

Issue

Brief

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Lessons from Joshimath: The Need for a Himalayan Development Model

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Abstract

The fragility of the Himalayan ecosystem was recently highlighted by incidents of land sinking in Joshimath, a small hill town in India's Uttarakhand. This crisis has generated intense debate on aspects of development and environmental sustainability in the region, including the exploitation of Himalayan natural wealth and the strain placed on the vulnerable area by the tourism industry. This brief argues that the Himalayan region needs a cogent developmental effort that considers its unique ecosystem and minimises the conflict between humans and nature.

Since early January 2023, Joshimath—a small town in the Chamoli district of Uttarakhand¹—has become a ‘sinking town’, with residential and commercial structures and road infrastructure developing cracks and many areas becoming unlivable or unusable.² Joshimath has since been declared a “disaster-prone area”.³ As a result, the state government banned further construction in and around the town, and ordered the evacuation of more than 600 families from the danger zones.⁴ Additionally, several structures were demolished for being “unsafe”.⁵

Joshimath is located at over 6,000 feet (1,890 metres) in the Garhwal Himalayas mountain ranges. As per the 2011 Census, it had a population of 16,709,⁶ up from 13,202 in the 2001 Census, a decadal rise of around 27 percent.⁷ In 2023, its population is estimated to be approximately 22,900.⁸ The town is a gateway to pilgrimage sites such as the Badrinath Temple and Hemkund Sahib, is the starting point for several mountain-climbing expeditions,⁹ and is located near Auli, one of India’s top three ski destinations.¹⁰ As such, Joshimath is a popular tourist location, which has had an impact on its sustainability. Joshimath and the surrounding area is also a key Indian garrison centre, in charge of defending the Line of Actual Control (LAC) with China. Over 20,000 troops are stationed in the area, along with military hardware and missile systems.

Many more structures will become unstable, and numerous people will be displaced as the incidence of land subsidence^a in Joshimath increase. A preliminary study by the Indian Space Research Organisation’s National Remote Sensing Centre found that land subsidence was “slow” between April and November 2022, with Joshimath sinking by 8.9 cm. However, between 27 December 2022 and 8 January 2023 (a 13-day period of “rapid subsidence”), the town sank by 5.4 cm. The report suggested that the entire town may face an existential threat due to land subsidence.¹¹ Some environmentalists have suggested that other human settlements in the region could also soon face a similar crisis.¹²

a Land subsidence is a gradual settling or sudden sinking of the Earth’s surface on account of underground material movement, most often caused by the removal of water, oil, natural gas, or mineral resources from the ground by pumping, fracking, or mining activities. Natural events (such as earthquakes) and heavy human activity (such as heavy construction or groundwater withdrawal) may also cause land subsidence.

Introduction

This brief assesses existing literature on Joshimath, mainly related to the developmental works that were undertaken in the town and its vicinity, the tourism load on the town, and defence requirements at the international border. Given the Joshimath experience, this brief highlights the need for a development model that considers the fragile Himalayan region, which includes several similar settlements (for instance, Nainital and Mussoorie) and especially given its significance to the Indian mainland: “The Himalayan ecosystem is vital to the ecological security of the Indian landmass through providing forest cover, feeding perennial rivers that are the source of drinking water, irrigation, and hydropower, conserving biodiversity, providing a rich base for high value agriculture, and spectacular landscapes for sustainable tourism”.¹³

The Joshimath Situation Explained

In 1976, the Uttar Pradesh government set up an 18-member committee headed by M.C Mishra, the then Commissioner of Garhwal, to study the issue of land subsidence in Joshimath.^b The report had pointed out that “Joshimath is not situated on in situ rocks. It sits on weathered, landslide mass of big un-settled boulders in the loose matrix of fine micaceous sandy and clayey material. The rocks are crystalline consisting of schistose gneissic and quartzitic.”¹⁴ Joshimath, the report said, also rested on an ancient landslide site of a substantial size.¹⁵

