No. 658 /DDMA-2024

From

The Deputy Commissioner-cum-Chairman,
District Disaster Management Authority,
District, Lahaul & Spiti.

To

The Additional Chief Secretary (Revenue-DM) to the
Govt. of Himachal Pradesh Shimla-2

Dated Keylong, the 20th August, 2023.

Sub: Regarding Mitigating risks arising from Glacial Lakefield (Field Expedition Report to Ghepang Gath Lake.)

Sir.

This is with reference to letter No. Rev (DMC) (F)-11-45/2009-GLOF, dated 24th May, 2024, from your good office, on the subject cited above and to say that, the risk due to Glacial Lake Outburst Floods (GLOFs) has been increasing over the Himalayan region. Taking a serious note of the catastrophic GLOF events in the past, the NDMA and the HPSDMA initiated to have detailed studies for developing Early Warning Systems within the catchments of the potential vulnerable lakes located in all the Himalayan States.

In this regard DDMA, Lahaul & Spiti, planned a field expedition to the Ghepang Ghat Glacial Lake from 24th to 26th July 2024, under the Chairmanship of the undersigned and along with a team comprising of members from various departments and organisations to study the GLOF and its various impacts on the low-lying areas.

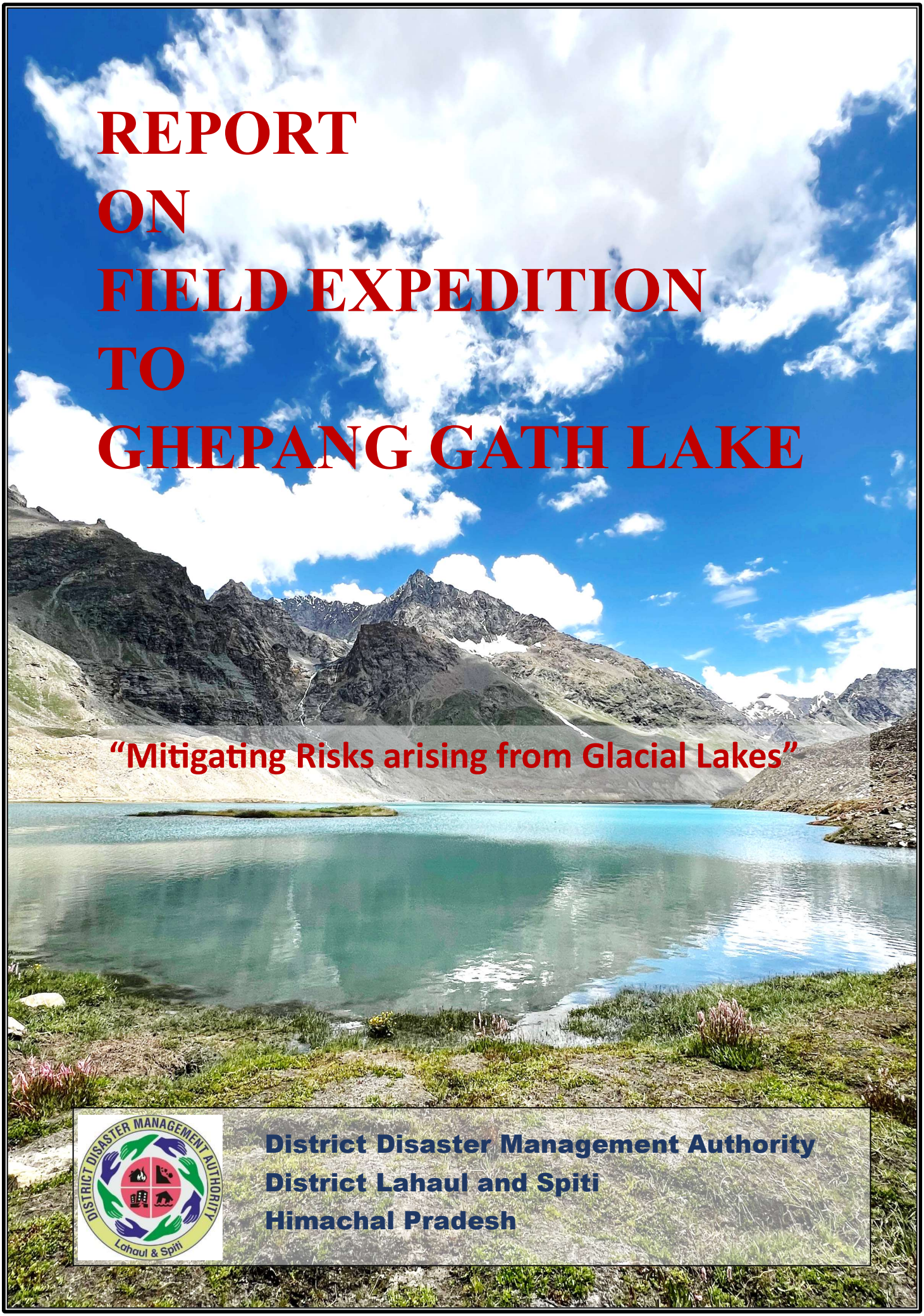
The report on the field expedition has been compiled with combined expert opinions and research based studied of these organisations enabling us in the development of effective mitigation strategies.

The Field Expedition Report is enclosed for kind information please.

Yours faithfully.

(Rahul Kumar), I.A.S
Deputy Commissioner-cum-Chairman,
District Disaster Management Authority,
District, Lahaul & Spiti.

REPORT
ON
FIELD EXPEDITION
TO
GHEPANG GATH LAKE



"Mitigating Risks arising from Glacial Lakes"

District Disaster Management Authority
District Lahaul and Spiti
Himachal Pradesh

Field Expedition Report:

Glacial Lake Outburst Flood (GLOF)

1. Introduction

Date of Visit: [24th July to 26th Juy 2024]

Location: Ghepang Gath Glacial Lake, Sub Division Lahaul, District Lahaul & Spiti.

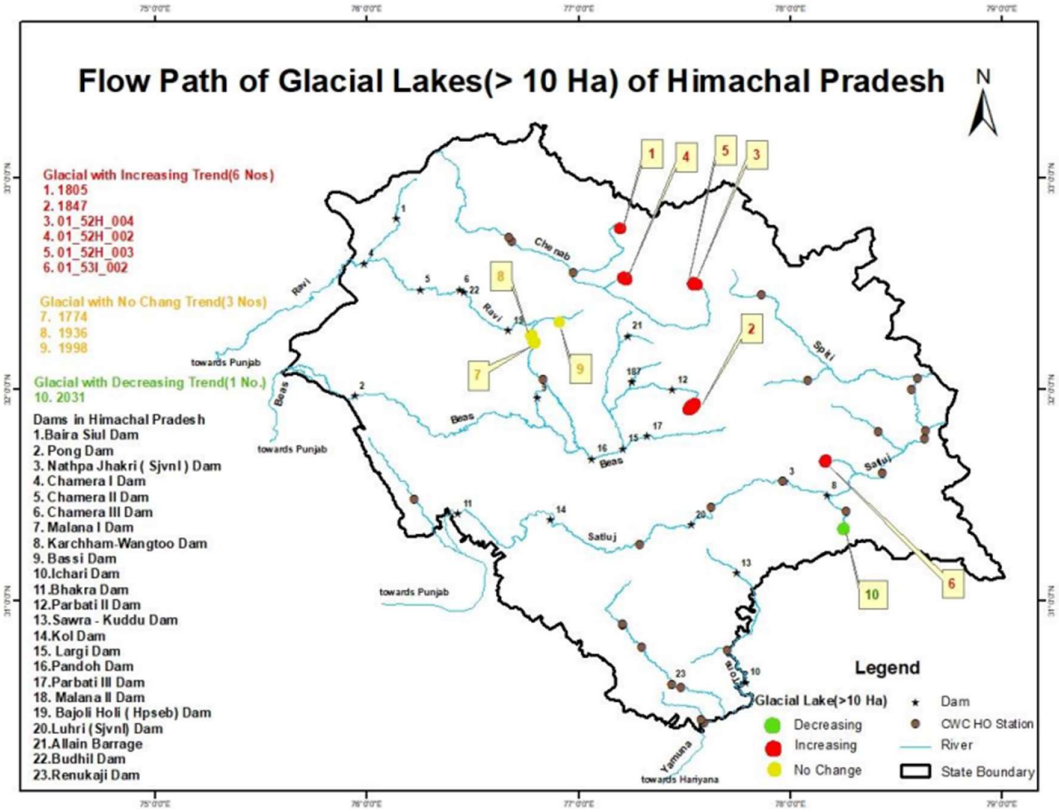
2. Glacial Lake Outburst Flood (GLOF)

Definition:

A Glacial Lake Outburst Flood (GLOF) occurs when a glacial lake's dam fails, leading to a sudden and massive release of water. A similar phenomenon, known as a jökulhlaup, involves the rapid release of water from beneath or overflowing a glacier. The dam in a GLOF can be made of glacier ice or terminal moraine. Failure of this dam can be triggered by several factors, including erosion, excessive water pressure, rock or snow avalanches, earthquakes or cryoseisms, volcanic activity beneath the ice, or the collapse of a glacier into the lake.

Increasing glacial melting because of climate change, alongside other environmental effects of climate change (i.e. permafrost melting) mean that regions with glaciers are likely to see increased flooding risks from GLOFs.This is especially true in the Himalayas where geologies are more active.

