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UTTRAKHAND TRAGDEY OF 07 FEB 2021: REMINISCENCE OF 2013 UTTRAKHAND FLOOD DISASTER

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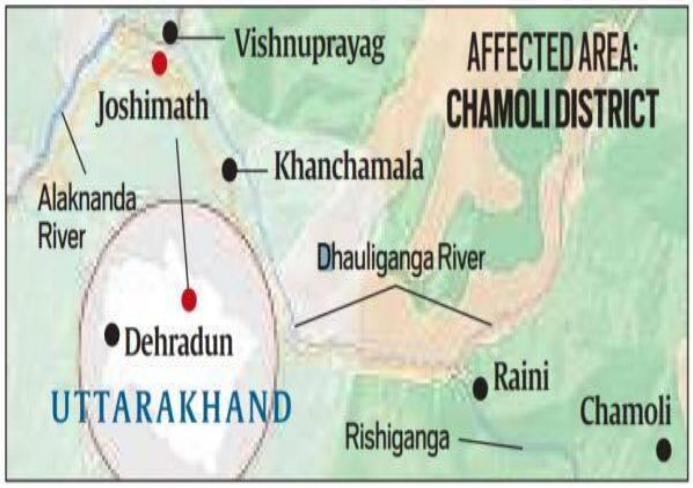
INTRODUCTION

The incident began on 07 Feb 2021, a Sunday morning below Nanda Devi, India's second-highest peak. Power minister, R.K. Singh, said an avalanche led to flash floods that swept away the small Rishi ganga hydro electric project and damaged a bigger one further down the Dhauli ganga river being built by state firm NTPC. 72 people have been confirmed killed and missing reports of 205 persons has been registered at Joshimath police station after an avalanche in India's Himalayan region broke dams, swept away bridges, and left dozens of construction workers trapped in the tunnels.



On February 7, 2021, the people of Reni village — the birthplace of India's environmental consciousness as this is where the women stopped the felling of trees — say they heard a loud bang. Within minutes the muddy deluge gushed down

damaging the 13.2 MW Rishiganga hydropower project and then washing away the under-construction 520 MW Tapovan-Vishnugad project downstream. It is not clear (as yet) if the glacier melted; or there was unseasonal snow that melted; or that it was a combination. What's clear is that there was a landslide or avalanche that blocked the river and when the natural dam broke because of the force of water, it brought the power of kilolitres of water mixed with moraine, rock and silt.

PAST EXPERIENCES

Incidents like 7 Feb 2021, are rare so early in the year, but avalanches and flash flooding in the Himalayas are common during summer and monsoon months, as snow starts to melt and heavy rains combine to trigger avalanches and flash flooding in the Himalayan region.

FLOOD DISASTER OF JUNE 2013

In June 2013, record monsoon rains in Uttarakhand caused devastating floods that claimed close to 6,000 lives. A government report said while the disaster occurred as a result of natural hazards, human activity had contributed significantly to the disaster.

On 16-17 June 2013, the state suffered its worst disaster in the living memory with huge loss of lives and widespread destruction. On June 16, 2013, many things went wrong with the Himalayan state of Uttarakhand. Heavy monsoon rains wreaked havoc in the hill states that triggered Ganga, Yamuna and their tributaries at most of the places, sweeping away a number of bridges, roads and buildings. As per the initial estimates the disaster claimed a massive death toll and numerous persons were reported missing. The disaster coincided with the peak tourist and pilgrimage season significantly enhancing the number of the causalities which resulted in adverse impact on the immediate rescue and relief operations. The mountainous region of Uttarakhand forms

