over the Himalayas.

Global warming is believed to be the main driver of this shifting trend. Meteorologists warn that extreme rainfall events will become more common in the future, particularly in hilly regions, along with longer periods of dry spells during the season.

Arctic sea ice melting could represent yet another factor in this deepening mystery of monsoon variations in the hills.