Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(1), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.04
www.ijmer.in

STUDY OF "SINKING TOWN-JOSHIMATH" CRISIS – ISSUES AND CHALLENGES

Dr. Hena Siddiqui
Head, Department of Education
Isabella Thoburn College
Lucknow, Uttar Pradesh, India

Introduction

Joshimath, (also called Jyotirmath), a small town in the Chamoli district of the Himalayan state of Uttarakhand was established by the Katyuri dynasty in the 11th and 12th centuries. Uttarakhand, is positioned in **seismic zone five** and is bound by two regional thrusts viz. in the north Vaikrita and in the south Munsiari. Joshimath is located at the centre of two drainages. They are AT Company Nala and Singhdhar Nala.

The city is built on loose unconsolidated surface. The material beneath the city is soil and debris. The presence of clay suggests that there must have been a glacier several years ago, in Joshimath. It has been under the spotlight ever since massive cracks emerged in hundreds of homes and roads in the recent time. This Himalayan town is on the verge of extinction. The "sinking town" of Joshimath has been recently declared disaster-prone due to rise in land subsidence.

The Prophetic MC Mishra Report on the Uttarakhand City of Joshimath

Everything we are struggling to implement today we were advised to do long time back i.e., firmly control construction work, do not blast the hillsides, improvise on drainage, avoid erosion of river banks, etc., etc.

Joshimath was built on an ancient landslide site and it always had low bearing capacity. Almost 50 years ago, the Centre had appointed MC Mishra, the then collector of Garhwal, to investigate why Joshimath was sinking. The 18-member committee report could not have been more prophetic. It undoubtedly claimed that Joshimath is located on an old landslide zone and may possibly sink if developmental work continued relentlessly and proposed that construction work should be prohibited in Joshimath.

Salient Observations of M.C.Mishra Committee Report

- Joshimath sits on an ancient landslide, resting on a deposit of sand and stone, not rock. The rivers Alaknanda and Dhauli Ganga are important in playing their part in triggering landslides, by eroding the river banks and mountain sides. It is alleged that intensified construction activity and increasing population have caused repeated landslides in the area.
- Since Joshimath is not the main rock —it is a deposit of sand and stone, hence it was not suitable for township. The vibrations generated by blasting, heavy traffic, etc., will lead to imbalance in natural factors.
- Absence of good drainage services also leads to landslides. The continuation of soak pits, which allow water to gradually absorb into the ground, is responsible for the formation of cracks between the soil and the boulders. Thus, leading to water seepage and soil erosion.
- Increase in construction activity and rising population have considerably contributed to regular landslides in the area.
- The debris and soil had come down from top of the mountain and the city of Joshimath is perched on that mass. All the construction should be prohibited in this region.

Giving to Mishra Committee Report of 1976, Joshimath is positioned on an old landslide zone and could sink if the development work continued unabated. The report explicitly said that the area of Joshimath is a deposit of sand and stone and not the main rock, hence it was not suitable for a township. Vibrations produced by blasting, heavy traffic, etc., will lead to a disequilibrium in natural factors.

Mishra Committee (1976) Recommendations

This Mishra Committee gave various suggestions regarding sinking experience of Joshimath

- No new construction should be undertaken in the slip zone. Construction should only be approved once the location's stability has been evaluated, and such areas should be aptly examined before being demarcated.
- Not a single tree should be cut down within landslide-prone sites, nor the boulders should be removed by excavating or blasting to mend roads or execute any other construction activity.
- The most affected region during the recent time is the region between Marwari and Joshimath. The area below the Joshimath Reserve Forest, and in the cantonment should undergo extensive planting.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(1), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.04
www.ijmer.in

- The committee also highlighted that there should be total restriction on storing construction material within a radius of 3 to 5 kilometres of the Joshimath township.

Other Observations Regarding Joshimath City

- Several experts have indicated that Joshimath township has been built on an ancient landslide material i.e., it lies on a deposit of sand and stone and not rock. It does not have a high load-bearing capacity. This makes the region particularly susceptible to ever-increasing infrastructure and population.
- The Alaknanda and Dhauli Ganga river trigger landslides, by eroding the river banks and mountain edges.
- The reactivation of a geographic fault may also be one of the reasons. The geographic fault is defined as a fracture or zone of fractures stuck between two blocks of rock, where the Indian Plate has pressed under the Eurasian Plate along the Himalayas.
- Joshimath is a deposit of sand and stone, it is not the main rock — therefore it was never suitable for a township.
- Poor drainage facilities too lead to landslides.

Fragile ecosystem and seismic zone

The National Centre for Seismology is the nodal agency of the Government of India (GoI), under the Ministry of Earth Sciences, for monitoring earthquakes in and around the country.