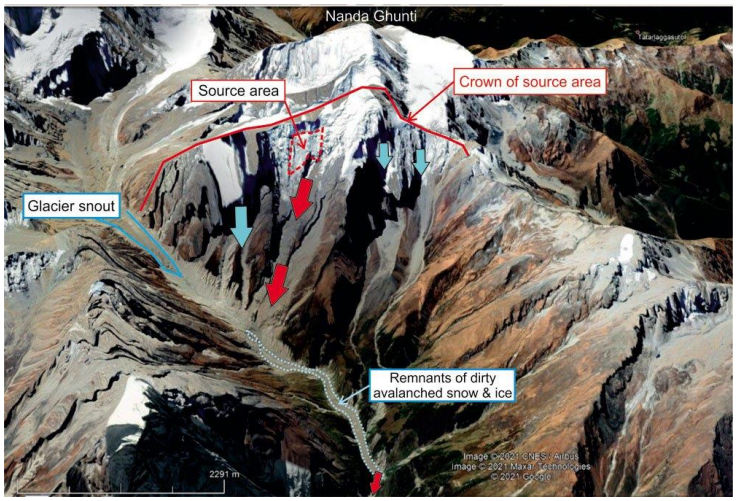
part of the Himalaya, which is the youngest folded mountain range in the world consisting mostly of uplifted sedimentary and metamorphic rocks and tectonically very active, the region is extremely vulnerable to natural disasters.

The entire state was hit by abnormally heavy rainfall, possibly due to the fusion of Westerlies with the Indian monsoonal cloud system, resulting in flash floods and landslides over a wide area. The districts of Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were most affected by this disaster. The large population in several areas were cut off across the state and suffered due to shortage of essential commodities.

After study of the high resolution images from ISRO's Geographic Information System (GIS) platform, Bhuvan, a massive landslide in the north-east region of the Kedar valley and heavy rainfall in the north-west of the Kedar valley occurred at the same time and formed a small lake. Under normal circumstances, water would have flowed away but a block was formed by debris that led to the accumulation of water. When extreme pressure caused a breach in the boundary of the lake, a large amount of water gushed out, forcing another rock to flow away. This created a new stream of water in addition to the two streams that existed already. The amount of water, moraines and debris was high enough to increase the level of the biggest stream in the west, creating a new stream in between, and increased water level substantially in the eastern stream. The debris from the landslide and water from the lake travelled down the slope, channelled into the glacier, and came down to Kedarnath town. High resolution images show that the flow of the land slide eroded a large amount of material. The amount and the flow of the debris was so high, that the boulders did not stop at Kedarnath and were carried to Rambara village and beyond.

CHAMOLI DISASTER, UTTARAKHAND OF 7TH FEBRUARY 2021

Disaster struck Uttarakhand's Chamoli district on February 7, 2021 in the form of an avalanche and deluge, after a portion of the Nanda Devi glacier broke off. The sudden flood in the middle of the day in the Dhauli Ganga, Rishi Ganga and Alaknanda rivers, all intricately linked tributaries of the Ganga triggered widespread panic and large-scale devastation in the high mountain areas.



Two power projects ie NTPC's Tapovan-Vishnugad hydel project and the Rishi Ganga Hydel Project were extensively damaged with scores of laborers were trapped in the tunnels of the hydel projects as the flood waters came rushing into the tunnels. At least 72 people were feared dead, and over 205 people were reported missing due to the Flood Disaster.

From Planet Labs satellite imagery acquired the day before and day after the event the source of the event was clearly identified. It had an area of ~200,000 square meters and was probably tens of metres thick. It would appear from initial inspection of this satellite image that the top of the source area is at 5,600 meters. The snow, ice, and rock mass fell to 3,800 meters down the steep mountain flank pulverising the impact leading to the disaster.

The major landslide/rock avalanche also produced a huge and widespread dust cloud along the valley seen on some videos of the event and captured on the Planet Labs satellite images. It is presumed at this preliminary stage that the landslide/rock avalanche collapsed onto the floor of the valley about 1.5 km downstream from the adjacent glacier snout. From analysis of time series satellite imagery, it is thought that there were several previous large snow and ice avalanches in this region during the period between year 2014 and 2016. There was one notable significant snow and ice avalanche between the 19th and 24th September 2016 that ran-out along a ~3.4-km stretch of the river valley, leaving an area of about 300,000 cubic metres of variably thick remnant compressed snow and ice.

It is not known whether much of this remnant ice was there at the time of the latest landslide or if even more had accumulated from more recent snow and ice avalanches.