Several subsequent studies also reiterated some of these facts. In 2018, the Uttarakhand State Disaster Management Authority (USDMA) noted that the town’s location was prone to landslides, and the area around Joshimath was covered with a thick layer of overburdened material.¹⁶ It also said the town was situated on a fragile mountain slope that was bounded by the Karmanasa and Dhaknala rivers on the west and the east, and Dhauliganga and Alaknanda rivers on the south and the north.¹⁷ “Large boulders of gneisses and fragments of basics and schistose rocks are embedded in grey-coloured, silty-sandy matrix. This makes the town highly vulnerable to sinking,” Piyoosh Rautela, USDMA executive director, is quoted as saying.¹⁸ The USDMA study found that the perennial streams, significant snow in the upper reaches, and highly weathered gneissic rocks with low cohesive characteristics made the area prone to landslides.¹⁹ These facts are further corroborated by research studies that find the Uttarakhand Himalayas highly susceptible to meteorological and geophysical hazards.²⁰

In February 2021, a glacial lake outburst in Chamoli caused a devastating flood that led to the deaths of 204 persons and 186 livestock. It damaged buildings, roads, bridges, and the hydro-projects at Raini and Tapovan. More importantly, it had an adverse impact on the landslide zone.²¹ This zone was further weakened when Joshimath recorded a heavy downpour of 190 mm on 17 October 2021. As highlighted by satellite data, its impact was that mountain streams expanded their channels and changed course, which aggravated the slope instability.²²

^b Prior to the formation of Uttarakhand as a separate state in 2000, Joshimath was in the state of Uttar Pradesh.

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Studies have also established that eco-tectonic^c and geomorphic^d factors coupled with meteorological^e characteristics have rendered the Joshimath region highly vulnerable to subsidence.²³ Notably, Chamoli district falls in Zone V (areas most susceptible to earthquakes) of the Seismic Zoning Map of India.²⁴ Joshimath also sits on the Vaikrita Thrust, a tectonic fault line. The Main Central Thrust and the Pandukeshwar Thrust (the main geological fault lines^f) are also in close vicinity.²⁵

Mishra Committee Recommendations and Developmental Works

The Mishra Committee made several recommendations pertaining to Joshimath and the wider region based on its on-ground observations. It took stock of the heavy construction projects undertaken in this area after 1962 and the indiscriminate felling of trees to develop roads and buildings, which destroyed the natural forest cover in Joshimath.²⁶ The committee advised that heavy construction work be restricted and that such activities be permitted only after a thorough examination of the soil's load-bearing capacity and the site's stability. It was also recommended that restrictions be placed on the excavation of slopes. Notably, the committee recommended avoiding blasting or digging to remove boulders for road repairs or other construction. Further, it suggested that stones and boulders should not be removed from the bottom of the hill in landslide-prone areas as doing so would take away toe support^g and increase the possibility of landslides.²⁷ It also suggested that if cracks developed, they should be sealed with lime, local soil, and sand. The committee pointed out that the felling of trees posed a danger to the town's sustainability and encouraged that trees and grass be planted widely to conserve soil and water resources. It said that cutting trees to supply the township with timber and firewood be strictly regulated, and the locals be provided with alternative sources of fuel. It also recommended avoiding any agricultural activity on the slopes.²⁸

c Tectonic relates to the structure of the Earth's crust and the large-scale processes that occur within it.

d Geomorphic relates to the form of landscape and other natural features of the Earth's surface.

e Meteorology is a branch of the atmospheric sciences with a major focus on weather forecasting.

f A fault is a fracture or zone of fractures between two blocks of rock. Faults enable the blocks to move relative to each other. This movement may occur rapidly resulting in an earthquake or may occur slowly. Faults may run from a few millimeters to thousands of kilometers.

g The toe of a slope denotes the bottom or baseline section of the soil mass comprising the slope.