According to the seismic zoning map of the country, the entire region is categorized into four seismic zones - Seismically the most active region is Zone -V and Zone -II is the least.
11% of the country falls in zone V, 18% in zone IV, 30% in zone III and the remaining in zone II.
Joshimath is a sensitive seismic zone -V area which is more prone to earthquakes. The continuing eroding and water filtration lessen the cohesive strength of the rocks over time.

Land Subsidence

Land subsidence can be explained as the sinking of the ground because of underground material movement. Subsidence can be triggered by steady settling or abrupt sinking of the Earth's surface (National Oceanic and Atmospheric Administration (NOAA, USA)). The main reasons for subsidence usually are:

- Natural causes – earthquakes, soil compaction, glacial isostatic adjustment, erosion, sinkhole formation, etc.
- Resource extraction – extracting resources such as oil, natural gas, water, minerals, etc. from the ground by mining, fracking, or pumping.
- Construction of infrastructure – excess infrastructure load beyond the holding capacity of the soil.

Joshimath Subsidence: Experts pitch for water chemistry study

Joshimath region has been shaky because of massive development projects. The early warnings regarding the same was announced years ago but was overlooked and ignored. Currently, experts are of the opinion that water chemistry study would benefit, as it would help out in chalking out the derivation of the water around the "sinking town".

The Geologists have the view point that explanation behind the seepage of muddy water in Joshimath could be due to a cavity or fissure. Also, due to tremors produced by development works to the faults under Joshimath, may well have openned up the fractures due to which water is flushing out from the surface. Nevertheless, this requires to be comprehensively investigated.

Joshimath is a glaciated area, owing to which there is more clay in this region. The city of Joshimath is located on a hollow earth womb, whose soil and debris are very fragile and flowing like water, due to which the houses are showing cracks and the ground is breaking up**.**

The Way Ahead- Water Chemistry Research

Geologically the township of Joshimath is located in the Central Himalayas. Seismically the area is in seismic zone -V. It is extremely weak. The town is at the high-level on the mountain (6150 feet) and beneath the mountain, there is convergence of the two rivers Alaknanda and Dhauliganga. The town is positioned on an old glacier pile up in a landslide region and therefore the topsoil is very soft. The natural drainage has been obstructed due to huge construction work. The flooded water is open to move around and absorb into the land. It is found that drainage of the underground water scheme is not working adequately. The Marwadi village situated on the slope just below Joshimath is currently flooded with water. To be precise water is muddy and incessantly flowing and the source of this flow of water is not established. The town of Joshimath is on the left bank of Alaknanda River which is wearing down the mountain.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(1), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.04
www.ijmer.in

Water chemistry research must be done to determine the type of water seeping out of the surface area. Seismic monitors must be set up to record vibrations and waves impacting the faults and fractures underneath. GPS motion sensors should be installed to monitor subsidence or mass movement as the town has been witnessing a spate of land subsidence, cracks, and crevices in most of the structures. While the reason may be geological, experts are of the opinion that population, developmental projects, and hydropower construction in the area may have caused the ongoing havoc.

Preventive measures

- Imposition of restrictions on heavy construction is one of the foremost measures to be observed. Construction work should only be permitted after examining the load-bearing capacity of the soil and the strength of the site. Strict restrictions should also be enforced on the digging of slopes.
- It is highly advisable not to remove boulders by digging or blasting the hill side for road repairs and other construction work. Also, in the landslide zones, stones and boulders should not be removed from the base of the hill as it would cut off toe support thus raising the chance of landslides. Cracks formed on the slopes should be sealed and closed. The toe of a landslip is its bottom-most point.
- It is strongly advised not to cut trees in the landslide region and said that vast plantation work should be commenced in the area, specifically between Marwari and Joshimath, to protect soil and water reserves.
- The cutting of trees to supply timber and firewood in the city should be rigorously controlled. It is essential that the local people are supplied with an alternative source of fuel.
- To be very precise agriculture on the slopes must be avoided.
- Water leakage in the region is profuse. Consequently, to thwart any more landslides in the time to come, the seepage of open rainwater must be stopped by constructing proper drainage system.
- The roads must be metalled and without scuttles, that immediately drain away the water from the surface of the road.
- Water should not be allowed to collect in any part of the land. The water system should be built to carry it away to desirable areas.
- To avert the wearing down of the riverbank, cement units should be positioned at vulnerable sites on the bank.
- Hanging boulders on the slopes must be provided with suitable support. Preventing erosion and river training processes should be taken up (River training is the building of structures to guide the flow of the river).

Finding solutions for Joshimath-

There can be manifold ways to seek and solve the problem of Joshimath. These are:

Short-Term Measures

The short-term measures are –

- to halt all construction and building work in and around Joshimath.
- Proper drainage system should be installed. Water should not be allowed to precipitate and sink to the ground whether rainy or from any other source. Instead, it should be redirected to the close- by stream which will ultimately flow to the river.
- Certain chemicals can be used to boost the water-absorbing capacity of the soil.
- A provisional settlement should be provided for affected people by the government. There may well be controls and restrictions on the number of visitors for Joshimath. This also applies to all the other towns of Uttarakhand like Badrinath and Kedarnath.