The Rishi Ganga River has melted a tunnel underneath this residual avalanche material. This latest major rockslide has fallen onto this avalanche remnant ice area, probably melted it from the frictional heat associated with the pulverised landslide fragments, contributing 1 million cubic meters of water on top of the existing river flow. Coupled with the large volume of debris from the landslide itself (of the order of 10 million cubic metres), the combined mass was able to travel with considerable speed down valley, wreaking the scale of devastation at several locations downstream. Figures and specific details quoted here are approximate and undoubtedly will be revised once more imagery and data becomes available on the probable causes of the disaster.

POSSIBLE CAUSES OF THE 7 FEB 2021 TRAGDEY

There are many hypotheses circulating on the possible causes of the massive flood in the Chamoli district of Uttarakhand February 7, 2021 that has killed 72 people till now, with 205 people still missing. While it is too early to conclusively determine how the disaster began, experts said heavy snowfall followed by bright sunshine led to excessive snow-melting thus triggering a chain reaction that led to the avalanche.

"On Sunday morning it was a bright, sunny day, and some of the snow started melting, which possibly led to an avalanche"

The experts believe that the disaster originated as a major snow, ice, and rock avalanche as a result of ***Glacial Lake Outburst Flood (GLOF).*** The source area, has been identified as being located around 3.25 km to the north of Nanda Ghunti peak (6,309 m), and it has a history of causing significant avalanches and landslides in the area.

What is Glacial Outburst?

When glaciers break off, the space underneath them develops into a glacial lake filled with water. The breaking off of the glacial lake is termed as Glacial Lake Outburst Flood (GLOF) or glacial outburst. The glacial outburst occurs when the water level of lake rises or when the glacier retreats. The occurrence of GLOF is very rare. Some experts are calling the Uttarakhand glacier burst as the GLOF. However, the researchers and scientists are yet to investigate the real reason behind the incident.

What causes Glacier Outburst?

Earthquakes, erosion, volcanic eruptions, build of water pressure or an avalanche of heavy snow can cause the glaciers to burst. The glacier outburst can also happen after the displacement of massive water pocket in a glacial lake when an adjacent glacier retreats into it.

Failure leading to avalanche can happen due to multiple reasons like erosion, the build-up of water pressure, an avalanche of snow or rocks, and also an earthquake under the ice. It can also happen if there is a massive displacement of water in the glacial area when a large portion of an adjacent glacier collapses. Glacier lakes can vary in volume but are known to hold millions to hundreds of millions of cubic metres of water. Failure to contain ice or glacial sediment can result in water being released for minutes, hours, or even days.

A glacial outburst may occur due to several factors. According to experts, the direct causes of glacial lake outbursts resulting in floods are heavy rainfall/snowmelt, earthquake, cascading process, long term dam degradation, and rapid slope movement into the lake.

What led to the Uttarakhand glacier burst?

In case of Uttarakhand glacier burst tragedy, it is not yet clearly known that what caused the outburst of Nanda Devi glacier. As per the experts, the breaking off of this huge chunk of Nanda Devi glacier into the Dhauli Ganga river is a rare incident as the Google Earth images and satellite did not show any glacial lake underneath the glacier that broke off. Usually, Glacial Lakes are formed beneath the big glaciers and flow within these massive ice sheets. At times, these lakes create enough pressure causing the glacier chunks to break off. The glacial lakes are not like usual lakes; they comprise ice boulders that have potential of bursting the glacier banks.

In Uttarakhand glacier burst case, it is believed that the water pockets might have developed within the Nanda Devi glacier that led to this incident. Some experts also link this tragedy to climate change and global warming. High temperatures and less of snowfall can lead to increase in melting of glaciers, causing glacial lake water to rise beyond the levels.

A 2019 study published in the Science Advances journal had warned that the Himalayan glaciers are melting at an alarming speed and the 2013 Kedarnath-like tragedy may occur again. The study had warned that glaciers of the Himalayas have been melting twice as fast since the beginning of this century due to the climate change. The study was based on satellite observations of 40 years across India, Nepal, Bhutan and China. The study showed that glaciers have been losing half of their ice every year and the formation of glacial lakes had increased by 50% since 2000. The formation of increased number of glacial lakes pose an existential threat to Himalayan glaciers and the rivers flowing from near them and extreme care should be taken to maintain the ecological balance in this region.

