



Joshimath Sinking: Causes, Social, and Environmental Impacts

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ABSTRACT :

This paper reviews the history of the "sinking town," Joshimath, the first wake-up call, the repercussions of human activities, the numerous casualties, and how the residents are being compensated for the same. It captures the gradual devastation of Joshimath, where people woke up to cracks in their houses and how the vibrant, energetic bazaars and lovely mountain views mask a bleak reality of unregulated expansion and a crumbling town.

Keywords: Shinking, Impact, Disaster and flash flood.

INTRODUCTION :

Joshimath, a Himalayan town born in vulnerable geological conditions. The town, which is positioned in a microseismic zone on a hill's middle slope, was constructed on the remains of a landslide that occurred more than a century ago. Joshimath is experiencing land subsidence, or to be more precise, it is "sinking" for various natural and anthropogenic reasons. The town saw a terrifying glacier outburst in February 2021, but one of the main causes of the disaster was extensive industrialization brought on by the rise in tourist visits. When a sizable portion of the Nanda Devi glacier burst, it was regarded as a glacier outburst as it seriously damaged the region's infrastructure and caused massive flooding. If the issue were to be tracked over a number of decades, it would become apparent that Joshimath was built on an enormous amount of debris that was collected due to a significant landslide caused by an earthquake that happened more than a century ago. The National Remote Sensing Centre (NRSC) of the Indian Space Research Organization (ISRO) released satellite photographs of Joshimath, and a subsequent study on land subsidence suggested that the entire town could submerge.

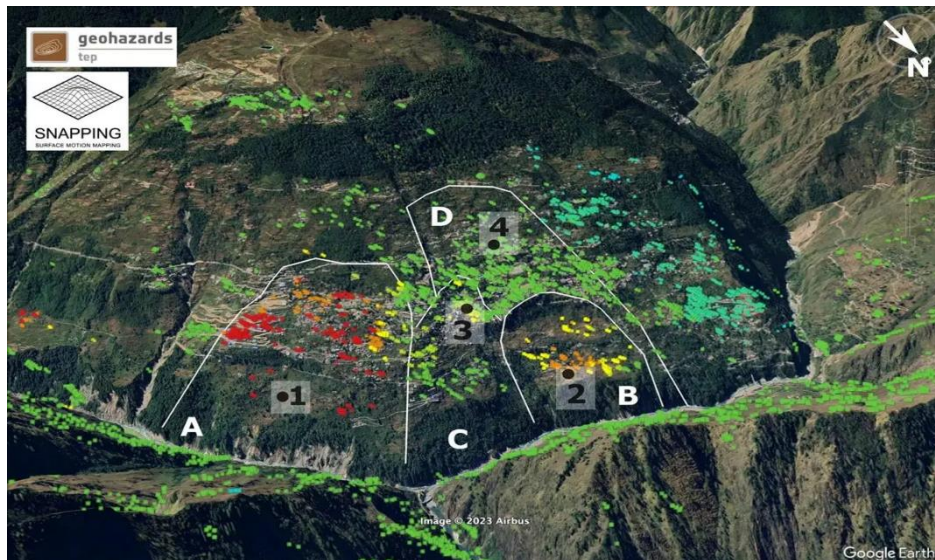


Figure 1 Joshimath sinking images. Photo: Sentinel-1 mission data

During the Sentinel-1 mission on the Geohazards Exploitation Platform (GEP), recent developments were monitored using the SURFACE MOTION MAPPING (SNAPPING) service to generate a ground deformation map encompassing a significant geographic region. For each PSI, SNAPPING offers the average velocities in addition to the whole displacement time series (i.e., the development of motion over time) (Persistent Scattering Interferometry).