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The report noted that there was excessive water seepage in the area. Since any percolation of water would be disastrous, the committee recommended the closure of open drains and soaking pits, and the halting of construction of concrete sewage lines for sewerage flow.²⁹ To prevent landslides, it recommended constructing a fixed draining system to avoid the seepage of open rainwater. Further, it suggested that roads should be metalled and be without scuppers that drain away the water from the road surface.³⁰ It suggested that cement blocks should be placed in vulnerable spots on the riverbank to prevent erosion. It also recommended that hanging boulders on the foothills be provided with appropriate support, and that erosion prevention and river training^h measures be taken up.

Despite the Mishra Committee's recommendations, several infrastructure projects were undertaken in the region. The Tapovan-Vishnugad project,³¹ a 520-MW run-of-river hydropower project by the National Thermal Power Corporation (NTPC), is being constructed on the Dhauliganga River in Chamoli district, and is expected to generate approximately 2,558 GWh of electricity annually. The project involves the excavation of a 12.1-km longhead race tunnelⁱ and three adits.^j These works require the use of a tunnel boring machine and possibly the use of the drill and blast method of tunnelling.³²

Some experts have said the blasting activities for tunnelling caused cracks to appear across Joshimath,³³ and the state government said it would probe the project's role in land subsidence.³⁴ However, in a letter to the state government, an official from the Ministry of Power stressed that the project did not have any adverse role in the current crisis and reiterated the Mishra Committee's conclusion of the town's vulnerability due to its location.³⁵ Several on-ground studies have corroborated these assertions.³⁶

The Helang-Marwari bypass road under the All Weather Road initiative, starting 13 km before Joshimath, is another major construction project in the region.³⁷ The road has two major objectives—cutting the distance to Badrinath Dham by about 30 km, and easing and expediting the movement of troops to the Indo-China border. Although the project faced some opposition from the Joshimath Bachao Sangharsh Samiti (Save Joshimath Movement), a citizens'

h River training is the construction of structures to guide the river's flow.

i Head race tunnels, or pressure tunnels, are modest-sized dams with very long tunnels and shafts that generate a high head for water for the generation of electricity. They are widely used in hydroelectric projects.

j Adits are horizontal passages leading into a mine for the purposes of access or drainage.

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initiative, which took the matter to the Supreme Court, the court authorised the construction in May 2022.³⁸ Notably, the group has repeatedly opposed major infrastructure projects in the region, warning of their consequences.³⁹ In 2021-22, the group formed several internal committees comprising locals and independent scientists to assess the problems in the area and compile a report that offered several alternative solutions. This report was handed over to the government in 2022 but was rejected.

Increased tourist activity in Joshimath also led to the construction of many multistorey buildings. An August 2022 report by the USDMA noted many improperly planned structures without due regard to carrying capacity.^k These have aggravated issues related to slope instability. Additionally, since Joshimath does not have a wastewater disposal system, increased on-surface anthropogenic activities^l have blocked natural water drainage systems, forcing water to find new drainage routes, thereby reducing the shear strength of the overburdened soil.

“Several studies, including the Mishra Committee report in 1976, have repeatedly highlighted the vulnerability of Joshimath and warned against unbridled development.”

k Carrying capacity is the level until which a group of activities can be sustained by an area.

l This refers to environmental change caused by human activity, either directly or indirectly.

A Himalayan Developmental Strategy

While Joshimath residents and army troops⁴⁰ are currently being relocated, authorities are also considering the creation of a ‘new Joshimath’ and assessing four locations near the town.⁴¹ Still, this crisis has raised the need to acknowledge the fragility of the larger Himalayan zone and consider alternative approaches to avoid similar catastrophes in other mountain towns.