LESSON NOT LEARNT EVEN AFTER 2013 DISASTER

In 2019, residents of Raini - one of the villages worst affected by 7 Feb 2021 avalanche approached Uttarakhand's top court, asking the state government to investigate the reasons for consistent breaches of the safety guidelines in the area and why no preventive measures were taken to avoid such incidents. The court ordered local officials to investigate the claims. But experts said that little has been done to curb the use of dynamite in construction, which significantly weakens the surrounding hills.

"It would definitely have had a major impact & there have been clear violations of the safety guidelines in the region"

The flash flood in high Himalayas, which has claimed 72 lives and wiped out two hydroelectric plants on the Ganga, should be a grim reminder of the mistakes we continue to make. It's easy to understand and guess why this devastation happened. The Himalayas are the world's youngest mountain ranges, prone to erosion and landslides and unstable because of high seismic activity.

This problem is compounded by the sheer madness of development, with hydropower projects being built back to back in this region. On top of this, climate change and its resultant warming of glaciers and unseasonal snow and heat are exacerbating conditions in the already fragile ecosystem. It is important to note is that this flash flood occurred in winter, when there is less water; so, destruction was limited.

This disaster should be a warning of the scale of devastation that can happen. There is every possibility that we are going to see more of such disasters in future, unless we change the way we do business with the environment. But more importantly it will happen until we take better studied decisions on the projects and on mitigating their impacts. This is where we falter. Our systems for decision-making to assess the

impacts of "development" projects were already weak and have become virtually non-existent by now which should be looked into seriously.

This is where the Himalayan saga must be understood. The water and power engineers had calculated the hydropower potential as 9,000 MW, which would be generated by 70-odd projects, small and big. As per their own admission these projects, mostly in the upper catchment of Uttarakhand Himalayas, would "affect" 80-90 per cent of the stretches of the river. As these are mostly run-of-the-river projects where the water is diverted through tunnels or reservoirs and then released into the river, this meant that the river would not flow naturally, but would be re-constructed to 80-90 per cent of its length.

The projects were designed to draw the last drop of water and during lean seasons, as per the project designers, the river would cease to flow naturally. The inter-ministerial group was to assess this and provide guidance on the required ecological flows. The engineers argued 10 per cent ecological flow would be adequate and this is how they had designed the plethora of projects.

Since 2013, much more water has flowed down the Ganga and there has been much activism from courts and governments about the need to curtail these projects. But after all the big talk, not much has changed. As of today, some 7,000 MW of hydroelectric projects are either operating or being constructed in this fragile region; back to back; with no respect for the river or its need to flow naturally.

The issue is not about hydropower generation or the need for energy or development. It is about the carrying capacity of this fragile region, which is even more at risk because of climate change. This needs to be assessed, but by keeping the river first and our needs next. Otherwise, the river will continue to teach us bitter lessons; it will be the revenge and rage of nature.

Then there are also issues to consider, like climate change or disproportionate construction in a fragile ecosystem, which were supposed to have contributed significantly to the 2013 disaster as well.

The Damage Caused

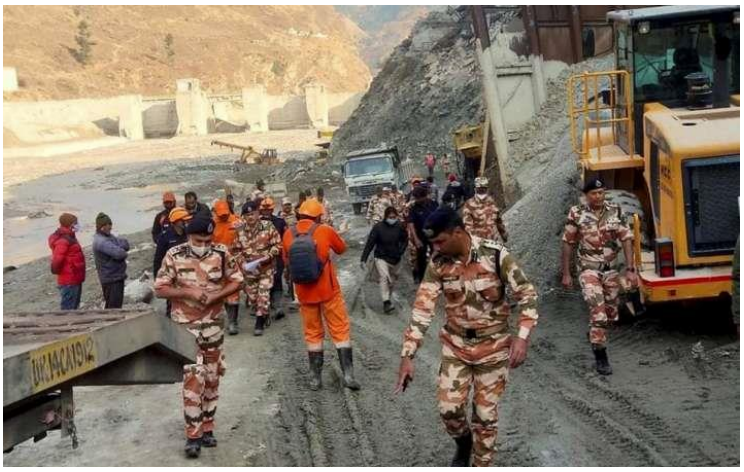
72 people have been confirmed killed and missing reports of 205 persons has been registered at Joshimath police station after the avalanche in India's Himalayan region

broke dams, swept away bridges, and left dozens of construction workers trapped in the tunnels.