A 2023 study found 15 million people at risk from this hazard, mostly in China, India, Pakistan, and Peru



Examples of Notable GLOFs:

- **Nepal:** The 1985 GLOF from the Dig Tsho lake in Nepal resulted in substantial damage to the downstream area.
- **Pakistan:** The 2010 GLOF in the Hunza Valley, caused by the collapse of a glacier-dammed lake, led to significant flooding and destruction.
- **Sikkim:** The 2023 South Lhonak Lake in Sikkim caused by the collapse of a glacier-dammed lake, led to significant flooding and destruction.

Causes:

GLOFs can occur due to various triggers:

1. **Dam Failure:** The natural dam, often composed of moraine (glacial debris) or ice, may collapse or fail due to overtopping, erosion, or seismic activity.
2. **Glacial Melt:** Increased glacier melt due to rising temperatures can cause the glacial lake to expand and become unstable.
3. **Rockfall or Landslide:** Material falling into the lake can displace water rapidly, leading to a wave that may breach the dam.
4. **Ice-Related Events:** Ice calving from the glacier into the lake or the formation of ice-dammed lakes can also contribute to outburst floods.

Impacts:

- **Infrastructure Damage:** Bridges, roads, and buildings in the flood path can be destroyed or severely damaged.
- **Ecosystem Disruption:** The sudden influx of water and sediment can alter river ecosystems, affect aquatic habitats, and lead to erosion.
- **Human Settlements:** Communities living downstream of the glacial lake are at high risk, with potential loss of life and displacement of populations.

Monitoring and Management:

- **Early Warning Systems:** Implementing monitoring systems to detect changes in lake levels, ice conditions, and other risk factors can provide advance warning to at-risk communities.
- **Engineering Solutions:** Strengthening natural dams, constructing spillways, or improving infrastructure to withstand potential GLOF impacts can help mitigate damage.
- **Community Preparedness:** Educating local populations about GLOF risks and developing emergency response plans are crucial for minimizing the impact of such events.

Understanding and managing GLOFs involves a combination of scientific research, engineering, and community engagement to reduce risks and enhance resilience.

Background Information

- **Geographical Conditions**

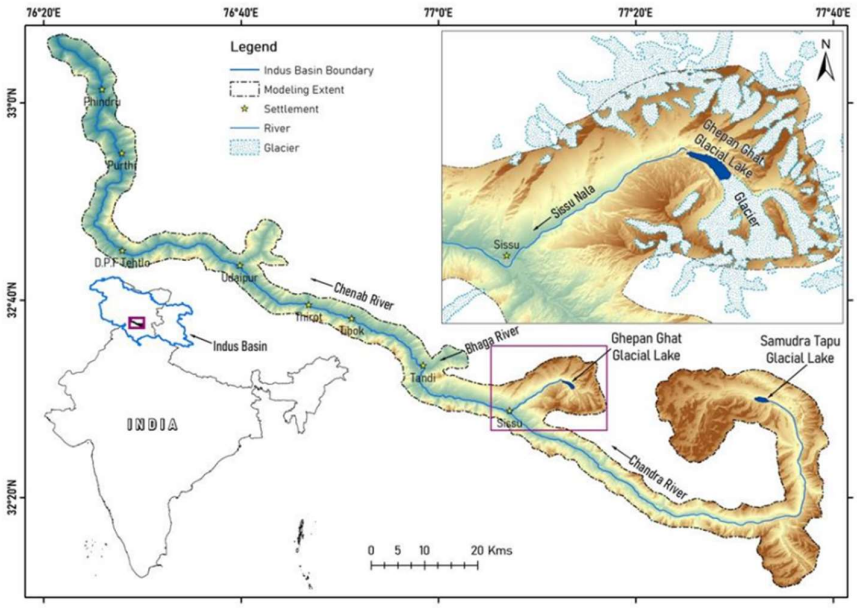
  The valley of Lahaul is situated to the south of Ladakh. For this very reason this place derived its name LhoYul meaning “Southern Country”. To its south is situated the beautiful valley of Kullu across the Rohtang Pass (3195Mtrs) and the Bara Bangahal (Kangra) across the Asakh pass (5051Mtrs) . Its western boundaries touch the Pangi and Churah areas of Distt. Chamba. To its north situated the valleys of Zanskar and Ladakh across Shingola (5090 Mtrs) and Baralacha la (5450 Mtrs) respectively. Its eastern and south eastern boundaries coincide with those of Spiti and Western Tibet across the Kunzom Pass (4500 Mtrs).

- **Description of the Area:**

  The Ghepan Ghat Glacial Lake is located at an elevation of 4,068 m a.m.s.l. in the state of Himachal Pradesh, India. The stream emerging from this lake called Sissu nalla joins the Chandra river at about 11 km from the origin of lake in North side. A change analysis of the lake water spread area carried out using Landsat-5 of 1989 and Sentinel-2 of 2022 multi-temporal optical imagery revealed a 178% increase in size from 36.49 ha to 101.30 ha. Such alarming rate of lake expansion and the rapid urbanization of its downstream settlements have increased the possibilities of a catastrophic impact due to GLOF event by many folds.. The GLOF peak hydrograph of 9,673 cumecs propagated from the moraine dam to the nearest settlement of Sissu in just 21 minutes where it was estimated as 9,450 cumecs. The narrow and steep V-shaped valley from the downstream of glacial lake to Sissu village has resulted in high flood depths of around 20 m along with velocities of approximately 12 m/s during the peak of the flood wave near the village. The simulated GLOF peak of flood hydrographs for 100%, 75% and 50% of lake water releases scenarios yielded 9,378 cumecs, 6,628 cumecs and 3,127 cumecs near Sissu village for overtopping failure.

  Ghepang Ghat glacial lake is one the top five prioritized glacial lakes in Indus river basin and hence taken up for further detailed study. The glacial lake is located in the upper reaches of in the Chandra sub-basin of the Indus Basin, Himachal Pradesh. The geographical co-ordinates of Ghepang Ghat Glacial Lake are 32º 31‘ 11“ N and 77º 13‘ 38“ E. The river Chenab is formed after the two streams the Chandra and the Bhaga merge with each other. The Chandra and the Bhaga originate from the south-west and north-west faces of Barelacha pass respectively in the Himalayan canton of Lahul and Spiti valley in Himachal Pradesh. The course of Bhaga upto the confluence is 80 km only having a steep slope with an average fall of about 24 metre per kilometre. The stream originating from Ghepng Ghat glacial lake called Sissu nalla joins Chandra river about 11 km from its origin. The confluence of Sissu nalla with Chandra river is at distance of about 90 km from Samudra Tapu glacier from where the Chandra river originates. The Chandra initially flowing southeast for about 88 km sweeps round the base of the mid-Himalayas and joins the Bhaga at Tandi, after traversing a total length of about 125 km. Thereafter the united stream, known as the Chenab or Chandra Bhaga, flows in a north-westerly course for about 46 km where it receives its first major tributary the Miyar Nalla on the right bank. Then it flows for another 90 km generally in a northerly direction in Himachal Pradesh when it crosses the Pangi valley before entering to Padder area of Doda district of Jammu province in Jammu & Kashmir State.

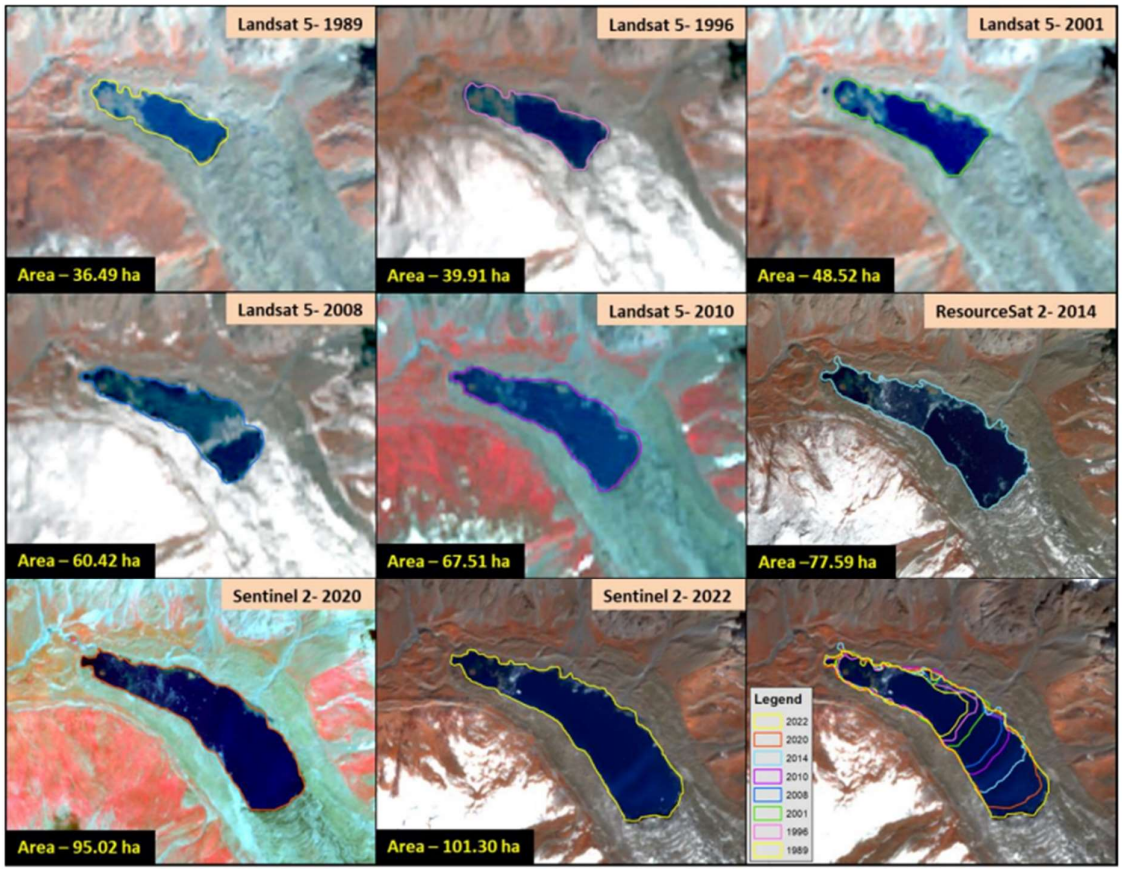
- **Climate and weather conditions**
  Since the valley is situated in rain shadow area, north of the Pir Panjal ranges the weather remains pleasant and quite comfortable during summers i.e. from May to mid Oct. This is the best season to visit this valley. It seldom rains, and the Mercury level does not exceed 25 C to -25 C throughout the period mentioned above. One can always enjoy bright sunshine wandering within lush green valley. There is little or no rain in monsoons. The climate remains dry & invigorating. The days are hot and night are extremely cold. Heavy/Light woolens are recommended. During winter, i.e. from Nov. last to April because of western disturbances it snows heavily and the temp. goes down below minus. There is an average annual snow fall of about 7 feet.