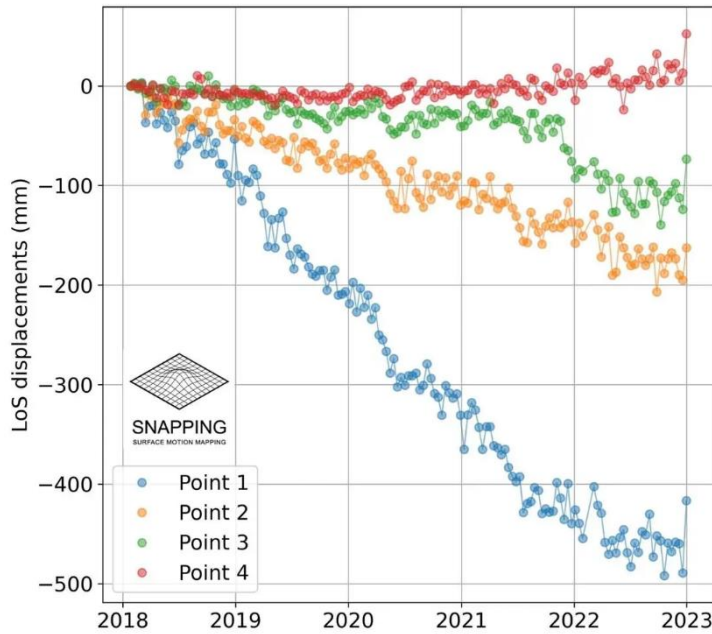


Figure 2 Joshimath sinking images. Photo: Sentinel-1 mission data

Dave Petley, Vice-Chancellor of the British University of Hull, which offers observation and analysis on landslide occurrences around the world, pointed to the above-mentioned analysis made possible by Sentinel-1's images and said that this diagram clearly shows the numerous landslide units upon which the town is constructed as well as the trends of activity they exhibit over a prolonged period. This demonstrates that it is indeed being displaced rather than decreasing as anticipated¹.

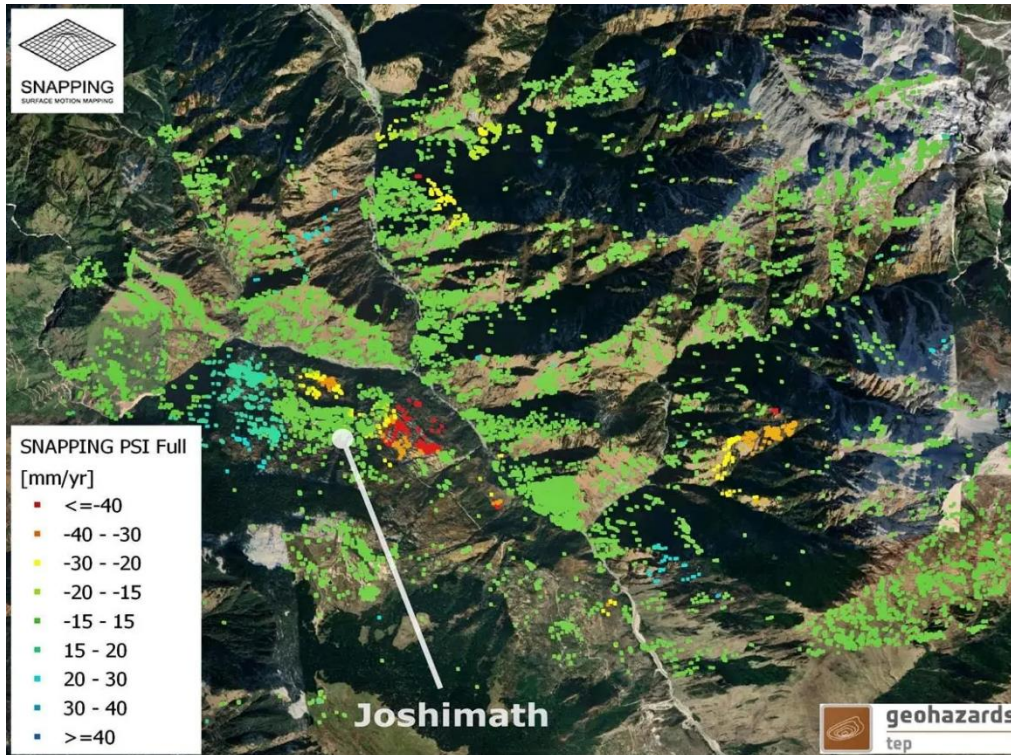


Figure 3 Joshimath sinking images. Photo: Sentinel-1 mission data

After reviewing the photos taken by the Sentinel-1 SAR satellite operated by the European Space Agency, India's National Remote Sensing Centre (NRSC) published a report on ground subsidence near Joshimath according to which Narasimha shrine and the Army's helipad were both designated as

sensitive zones, as well as the entire town. The Uttarakhand Disaster and Accident Synopsis (UDAS) study states that 700 homes in Joshimath are unfit for habitation¹.

The PMO² (Prime Minister's Office) is currently keeping an eye on the issue, but how did the circumstances come about in Joshimath?

GEOGRAPHY :

Joshimath is on the central slopes of the hill, with Dhauliganga and Alaknanda on the opposite sides, and Karmanasa and Dhaknala to the west and east, respectively. Several significant rivers and their tributaries have dendritic patterns in the Joshimath block of Chamoli district. A variety of streams, including Dhaknala, Karmanasa, Patalganga, Belakuchi, and Garurganga, have their origins in the Central Himalayan region near Kunwari Pass. The first flows into the Alaknanda, while the others flow into the Dhauliganga. All these Alaknanda tributaries combined with the Alaknanda flash flood swamped the town in June 2013 and created a chaotic situation³.