The Uttarakhand glacier burst also caused an *estimated loss of ₹1,500 crore* at the NTPC's 480 mw Tapovan-Vishnugad hydel project and has put a question mark on its scheduled commissioning in 2023, Union Power Minister R K Singh said. The minister visited Tapovan to assess the extent of damage at the project site, a day after the glacier burst in Chamoli district. To a question, he said estimated losses caused to the project are worth around ₹1,500 crore. However, the Union Minister ruled out any possibility of the project being scrapped.

ARMED FORCES RESCUE OPERATIONS

The government asked the Army to help district administration and the disaster management teams of the central and state government were pressed into rescue operations. The Army was pressed into service to carry out rescue operations in flood-affected areas. Troops were moved towards the flood-affected areas in Dhauliganga, where the massive flood occurred after the glacier broke. Four columns of around 400 personnel of army were moved to flood-affected areas.



The Army aviation wing was also pressed into service to carry out an aerial survey and evacuate trapped people. "One advance light helicopter and two Cheetah helicopters were evacuating persons in the area,"

"**Indian Air Force C-130 and AN-32 aircraft** are being used to airlift National Disaster Response Force (NDRF) personnel,"

Members of **Indo-Tibetan Border Police (ITBP)** were also pressed into service and they searched for survivors after a Himalayan glacier broke and swept away a small hydroelectric dam, in Chormi village in Tapovan in Uttarakhand.

Indo-Tibetan Border Police personnel safely evacuated 16 people who were trapped in the tunnel near Tapovan in Uttarakhand's Chamoli district following a glacier burst. Three persons taken out from the tunnel were provided oxygen as they were found unconscious. Rescue teams evacuated 12 people from the another tunnel, however, excessive debris and muddy waters made the rescue operation strenuous and time consuming.

RECOMMENDATIONS

There is sheer knowledge gap and lack of understanding on various mountain and climate linked issues, while no adequate shared understanding and action plan are in place for the regional problems as a whole, and no map of potential risks is available. A set of factors can be identified that make efforts to systematically manage current

disaster risks more successfully. Systems to manage current disaster risk can be more successful if:-

- Risks are recognized as dynamic and are mainstreamed and integrated into development policies, strategies, and actions, and into environmental management.
- Legislation for managing disaster risks is supported by clear regulations that are effectively enforced across scales and complemented by other sectoral development and management legislations where risk considerations are explicitly integrated.
- Disaster risk management functions are coordinated across sectors and scales and led by organizations at the highest political level.
- Risk is quantified and factored into national budgetary processes, and a range of measures including budgeting for relief expenditure, reserve funds, and other forms of risk financing have been considered or implemented.
- Decisions should be taken based on comprehensive information about observed changes in weather, climate, vulnerability, exposure, and historic disaster losses, using a diversity of readily available tools and guidelines.
- Early warning systems deliver timely, relevant, and accurate predictions of hazards, and are developed and made operational in partnership with the public and trigger effective response actions.
- Strategies include a combination of hard infrastructure-based options responses and soft solutions such as individual and institutional capacity building and ecosystem-based responses, including conservation measures associated with, for example, forestry, river catchments, coastal wetlands, and biodiversity.

CONCLUSION

The people living in high Himalayas would need to learn to live with natural hazards, which are likely to increase in frequency and intensity in a warming world. They not only need access to modern tools and facilities to deal with disasters, but also employment in disaster management. How to win the confidence of tourists after the June tragedy is a great challenge, and calls for taking a series of measures, including extending religious tourism to winters when mountain life is almost free from landslides and road disruptions. There is a need to develop the science of ecological restoration of landslide damaged sites, as many times landslides result in lands with less steep slopes.

New land use development including road construction in Himalayan mountains should mandatorily consider the geological and geotechnical slope stability conditions and landslide susceptibility zones. Excavation or slope modification and protection measures for modified slopes should go hand in hand for ensuring slope stability.

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