Location of Ghepang Ghat Glacial Lake

Ghepang Ghat Glacial Lake and its environs

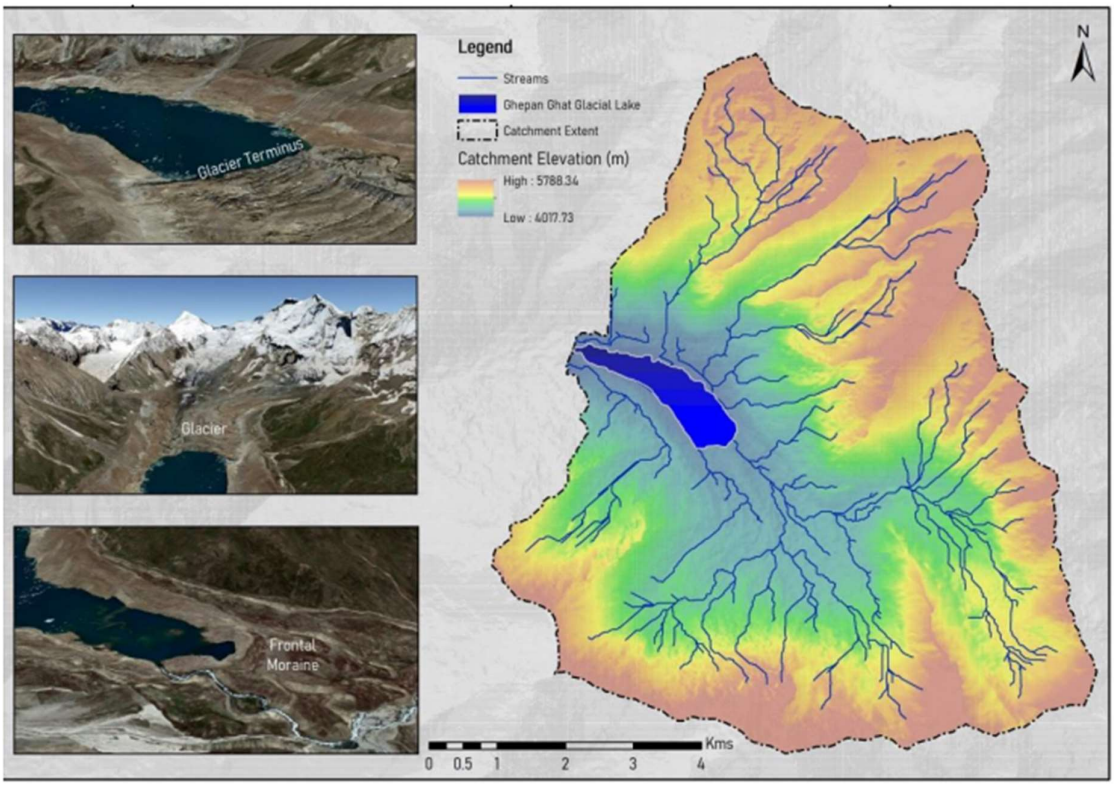
Figure 3 shows Resourcest-2 LISS-IV multispectral satellite image of Ghepang Ghat glacial lake and its surroundings. The nearest settlement of Sissu lies around 11 km downstream of the lake at an elevation of 3,070 m a.m.s.l, i.e., 1000 m below the lake. The Sissu nalla has very steep slope with an average fall of about 90 metre per kilometre between the lake and Sissu village. In addition to very steep slopes, the channel is also narrow leading to higher flow depths. These conditions are highly favorable for catastrophic flooding in case of a GLOF event. Additionally, the slopes at the periphery of the lake are susceptible to avalanches and mass movements, which act as triggering factors for overtopping wave failure of the moraine dam. According to Sattar et al. (2023), Ghepang Ghat has evolved from a supra-glacial lake into a pro-glacial one over the years. An analysis of multi-temporal satellite data using Landsat-5 of 1989 and Sentinel-2 of 2022 revealed a 178% increase in size. Figure 4 shows the lake water-spread area at different time periods, which increased from 36.49 hectare to 101.30 in a span of 33 years. Sattar et al. (2023) have carried out a comparison of the downstream settlements over a 12-year period (2010-2022) and provided evidence of significant infrastructure and agricultural land development. Such alarming rate of lake expansion and the rapid urbanization of its downstream settlements have increased the chances of a catastrophic GLOF event by many folds.



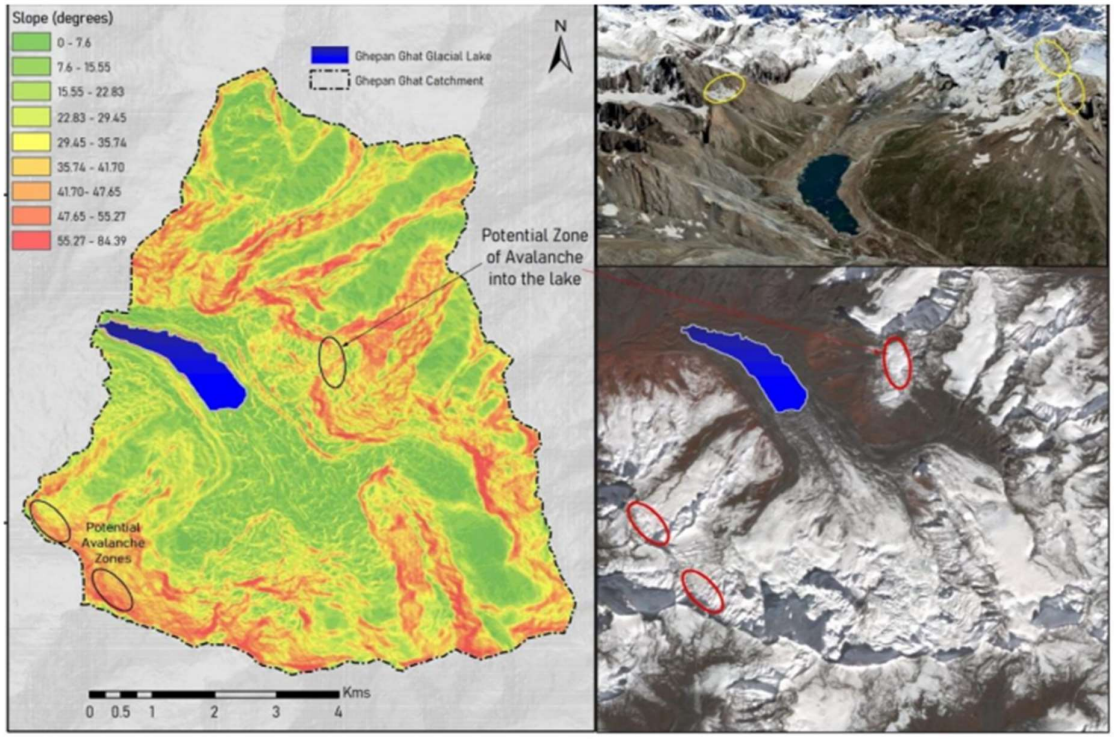
Long-term changes in Ghepang Ghat Glacial Lake water spread area

Catchment Area of Ghepang Ghat glacial lake Ghepang Ghat glacial lake is fed by snowmelt and precipitation runoff from a catchment of area 4,870 hectare. Assuming rainfall occurs