Due to the flash floods that occurred when these streams were blocked by landslides, these streams are well-known for the destruction they had previously inflicted⁴. According to a study⁵ conducted using the landslide zonation map, Joshimath is categorised as a landslide-prone area.

LATEST EVENTS :

In Joshimath, Uttarakhand, cracks started showing in a few homes in October 2021. On January 11, and over a year later, significant, or small fractures appeared in the floors, ceilings, and walls of 723 homes throughout the town's nine wards⁶. Far worse, 80 kilometres downstream from Joshimath, in Karanprayag, another sacred town, new fissures have already developed in buildings. The local municipality has asked the administration of Chief Minister Pushkar Singh Dhami for assistance. This occurs while Joshimath's land sinking problem continues. The alert claims that 678 structures in the Joshimath town region have fractures in them⁷.

Way back in 1976

This potential tragedy of Joshimath being declared a 'landslide subsidence zone' was officially forewarned 46 years ago. As early as over 50 years ago, an 18-member group proposed numerous limits and corrective actions due to Joshimath's "geological instability." The committee was established to investigate the reasons behind the landslides and sinking of Joshimath town. Its head was the then-Commissioner of Garhwal Mandal, Mahesh Chandra Mishra. The Mishra Commission^{4,8} (1976) reported that Joshimath is situated on an old landslide zone and is sinking. The report suggested that heavy construction be forbidden in the area around Joshimath. Any new construction must be avoided in the slip zone. The stability of the site should be evaluated before construction is allowed, and such areas should be thoroughly researched before being demarcated. No trees should be cut down inside landslide-prone areas, and stones shouldn't be removed using blasting or excavation to fix roads or carry out any other construction task. Extensive planting should be done in the cantonment, below the Joshimath Reserve Forest (which was severely impacted by the current occurrence), and in the area between Marwari and Joshimath. Also, it was stressed that there should be a severe prohibition on collecting building materials within a 3- to 5-kilometer radius of the Joshimath municipality⁹.

The quakes from 1991 and 1999 demonstrated the region's seismic susceptibility. Additionally, Heim, Arnold, and August Gansser initially observed the town's location on a paleo landslide-prone slope in 1939. These facts highlight Joshimath's shaky foundation, which has existed since the beginning. In 1985, Padma Bhushan Chandni Prasad Bhatt, MS Kunwar, the founder of HARC (an NGO), and Dr. Navin Juyal¹⁰, a former researcher at the Physical Research Laboratory in Ahmedabad, published a paper titled "Vishnu Prayag Project: A Risky Venture in the Upper Himalaya". The book described how huge volumes of soil and stones were evacuated using dynamite during the ramping up of the infrastructure, along with the construction of roadways and residences, to facilitate the alleged development of Joshimath. In the 1970s, forests were additionally cleared for lumber used in building. Moreover, they stressed how the slope's erratic drainage had left it susceptible to erosion. As a result, the town has suffered extensive sinking. Bhatt, Juyal, and Kunwar went on to emphasize recommendations of the Mishra Committee (1976).

REASONS BEHIND THE "VERTICAL SINKING" OF THE SACRED TOWN:

Both natural and unnatural causes triggered the Joshimath disaster. Several hydropower projects surrounding Joshimath and Tapovan have been approved despite being aware of the area's geological and environmental sensitivity. One major concern is the Tapovan Vishnugad hydropower project. The project's headrace tunnel runs entirely through the geologically susceptible area below Joshimath. It is particularly notable that the National Thermal Power Corporation (NTPC) ended up choosing a private company over the Geological Survey of India to carry out the project-related geological investigations¹¹. These investigations made no attempt to determine the depth of overburden across the tunnel alignment and failed to consider the prior geological studies conducted in the region. On December 24, 2009, in order to construct the head race tunnel, a tunnel boring machine (TBM) which happened to pierce a water-bearing stratum about 3 kilometres within the left bank of the Alaknanda, close to the settlement of Shelong. According to the project's administrators, the location was located more than a kilometre below the surface, somewhere below Auli. According to reports, the water outflow was between 700 and 800 litres per second. Around 60–70 million litres per day, or enough water to support 2–3 million people, were discharged from the aquifer. The aquifer had not drained out even after a month. What a waste of a precious resource!