Long-Term Measures

The long-term measure is to explore and investigate scientifically the reasons and solutions for the dismal conditions in Joshimath. One should understand the geology of the town and its surrounding areas to get some solution for the 'sinking town' e.g.,

- Geophysics will inform what is below Joshimath,
- Hydrology will give an idea about the source of water all around Joshimath and Marwadi,
- Glaciology will talk about the present picture of debris deposition and its holding capacity in and around Joshimath,
- Seismology guides for micro zonation of Joshimath township which will help scientists and engineers, the sort of construction to be done of building and roads.
- Meteorology tells about rainfall and cloud bursts in the area.
- Geochemistry informs the chemical properties of the subsurface and some chemicals can fill up the cracks in buildings and roads which are becoming source of underground water storage.
- Plantation is one of the very important methods that can hold the soil thus preventing landslides.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(1), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.04
www.ijmer.in

The Way Forward

The way forward is both short-term and long-term. The short term is promptly moving the people of Joshimath to safer locations. It is largely found that there are very few places where the sub-surface is solid rocks, as most of the areas are with loose soil. It is vital to find sites where the ground is rocky, and this can be found swiftly by getting aero geophysical surveys. The previous flood experience shows that there are places that have been swept out due to flood e.g., Srinagar town is on loose soil. While the left bank of Chamoli town, headquarters of Tehsil Chamoli of District Chamoli, was never affected by the flood, even during Alaknanda flood in 1970. Geophysics can be very beneficial in selecting such sites.

The long-term way forward is a lasting and permanent solution for Uttarakhand. Following the Kedarnath disaster in June 2013, it was proposed in the Parliament in 2014 that a Centre for Himalaya Study be set up in Uttarakhand. This proposed centre is suggested to have four divisions –

1. Earth Science,
2. Climate,
3. Hydrology,
4. Environment.

Earth science division would have –

1.Geology,
2.Geophysics and
3.Seismology.

The Climate division can consist of-

Meteorology and
Glaciology.

The Hydrology division can have-

Water resources and
Civil Construction,

The Environment can have –

1.Ecology and
2. Biodiversity.

In addition, Geographical Information Systems and Remote Sensing should be to monitor from space and the processing of huge data and information.

Conclusion

The troubles of Joshimath are multi-folds. It is built on debris with the influx of water from above. The capillary upward movement of water is due to the rivers, fragile and unstable mountains and extremely seismologically vulnerable regions. The scientific answer to this grave issue is based on multidisciplinary studies such as Geological, Seismological, Geophysical, Hydrological, Glaciological, and Geotechnical which also incorporates monitoring it through space such as remote sensing and other methods.

There are various other such Joshimath in the mountainous districts of Uttarakhand - Uttarkashi, Nainital, Almora, Pithoragarh, Champawat, and others. The way out of such an enormous problem cannot be resolved by any one branch of science but demands multidisciplinary approach. In fact, this type of approach was suggested in the Parliament of India in 2014 during its first budget offered by the newly elected government. The announcement was given a big welcome by all, especially the people of Uttarakhand. We look for reasons and solutions when things go out of our hands. We must act as soon as we get early signs and warnings.

Reference

- https://www.financialexpress.com/lifestyle/science/explained-4-reasons-why-joshimath-is-sinking-know-whats-happening-under-the-ground-of-this-himalayan-town/2941826/
- https://www.drishtiias.com/daily-updates/daily-news-analysis/joshimath-land-subsidence
- https://plutusias.com/joshimath-crisis/
- https://www.deccanherald.com/science-and-environment/joshimath-a-grave-reminder-that-we-are-messing-with-the-environment-experts-1179242.html
- https://scroll.in/latest/1041623/uttarakhand-joshimath-authorities-mark-86-homes-as-unsafe
- https://carbonimpacts.info/article/joshimath-subsidence-demonstrates-risks-of-unplanned-rampant-development-in-fragile-areas-experts-

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(1), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.04
www.ijmer.in

- https://www.india.com/news/india/joshimath-sinking-crisis-houses-temple-collapse-geophysical-survey-disaster-management-what-we-know-so-far-5853985/
- https://indianexpress.com/article/explained/explained-climate/joshimath-what-is-land-subsidence-and-why-does-it-happen-8370817/
- https://www.business-standard.com/article/current-affairs/joshimath-a-tale-of-unheard-warnings-as-the-area-sinks-beyond-repair-123010800434_1.html
- https://www.moneycontrol.com/news/business/joshimath-crisis-why-the-1976-mishra-committee-report-on-joshimath-is-prophetic-9829361.html
- https://jen.jiji.com/jc/eng_afp?k=20230112043973a
- https://www.pioneeredge.in/guest-column-joshimath-crisis-underlies-need-for-a-research-centre-for-himalayas/