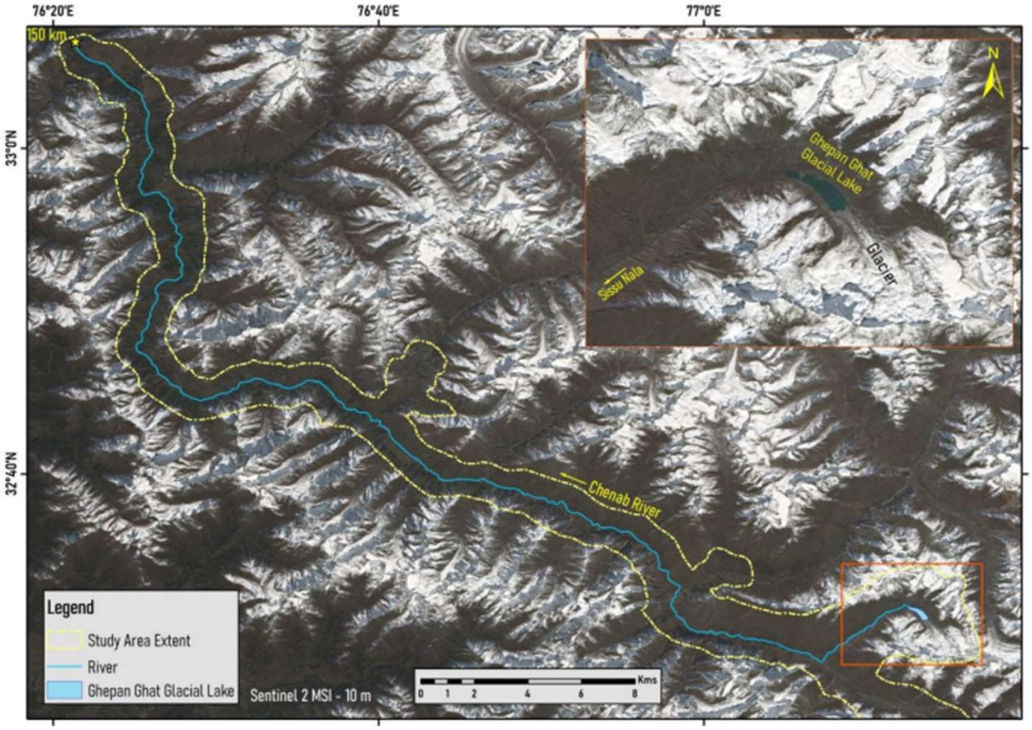
below 4,500 m elevation, about 1,486 hectares of catchment area contributes to rainfall runoff into the lake. The minimum and maximum elevations of the catchment are 4,017 m and 5,788 m respectively. The catchment area of the lake is located in the Lahul and Spiti district of Himachal Pradesh, and it is located in Chenab sub-basin in the Indus Basin. Figure 5 shows the drainage pattern upstream of the lake. Slopes in the catchment range from 0º to 84.39º near the peaks. Many studies mention the occurrence of ice and rock-ice avalanches over slopes ≥ 25º or 30º (Mohanty and Maiti, 2021; Allen et al., 2019; Alean, 1985) that act as the most common cause of GLOFs in the Himalayas (Wang et al., 2011). A preliminary visual interpretation of the slope map and high-resolution 3D-imagery from Google Earth Pro was used to identify some avalanche potential zones in the catchment as shown in Figure 6. Another source of GLOF is landslide phenomena occurring at steep slopes in the vicinity of the lake. The Ghepang Ghat catchment has steep non-vegetated slopes that commonly result in mass movements (Peduzzi, 2010) and may trigger a GLOF (Walder et al., 2003; Clague and Evans, 2000). Mass movements like avalanches and landslides into the lake generate large impulse waves that may overtop the moraine dam and eventually erode it to failure causing a sudden release of the lake water in a short duration leading to catastrophic flooding downstream.



Upstream of Ghepang Gat Glacial Lake



Slopes upstream of Ghepang Ghat Glacial Lake



Study Area Boundary of Ghepang Ghat Lake for GLOF Inundation Modelling

Purpose of Visit: To assess the current status and potential risks associated with glacial lakes and to evaluate recent impacts of GLOF events in the area.

Taking a serious note of the catastrophic GLOF event at South Lhonk Lake in Sikkim during the monsoon of 2023, the National Disaster Management Authority (NDMA) Ministry of Home Affairs, Govt of India initiated to have detailed studies for developing Early Warning Systems within the catchments of the potential vulnerable lakes located in all the Himalayan States. Accordingly, as per the directions from MHA, a 10- point Action Plan was finalized centered on four basic theses such identifying the Lead Technicala Agency (LTA) instrumentation and prioritizing early warning systems and mitigation strategies, to conduct field expeditions to assess all high risk and involvement of Armed Forces and ITBP in streamlining their support to the States in monitoring glacial lakes during operational petrol duties.

A 10-point Action Plan was finalised, centred on four basic themes:

a. States/UTs, with NDMA's backing, are tasked with overseeing glacial lake surveillance, Each State/UT will have a designated Lead Technical Agency, drawn from GOI's scientific institutions for specialized backstopping. SDMAs require to develop in-house scientific expertise for continuous monitoring due to the evolving nature of GLOF risks;
b. Comprehensive Instrumentation and prioritizing early warning systems and mitigation strategies is essential, coupled with a dedicated network. C-DAC, ISRO, DGRE and NCPOR already deploy such equipment in the Himalayas;
c. States/UTs are encouraged to expand capacities to conduct expeditions to directly assess all high-risk glacial lakes in 2024;
d. The Armed Forces and ITBP may consolidate and streamline their support to the State/UT governments in monitoring glacial lakes during operational patrol duties and operate as manual EWS.

- NDMA also demonstrated the presence of several open source GIS platforms which could be used by States/UTs to conduct desktop analysis of openly available remote sensing satellite Imagery (NRSC's Bhoonidhi, Bhuvan and EuroSAT's Sentinel-2) to conduct interferometry and predict slope failures around these lakes.
- Army / ITBP units are being encouraged to orient their outposts in the vicinity of these lakes towards establishing a manual EWS. This was demonstrated by staff at ITBP's Zanak post, located 6 kms downstream of South Lhonak on the night of October 3, 2023-a warning that allowed the Sikkim State administration to sound an alert to downstream communities, which saved several lives. ITBP has indicated that it has outposts at 39 of the 188 lakes highlighted as risky by NDMA.

In view of aforesaid Government of Himachal Pradesh has identified C-DAC Pune as the Lead Technical Agency (LTA) for the State of Himachal Pradesh. The Government of Himachal Pradesh has also identified the following four lakes based on the input from NDMA and from the State Centre on Climate Change under the aegis of the Himachal Pradesh Council for Science Technology Environment for potential vulnerable lakes in Himachal Pradesh.

The Field Expedition

Team Members:

Sr. No.	Name	Designation	Dept/ Org
1	Sh. Rahul Kumar	Deputy Commissioner	DC Office
2	Sh.Sankalp Gautam	AC to DC- DEOC Nodal Officer	DC Office
3	Sh. Aniket Maruti Wanve	DCF	Forest
4	Er. Sanju Bodh	Assistant Engineer	JSV
5	Sh. Avtar Singh	Junior Engineer	HPPWD
6	Er. Rohit Kumar	Junior Engineer	JSV
7	Sh. Bhupender Paul	RFO	Forest
8	Dr. Mohan	Doctor	PHC Shansha
9	Sh. Tanzin	Inspector (GD)Regt.	2Bn ITBP Kullu
10	Sh. Gagan Pradeep	SMS	Agriculture
11	Sh. Mohan Lal	In-charge	ABVIMAS
12	Sh. Ravinder	Instructor	ABVIMAS
13	Sh. Ravi	Instructor	ABVIMAS
14	Sh. Ram Avtar Singh	EE CWC	CWC
15	Sh. Bhuwan Adhikari	CWC	CWC
16	Dr. Bhanu Partap	Researcher	NCPOR
17	Sh. Kamlesh Kumar,	Technical Officer-B	DGRE
18	Dr. Krishan Chand	T&CB Spl., DMC,	HPSDMA
19	Sh Inderjeet	AGISAC	AGISAC
20	Sh. Kalzang C Dunny	Documentation Coordinator	DDMA
21	Sh. Nitin Sharma	T & CB Coordinator	DDMA
22	Sh. Prakash Chand	Supervisor	DDMA
23	Sh. Arun Kumar	Supervisor	DDMA
24	Sh. Dinesh	PSO DC	Police

3. Observations

1. **Width and length of the lake**
   The lake has an approximate length of 2.48 Kms and maximum width of 0.59Kms.

2. **Barrier strength - solid or loose.**
   Moraines are accumulations of unconsolidated debris (regolith and rock), often referred to as glacial till, deposited by glaciers. This material is a diverse mix of particles ranging in size from clay-sized particles to massive boulders. Ghepan Ghat glacial lake is bound by a terminal moraine at its frontal end. The elevation of the crest of the frontal moraine is around 4,069 m, i.e., 35 m above the bed of the lake at its outlet. Width of the crest of the moraine is ~150m. It has slopes of 9.3% and 22.2% at the upstream and downstream faces respectively. The downstream face of the moraine dam is slightly vegetated with grasses and shrubs, and the absence of dense vegetation makes it prone to erosion even in case of a small overtopping wave. An overtopping wave could significantly erode the downstream face of the moraine dam and eventually cause its failure

3. **Moraine/dam height and width**
   Width of the Moraine dam is around 708Mts with a varying height of 3 Mts to 11 Mts.