This abrupt and widespread dewatering of the stratum has the potential to cause ground subsidence in the area, which would aggravate the challenges faced by the local population. Decreased underground moisture regime would result in reduced agricultural production and availability of biomass, which would be detrimental not only to the people but also the flora and fauna of the region^{4,11}.

Millions of pilgrims go to the Indian state of Uttarakhand, which is home to famous shrines such as Badrinath, Kedarnath, Gangotri, Yamunotri, and Hemkund. An elaborate network of roads, hotels, lodges, and related support systems were created into the secluded high-latitude regions of the Himalaya through unplanned construction and insufficient soil analyses to accommodate the needs of such a sizable number of pilgrims. The vested interests of people in real estate, haphazard tourism, overexploitation, and the installation of mega hydro power projects are making Uttarakhand's delicate natural features, such as its fragile environment, geological setup, and heavy precipitation, increasingly insecure¹². The extensive construction has wrecked the city and forced residents to plead for their town's survival. More than 800 homes had fissures that snaked through the ground, roofs, and walls, leaving them unsafe. By limiting construction and successfully addressing climate change, the eco-sensitive town can be saved¹³.

CRISIS AND RESCUE :

Anxiety, despair, insomnia, and excruciating future uncertainty. Residents and specialists in Joshimath report that hundreds of individuals who were evacuated by land subsidence and pushed into relief camps are suffering a variety of mental health issues as the days turn into weeks and the fractures in their town become wider and deeper. According to Dr. Jyotsana Naithwal, a psychiatrist from AIIMS Rishikesh stationed at the community health center (CHC) in Joshimath, insomnia and anxiety are the main symptoms among those who were impacted by the disaster¹⁴. The town's foundation continues to slowly sink, and as a result, more than 700 homes as well as a number of roadways have already developed cracks. In Joshimath, the gateway town to Badrinath, which is already "sinking" owing to "land submergence," the state government has begun providing compensation to individuals for collapsed buildings under the latest rehabilitation scheme. The three residents received more than Rs 63 lakh in compensation within the first 24 hours. Owners of buildings that the Central Building Research Institute has deemed to have been extensively destroyed are now receiving compensation from the Chamoli district administration¹⁵ (CBRI). The central government set up a panel comprising representatives of the Ministry of Environment and Forest, the Central Water Commission, the Geological Survey of India, and the National Mission for Clean Ganga, among others, to conduct a rapid study and examine the cause of the occurrence and its impact or key impact and submit a report to the NMCG¹⁶. Over 25 NGOs and CBOs helped when the block was hit by a flash flood in 2013. Food, hygiene products, kitchenware, bedding, solar lamps, tents and tarpaulins, torches, and medicines for the health department were provided by Pragya, Janadesh, Save the Children, Karm Marg Kadam, Seeds India, and Shri Bhuvneshwari Mahila Ashram. Raahat Shelter and Veterinary Hospital, Pet Owners and Animal Lovers also provide veterinary relief¹⁷ (PAL).

In a developing state like Uttarakhand tourist industry¹⁸ contributes significantly to the creation of job possibilities that support the local population's means of subsistence. The state's tourist business has an impact on both the economy and the environment. With the extensive infrastructure development efforts being made to promote tourism, including estimates of the carrying capacity, mountain tourism demands significant attention. Due to its strong forward and backward links with other important economic sectors, the tourism industry in India has become a significant driver of sustained economic growth. As the tourism industry has strong forward and backward linkages with other important economic sectors, it appears that our planners and policymakers intentionally ignored the warnings given in order to use the region's resources for national development and to provide quick and simple access by building road networks stifled this knowledge.

Conclusion :

The loss of life and assets in Uttarakhand after the disaster is heart-wrenching. We could have saved lives and prepared ourselves to handle the crisis if we had acted in accordance with the information, but the severity of the information was underestimated, and as a result, we are all witnesses to calamity. Joshimath City is historically, religiously, and geographically significant, but its fate is still at stake. The number of landslides that occur throughout the city is steadily rising. It is quite evident that hydropower installations and uncontrolled development are to blame for Joshimath's sinking. It emphasizes the pressing need for sustainability and the necessity to re-evaluate major construction initiatives in the Himalayan region. Effective screening and outreach campaigns among survivors should be reinforced to avoid and alleviate psychiatric morbidity among survivors. Lessons learned from the tragedy in Uttarakhand include the necessity for more accurate and efficient flood-sensitive village design, the building of flood and landslide-proof shelters, and the insurance of disaster-vulnerable (both in regards of life and property) areas. Priority must be given to large-scale revegetation throughout river catchments and basins, including the planting of a variety of flora.

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