The Garhwal Himalayas are home to over 51 million people,⁴² and such a large population cannot be relocated entirely despite the area’s vulnerability. Importantly, the area also has certain advantages that can be harnessed for the greater good. For instance, it has considerable scope for hydroelectric projects. As a scenic natural area, the region is also a draw for mountain expeditions, rock climbing, trekking, and other tourist activities. It is also home to many religiously significant sites that attract numerous pilgrims. Such tourist activity provides a source of income to the locals, who may otherwise seek employment elsewhere. For instance, a 2018 survey of four towns preceding Joshimath on the Badrinath Temple route^m found that 57.5 percent of the households were engaged in tourism services, with 37.5 percent exclusively dependent on tourism.⁴³ Additionally, this region contains many sensitive areas that border China and, as such, requires Indian military presence and infrastructure.

In light of this, it is a given that certain developmental activities will need to be undertaken. The crucial factor is the manner and volume of activities that can be permitted such that it minimises human-nature conflict. The Himalayas are the world’s youngest mountain ranges, with unstable slopes that are prone to landslides and erosion.⁴⁴ The region is among India’s most earthquake-prone zones. Additionally, climate change has resulted in extreme and sudden rainfall.⁴⁵ As such, the Himalayan region is very different from India’s plains and so requires a different development model that considers this ecosystem.

Since the area is an important tourist destination, with high projected traveller numbers in the coming years,⁴⁶ there will likely be a spurt in tourist-related developmental activity. These must adhere to the concept of carrying capacity (which the Uttarakhand government already recommends⁴⁷). Notably,

m Ratura, Gauchar, Nandprayag, and Chamoli.

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the government has also urged the implementation of an effective pilgrim management system.⁴⁸ This would mean curbing the number of tourists permitted to visit the region or a particular site per day and each season. Uttarakhand, and indeed the other Indian states in the Himalayas, can learn from Bhutan, which has imposed steep sustainable development fees in a bid to control the number of travellers.⁴⁹ In addition, a hill-town levy, currently imposed in many hill stations to limit the inflow of vehicles, can be expanded to other towns. This will also provide some revenue for the upkeep of the town.⁵⁰

A different set of building standards and building regulations will need to be adopted for construction projects in the Himalayan region. These standards should mandate lightweight structures and a restriction on height. Building control regulations will have to be redrawn to conform to sustainability benchmarks in these fragile regions. In the 1960s, establishments (including government premises) were built with corrugated roofs to keep structures light and single-storied.⁵¹ But in recent years, the tourism boom in Joshimath and the surrounding areas led to the construction of many multistorey buildings on fragile slopes. Such constructions should be eschewed in favour of structures conducive to the ecosystem. Revised building regulations should also include earthquake-safe construction technologies and a mandated reduction of non-structural hazards in homes, schools, business centres, and offices.⁵² These new building codes will need to be strictly enforced to protect the built environment in the region. Importantly, there has been no reorganisation of the Town and Country Planning department since Uttarakhand's bifurcation from Uttar Pradesh.⁵³ This should be done urgently, with sufficient staff to oversee the town planning.

While it is important to exploit the potential of hydroelectricity, it is equally crucial that not every potential site be pressed into service.⁵⁴ The construction of very large dams should be completely ruled out because of high landslide vulnerability and large-scale human rehabilitation.⁵⁵ The current goal of the hydroelectric projects in the region is to build about 70 projects and create 9,000 MW of power,⁵⁶ but this needs to be reviewed urgently. Vulnerable areas in the river valleys need to be mapped, and villages on the riverbanks need to be rehabilitated in safer areas.⁵⁷ Additionally, projects that are already underway may need to be redesigned to mimic the river flow.⁵⁸

Conclusion

Given the national and local imperatives, there should be unanimity that development in the Himalayan region is necessary. The crucial factor is the volume and model of development that will be adopted. Developmental decisions on the region must be made after considering its entire ecosystem and the region's significance to the mainland.

The volume of development in the Himalayan region should be sustainable and not maximalist, and the model should respect the fragile ecosystem. However, while restrictions in tourism and infrastructure creation will adversely impact local employment, there is scope for greater investments in the environment sector—in biodiversity conservation, large-scale plantation and forestry, glacier and water body protection, and high-value organic farming.⁵⁹ The development of such activities will almost certainly generate enough jobs to replace those lost in the other sectors. 

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