4. **Discharge of water from lake**
   The discharge from the lake has not been calculated yet and a study to access the same shall be carried out soon.

5. **Outflow width:**
   The width of the outflow channel is 16.42 Mts with an approximate depth of around 1.5 Mts

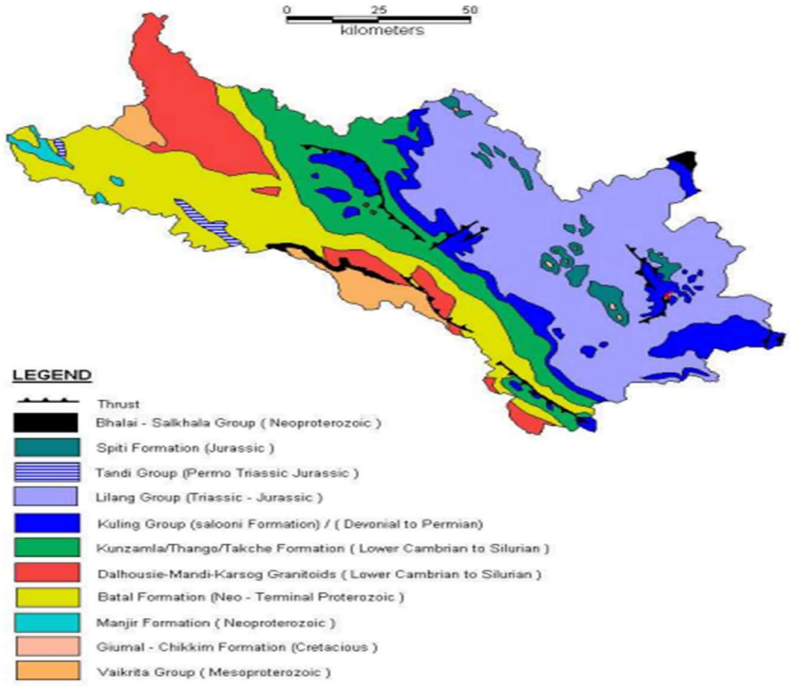
6. **Water level of the lake**
   The water level of the lake faces an annual variation of around 1 Mts due to the freezing of the lake in the winter season. Hower no extra ordinary variation in the water level of the lake was observed.
7. **Geology of the area such as type/nature of rocks**

   Geologically, the area is underlain by the rocks of Proterozoic era to the quaternary period. Hydrogeologically, all these formations can be divided into units namely fissured and porous formations.

   Fissured formations are constituted by hard rock formations ranging in age from Precambrian to Mesozoic and composed mainly of granites, gneisses, slates, phyllites, quarzites, schists and limestones. These rocks are generally massive and devoid of any primary porosity. However due to tectonic activities, secondary porosity has been developed along fractures, joints and faults zones. Weathered zones rarely form any aquifer because of their poor thickness. Sometimes contact zones of rocks unit forms poor to moderate aquifer. These are developed occasionally for localized and domestic water needs in low topographic areas. Ground water occurs generally under unconfined conditions and ooze out in the form of springs. Discharge of the springs varies from mere seepage to more than 20 lps with temperature varies from 10°C to 25°C in normal temperature of springs and 26°C to 60°C in hot water springs. This spring water is utilized for drinking and irrigation purposes.

   Porous formations include both fluviatile and fluvio-glacial deposits. There is no development of the alluvial terrains in the valley as most of their river courses flow through narrow valley portions between well defined compact and hard rock valley walls. In broader valleys, like on the right banks of Bhaga and Chandra Bhaga rivers where older glacial terrain exists, large cultivations are being practiced. The width of these deposits varies from less than

500m to about 2.5km with increasing thickness of sediments towards the center of valley. These deposits are isolated and discontinuous and forms potential ground water aquifer



8. Slope of valley near the lake and glacier

The valleys around the Lake and glacier are characterized by its steep slopes and rugged terrain. The left lateral moraines of the lake are elevated by ~100 m to the present glacier surface. However, the left side are gentle. The moraines on the left side are highly eroded and fragile and stretched all along the glacier area. The valley mountain is closely associated with the right side of the lake including steep avalanche and rock fall zone. The trekking route is steep, rough with uneven terrain conditions. As per the field observations, approx. at 05 locations, slopes are unstable along the track route which may cause landslides during heavy rain/cloudburst and may create landslide lake outburst flood (LLOF) situation downstream.

9. Whether or not the Lake is attached to the glacier snout

The Lake is connected to the glacial snout of the Ghepang Gath Glacier.

10. **Probability of cloud bursts in the area**

Cloud bursts are sudden, intense rainfall events that can cause significant flooding and damage, especially in mountainous regions like Lahaul and Spiti in Himachal Pradesh. The high probability of such events in this district can be attributed to several factors:

i. **Topography**: Lahaul and Spiti are mountainous regions with steep slopes. This topography can enhance the likelihood of intense rainfall and cloud bursts because the mountains can cause moist air to rapidly condense and precipitate.
ii. **Climate Patterns**: The region experiences a range of climate patterns, including the monsoon season, which can bring heavy rainfall. Changes in weather patterns due to climate change can also increase the frequency and intensity of extreme weather events like cloud bursts.
iii. **Historical Data**: Past incidents of cloud bursts and extreme rainfall events in the Lahaul and Spiti district provide evidence of the high probability of such occurrences. These events can be linked to specific weather conditions, like the presence of a particular type of weather front or a sudden influx of moisture.
iv. **Meteorological Studies**: Ongoing meteorological research and monitoring can help predict and understand the conditions that lead to cloud bursts. Analysis of historical weather data, satellite imagery, and other meteorological tools can indicate trends and patterns that are indicative of future risk.
v. **Geological Factors**: The geological structure of the region, including the type of soil and rock formations, can influence how rainfall is absorbed and how quickly it can lead to flooding. In mountainous areas, the rapid runoff from intense rainfall can exacerbate the effects of cloud bursts.

Mitigating the risks associated with cloud bursts involves improving weather forecasting, enhancing early warning systems, and planning infrastructure to handle sudden increases in water flow. Community preparedness and awareness are also crucial in managing the impacts of these extreme weather events.

11. **Probability of landslide and avalanche affecting the lake**

Ghepang Gath Lake, located in the Lahaul and Spiti district of Himachal Pradesh, is situated in a region characterized by its steep slopes and rugged terrain. This topography makes the area particularly vulnerable to landslides and avalanches. Several factors contribute to this susceptibility:

I. **Steep Slopes**: The high-gradient slopes around Ghepang Gath Lake are prone to instability. When heavy rainfall, rapid snowmelt, or other disturbances occur, these slopes can become unstable, leading to landslides.
II. **Geological Composition**: The geological structure of the region, including loose soil, debris, and fractured rock formations, can exacerbate the likelihood of landslides. The combination of these materials can make slopes more susceptible to failure.
III. **Weather Conditions**: Heavy rainfall, rapid snowmelt, or prolonged periods of rain can saturate the soil, increasing its weight and decreasing its stability. This can lead to both landslides and avalanches, especially in areas where snow accumulation is significant.

IV. **Vegetation**: The presence or absence of vegetation plays a crucial role in stabilizing slopes. In regions where vegetation is sparse or disturbed, there is less natural anchoring of the soil and rock, making landslides more likely.
V. **Seismic Activity**: Earthquakes and seismic activity can trigger landslides and avalanches in mountainous regions. Even minor tremors can destabilize slopes and lead to mass movements.

12. Probability of rock falls due to frost activity in terms of the distance of the high mountain cliffs.

The high-gradient slopes around Ghepang Gath Lake are prone to instability. When heavy rainfall, rapid snowmelt, or other disturbances occur, these slopes can become unstable, leading to landslides.

13. Whether Moraine contains ice core or free of ice core.

Visual observations indicate that the moraine appears to lack an ice core. However, to accurately determine the presence of an ice core, Ground Penetrating Radar (GPR) or other scientific methods are needed for a thorough investigation. In addition to this DEM based monitoring of the moraine is also required to determine the changes in the moraine dam.

14. Depth of lake real time or though visual observations

Based on the field-based studies carried out by National Centre for Polar and Ocean Research (MoES) Govt. of India has carried out the bathymetric studies of the Ghepang Gath Glacier Lake and the average lake depth has been estimated as 33.19 metres using Sonar method

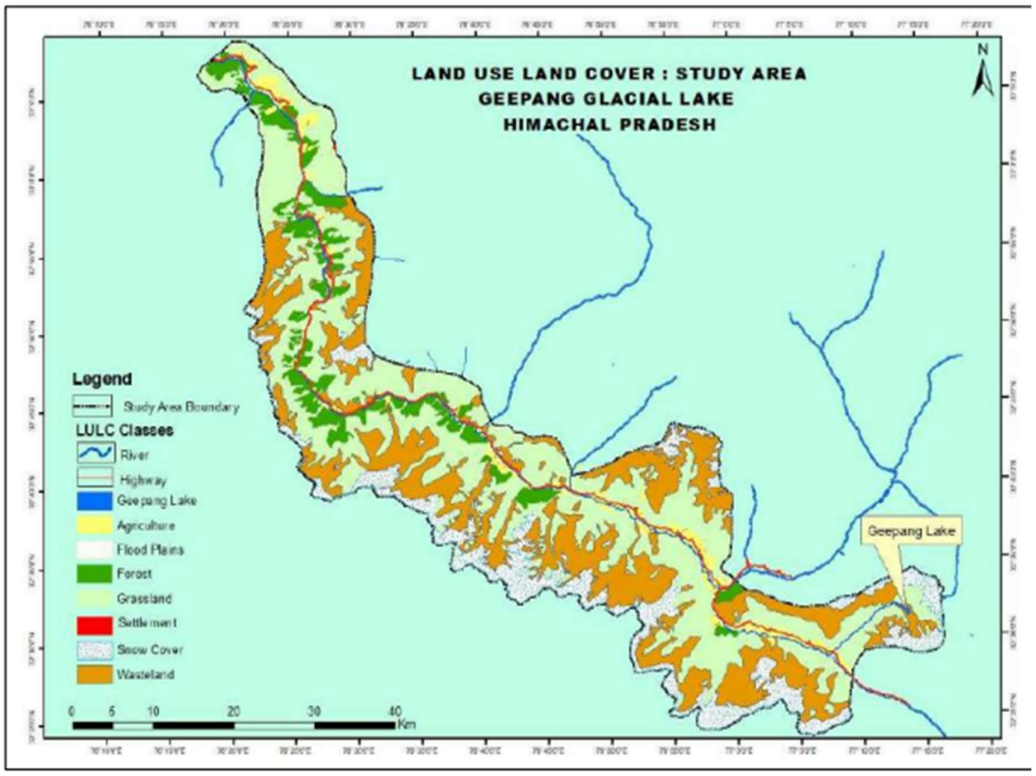
15. Downstream slope of the valley gentle of steep please indicate degree

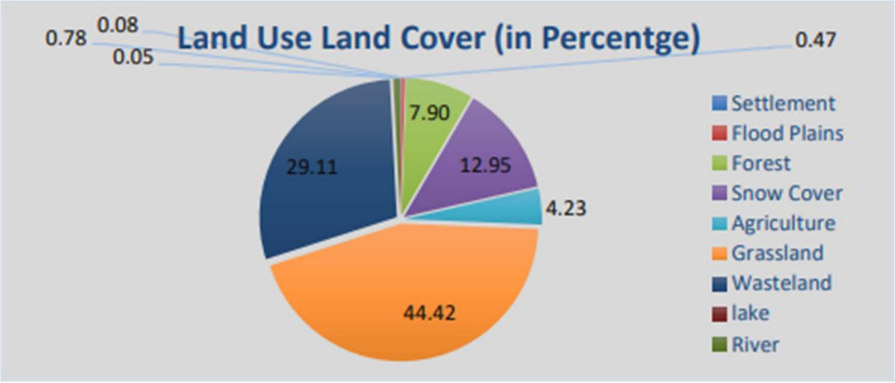
The glacial lake is located at an elevation of 4,070 m a.m.s.l in the upper reaches of in the Chandra sub-basin of the Indus Basin, Himachal. The nearest settlement of Sissu lies around 11 km downstream of the lake at an elevation of 3,070 m a.m.s.l, i.e., 1000 m below the lake. The Sissu nalla has very steep slope with an average fall of about 90 metre per kilometre between the lake and Sissu village. In addition to very steep slopes, the channel is also narrow leading to higher flow depths. These conditions are highly favorable for catastrophic flooding in case of a GLOF event. Additionally, the slopes at the periphery of the lake are susceptible to avalanches and mass movements, which act as triggering factors for overtopping wave failure of the moraine dam**.**

16. **Morphology of the downstream valley type of soil, rock, vegetation**

The land use land cover map of the study area is based on the satellite data analysis, the dominating land cover units observed in the immediate study area are grass land/pasture land constituting Page | 9 about 819.17 Km2 i.e. about 44.42% of the study area and wasteland comprises of 537.22 Km2 of the total area i.e. about 29.12% of the total area. Besides this, Snow cover comprising of 238.96 Km2 i.e. about 12% of the total area constitutes the third major land cover in the catchment and the forest constituting about 7.9% of the total area (145.84 Km2) is available in the study area. Agriculture constitutes 4.23% of the study area. The habited area constitutes only about 0.08% of the total area in the catchment. By virtue of climatic conditions, the lower elevations are suitable for the production of cereal crops, stone and citrus fruits and the higher elevations, are most suitable for the growing of seed potatoes, vegetables and temperate

fruits.





Land Use Land Cover of Geepang Gath glacial lake in Percentage.

17. **Any hydropower station in the downstream area approx. distance, if any**
    The Power House at Thirot may get affected due to the increase in water level of Chandra Bhaga river.

18. **Infrastructure in the downstream-road, bridge, built up structure**

19. **Turbidity of the lake:**
    The turbidity report as sampled by the JSV is as below:

Himachal Pradesh
Jal Shakti Vibhag
Water Testing Laboratory
Keylong L&S (H.P.) 175132

TEST REPORT

Sample No: 753 Date:25-07-2024

Test Report No. JSD 753

Name and address of Customer: Nawang Tashi
Sampling Method : IS-3025 ,APHA 24th Edition
Sample Description : Water Sample
Sample Quantity: 1 Ltr
Collected On: 25-07-2024
Received Date: 25-07-2024
Test Start Date: 25-07-2024
Test End Date: 26-07-2024

Condition Of Sample when Received: Good
Name Of Source/Scheme: WSS Sissu
Name Of Panchayat: Sissu
Name Of Village : Sissu
Name Of Habitation: Sissu Ghepan Ghat
Environmental Condition : Temp. 23.1°C ,Humidity 72%
Type Of source: Spring

Sr. No.	TEST PARAMETER	Test Method	Result	Requirement as per IS: 10500:2012	
				Acceptable Limits	Permissible Limits in absence of alternate source
	Physical Parameters				
1	pH Value	IS 3025(Part 11) 1983 Reaffirmed 2017	7.39	6.5-8.5	No relaxation
2	Turbidity, NTU,Max	IS 3025: (Part 10) 1984 Reaffirmed 2017	1.6	1NTU	5NTU
3	Odour	IS 3025: (Part 5) 1983 Reaffirmed 2018	Agrreable	Agreeable	Agreeable
4	Taste	IS 3025: (Part 7&8) 1984 Reaffirmed 2017	Agreeable	Agreeable	Agreeable
5	Total Dissolved Solids mg/l, Max	IS 3025: (Part 16) 1984 reaffirmed 2017	149.6	500mg/l	2000mg/l
6.	Colour, Hazem uunits, max	IS 3025: (Part 4) 1983 Reaffirmed 2012	0.0	5	15
	ChemicalParameters				
7	Total Alkalinity(As $CaCo_3$) mg/l, Max	IS 3025 (Part 23): 1986 Reaffirmed 2019	15	200 mg/l	600mg/l
8	Total Hardness (As $CaCo_3$) mg/l, Max	IS 3025 (Part 21) 2009 Reaffirmed 2019	137.8	200mg/l	600mg/l
9	Chloride(As Cl) mg/l, Max	IS 3025: (Part 32) 1988 Reaffirmed 2019	8.99	250mg/l	1000mg/l
10	Calcium (As Ca) mg/l,Max	APHA 24th Edition, 3500-Ca Method B (EDTA TITRIMETRIC METHOD)	33.34	75mg/l	200mg/l
11	Magnesium(As Mg) mg/l Max	APHA 24th Edition, 3500-Mg-B Method B (Calculation Method)	13.26	30mg/l	100mg/l

Remarks(If any): BDL :Below Detection Limit , DL= Detection Limit
Note: 1. This report should not be produced partly or full without approval of signatory authority for legal purpose.
2. The result refer only to tested samples and parameters tested.
3. Sample will be stored for a period of seven days from the date of issue of report.

Tested By:
Water testing laboratory
Keylong L&S

Authorized Signatory
(Shruti Sharma)
Water testing Laboratory
Keylong L&S

Himachal Pradesh
Jal Shakti Vibhag
Water Testing Laboratory
Keylong L&S (H.P.) 175132

TEST REPORT

Sample No: 753 Date:25-07-2024

Test Report No. JSD 753

Name and address of Customer: Nawang Tashi
Sampling Method : IS-3025 ,APHA 24th Edition
Sample Description : Water Sample
Sample Quantity: 1 Ltr
Collected On: 25-07-2024
Received Date: 25-07-2024
Test Start Date: 25-07-2024
Test End Date: 26-07-2024

Condition Of Sample when Received: Good
Name Of Source/Scheme: WSS Sissu
Name Of Panchayat: Sissu
Name Of Village : Sissu
Name Of Habitation: Sissu Ghepan Ghat
Environmental Condition : Temp. 23.1°C ,Humidity 72%
Type Of source: Spring

Sr. No.	TEST PARAMETER	Result	Requirement as per IS: 10500:2012	
			Acceptable Limits	Permissible Limits in absence of alternate source
	Physical Parameter			
1	Temperature		----------	----------
	Chemical Parameters			
2	Nitrate (as No_3),mg/l,Max	0.0	45mg/l Max	No Relaxation
3	Fluoride(as F)mg/l,Max	0.0	1.0mg/l Max	1.5mg/l Max
4	Sulphate(as So_4),mg/l,Max	-	200mg/l Max	400mg/l Max
5	Ammonia (as total Ammonia-N),nmg/l,Max	-	0.5mg/l Max	No Relaxation
6	Iron (as Fe),mg/l,Max	0.0	1.0mg/l Max	No Relaxation
7	Manganese (as Mn),mg/l, Max	-	0.1mg/l Max	0.3mg/l Max
8	Total Arsenic (as As)mg/l,Max	-	0.01mg/l Max	No Relaxation
9	Free residual chlorine ,mg/l,Max	0.0	0.2mg/l MAx	1.0mg/l Max
	Bacteriological Parameters			
10	Total Coliform Bacteria (shall not be detectable in any 100ml sample)	Nil	Nil	Nil
11	E.Coli or thermotolerant coliform bacteria (shall not be detectable in any 100ml sample)	Nil	Nil	Nil

Tested By:
Water testing laboratory
Keylong L&S

Authorized Signatory
(Shruti Sharma)
Water testing Laboratory
Keylong L&S

20. Nearest habitations in the downs:

S.No.	Settlement Name	Distance from lake (km)
1	Sissu	11
2	Ghondhla	21.1
3	Dalang	22.7
4	Shipting	27.5
5	Bha-Garang	30.5
6	Gushal	31
7	Tandi	31
8	Ruding	38.1
9	Lingar	39.6
10	Rapay	44.3
11	Tibok	47.9
12	Nalda	50.4
13	Thirot	56
14	Kishori	64
15	Shanur	65.2
16	Triloknath	66.2
17	D.P.F. Udaipur	66.9
18	D.P.F. Bardang	68.6
19	Lobar	70.4
20	Udaipur	71
21	Salpat	73.4
22	Margaraon	75.8
23	R.F. Khurail	78.1
24	R.F. Rhumas	82.2
25	Kurched	84.9
26	D.P.F. Dhanwani	88.8
27	D.P.F. Tehtlo	94.1
28	Purthi	118
29	Ajog	119
30	Chhau	119.5
31	Sach	130.8
32	Phindru	134

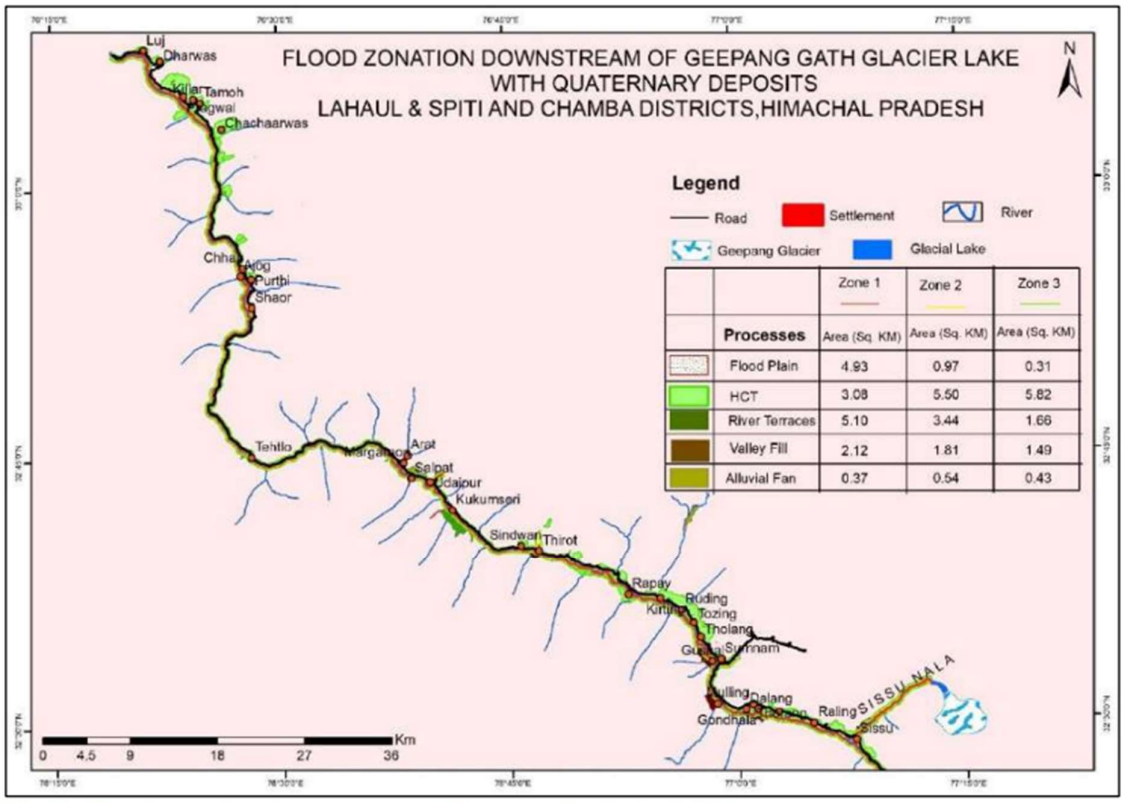
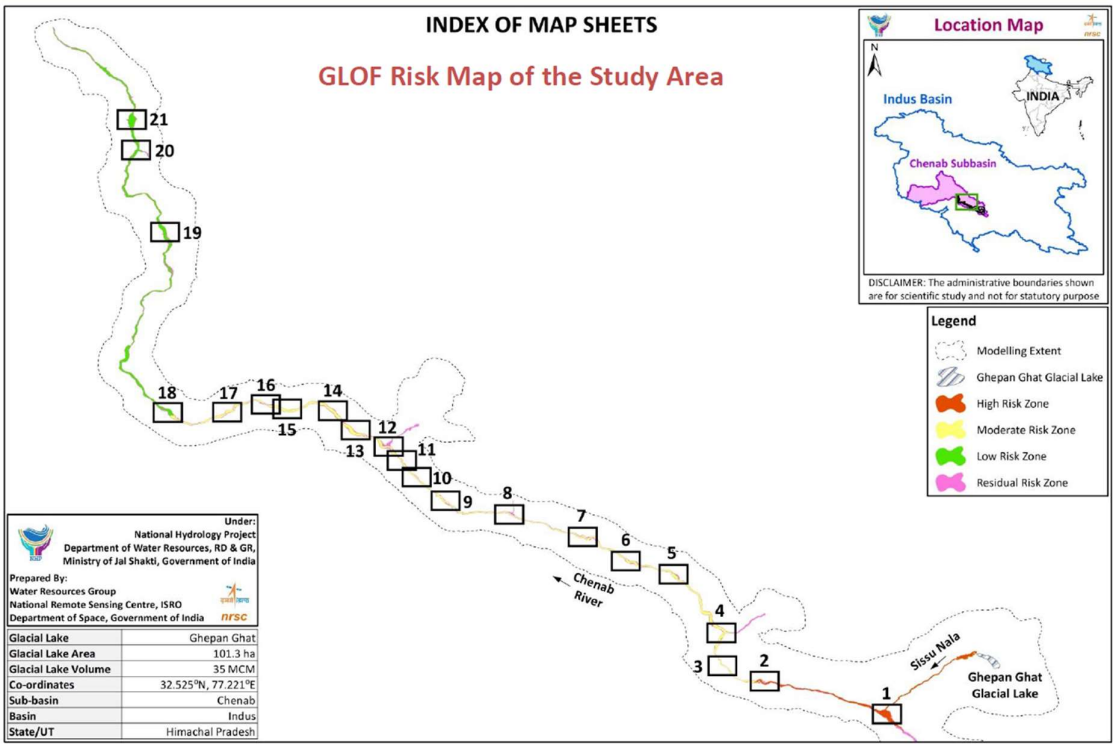


Fig. 8: Flood zonation downstream of Geepang Gath glacial lake.

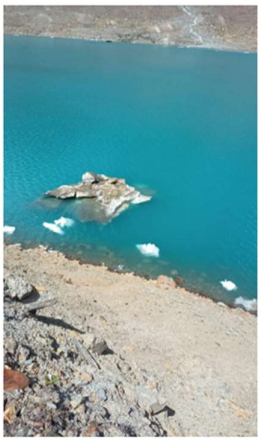


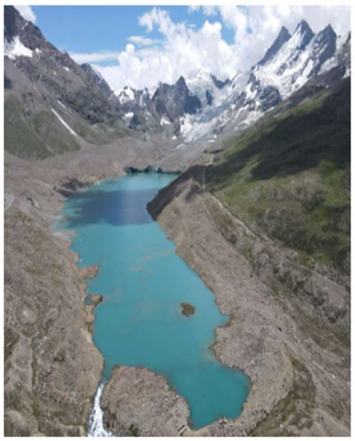
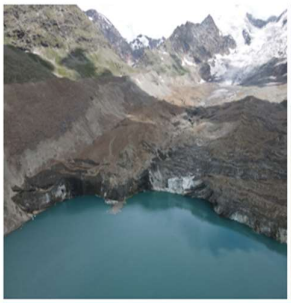
6. Conclusion

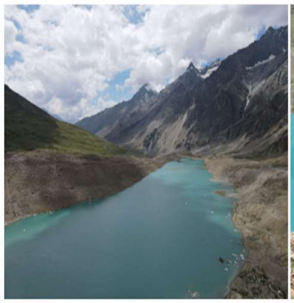
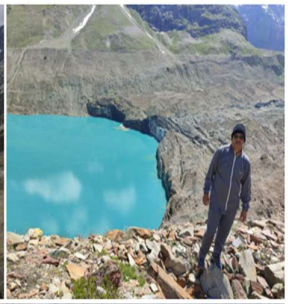
The present study has made it possible to make an attempt to visualize the impact of flood water in case of bursting of the Ghepang Gath glacial lake and its damage on different landforms unit along the river course. There are a few settlements identified in the red zone area. The highway along the river Chandra and many other infrastructures shall be affected. It also affects the agricultural land, forest and grassland within 300 meters of the flood zones of the study area. Based on the satellite data interpretation there do not seem to be any threat from the Ghepang Gath Lake at present but in future it may burst. So, monitoring and evaluation should be done time to time. This would help in making a prior assessment of the damages likely to occur and thereby planning accordingly in the light of the Himalayan conditions. Also it is worthwhile to mention that in case of any seismic activity, especially above 6+ on Richter scale, the risk of GLOF increases manifold.

Glimpse of the Field Expedition



New Cuttings

एक्सपर्ट टीम करेगी घेपन झील का मुआयना

झील फटने के संभावित खतरे से निपटने को केंद्र और राज्य सरकार तैयार

अशोक राणा-केतांग

हिमाचल के लाहुल स्पीति, किन्नौर और कुल्लू में समुद्रतल से 4714 मीटर की ऊंचाई पर बनी ग्लेशियर झीलों की पड़ताल के लिए उच्च स्तरीय विशेषज्ञों की टीम रैकी करेगी। यह दल लाहुल-स्पीति की घेपन लेक, किन्नौर की वास्पा अप्सट्रीम और सतलुज के साथ कुल्लू की पार्वती झील की गहन पड़ताल करेंगे। घेपन लेक अभियान के लिए टीम बुधवार को निकलेगी। दल में विक्रम गर्ग, कमलेश पवार, डाक्टर भानु प्रताप, डाक्टर विनय कुमार और डा. प्रदीप चतुर्वेदी विशेषज्ञ टीम में शामिल होंगे। इस टीम को सहायक आयुक्त संकल्प गौतम और डीएफओ अनिकेत चानवे की टीम बैकअप देगी। सैटेलाइट इमेजेज के आधार पर घेपन लेक का दायरा बढ़ने का दावा किया गया है। जिस कारण इस झील के टूटने से लाहुल में आपदा की स्थिति उत्पन्न होने की भी आशंका जाहिर की गई है। लिहाजा किसी आपदा से पहले इस जासदी से बचने के लिए केंद्र और राज्य सरकार ने यह पहल की है। 4098 मीटर की ऊंचाई पर स्थित मौजूदा समय में घेपन झील 92 हेक्टेयर क्षेत्र में फैली हुई है। उपायुक्त लाहुल स्पीति राहुल कुमार ने बताया कि घेपन लेक एक्सपिडीशन में देश के जाने माने भू-गर्भ और ग्लेशियर पर शोध करने वाले वैज्ञानिकों की टीम शामिल हैं। एक्सपिडीशन के दौरान टीम घेपन लेक से जुड़े कई महत्वपूर्ण पहलुओं पर स्टडी करेंगे। जिनमें झील की गहराई, बेरिया स्ट्रेथ, मोरेन-डेम हाइट एंड विडथ, झील में जल स्तर, क्षेत्र की जिलोजीकल स्थिति, भू-स्खलन और एवलांच की संभावना जैसे

- 92 हेक्टेयर में फैली है ग्लेशियर झील

करीब 20 महत्वपूर्ण बिंदुओं पर गहन जांच करेंगे। उपायुक्त राहुल कुमार ने बताया कि घेपन झील की बारीक निरीक्षण के बाद इस पर विस्तृत रिपोर्ट तैयार कर केंद्र और राज्य सरकार को सौंपी जाएगी। ताकि समय रहते किसी प्राकृतिक आपदा से बचने के लिए धरातल पर ठोस कदम उठाया जा सके। टीम 24 से 26 जुलाई तक घेपन लेक में जांच करेंगी। **एचडीएम**

विशेषज्ञों ने घेपांग घाट झील का किया मुआयना

टीम राज्य आपदा प्रबंधन प्राधिकरण को देगी रिपोर्ट, झील का स्तर बढ़ने को लेकर कार्य योजना कर रहे तैयार : डीसी

संवाद न्यूज एजेंसी

केलांग (लाहौल-स्पीति)। लाहौल-स्पीति के उपायुक्त अमृतवर्ष में उच्च स्तरीय विशेषज्ञों की टीम ने घेपांग घाट ग्लेशियर झील का मुआयना किया।

डीसीलाहुल सावीन के आधार पर घेपांग घाट ग्लेशियर झील का सर्वेक्षण यानिमें ने दावरा बढ़ने का दावा किया गया है। इस कारण इस झील के जलस्तर में बढ़ोतरी होने से आपदा की स्थिति उत्पन्न होने की भी आशंका जताई जा रही है।

आपदा न्यूनीकरण को लेकर राज्य और केंद्र सरकार ने इसको लेकर पहल की है।

संभावित खतरे से प्रभावी तौर पर निपटने के लिए कार्य योजना भी तैयार की जा रही है। घेपांग घाट झील जिला लाहौल एवं स्पीति में समुद्र तल से लगभग 4,098 मीटर की ऊंचाई पर है।

हिमालय की दूसरी ग्लेशियर झीलों की तरह घेपांग घाट झील का भी तेजस्वरूप खतरा पर खतरा बढ़ता जा रहा है। लिहाजा जिला आपदा प्रबंधन प्राधिकरण की ओर से इस झील के सामने वाले क्षेत्र और भोगदार पर भी फ्रोस से निगरानी रखी जा रही है।

उपायुक्त ने कहा कि घेपांग झील एक्सपिडीशन में भू-गर्भ और ग्लेशियर पर शोध करने वाले वैज्ञानिकों की टीम ने सीन दिनासीय दौरा किया। इस दौरान टीम ने घेपांग झील से जुड़े महत्वपूर्ण पहलुओं का अध्ययन किया। इसमें मुख्य रूप से झील की गहराई, बेरिया स्ट्रेथ, मोरेन-डेम की ऊंचाई और चौड़ाई, झील का जल स्तर, क्षेत्र की जियोलॉजिकल स्थिति, भू-स्खलन और हिमस्खलन की आशंका जैसे करीब 20 बिंदुओं का अध्ययन किया गया।

घेपांग झील का बारीकी से निरीक्षण के बाद इस पर विस्तृत रिपोर्ट तैयार कर राज्य आपदा प्रबंधन प्राधिकरण को सौंपी जाएगी।

विशेषज्ञों की टीम ने 24 से 26 जुलाई तक घेपांग झील में जांच की। उपायुक्त ने कहा कि राज्य आपदा प्रबंधन प्राधिकरण की ओर से इस झील के क्षेत्र में प्रारंभिक चेतावनी प्रणाली विकसित करने की संभावनाएं तलाशने की कवायद शुरू की गई है।125 सदस्यों की रैकी दल में सहायक आयुक्त संकल्प गौतम, डीएफओ अनिकेत चानवे आदि मौजूद रहे।

एक्सपर्ट टीम करेगी घेपन झील का मुआयना

झील फटने के संभावित खतरे से निपटने को केंद्र और राज्य सरकार तैयार

जलवायु परिवर्तन

हिमाचल में पिघल रहे ग्लेशियर

प्रदेश सरकार करवाएगी चार ग्लेशियरों का अध्ययन, जुलाई में भेजेगी टीम

विशेषज्ञों ने घेपांग घाट झील का किया मुआयना

टीम राज्य आपदा प्रबंधन प्राधिकरण को देगी रिपोर्ट, झील का स्तर बढ़ने को लेकर कार्य योजना कर रहे तैयार : डीसी

Disaster mgmt authority conducts expedition to Gepang Gath Lake

DIPENDER MANTA

MANDI, JULY 27

In response to the recent catastrophic Glacial Lake Outburst Flood event at South Lhonak Lake in Sikkim, the National Disaster Management Authority has mandated a comprehensive study of potential glacial lake hazards across Himalayan states. The Himachal Pradesh State Disaster Management Authority has initiated a detailed investigation into high-risk glacial lakes, including the Gepang Gath glacial lake.

A team led by Lahaul and Spiti Deputy Commissioner Rahul Kumar conducted an extensive field expedition from July 24 to 26, focusing on the Gepang Gath Lake, which is situated at an altitude of approximately 4,098 meters (32°31'N 77°13'E). The expedition aimed to assess various parameters crucial for early warning systems and risk mitigation.

The DC said that key aspects studied during the expedition included lake dimensions and barrier strength, moraine characteristics and water discharge, outflow and water level measurements, geology and valley slopes, risks of cloud bursts, landslides, and rockfalls, presence of ice core in the moraine and lake depth, downstream slope, soil, rock, vegetation, and infrastructure, turbidity and proximity to habitations.

"The Central Water Commission (CWC) examined the lake's outlet and evaluated the feasibility of establishing an early warning telemetry system. Drone-based GIS mapping was carried out in collaboration with the Lahaul Spiti district administration, producing high-resolution images for detailed analysis and risk assessment," he added.

"The National Centre for Polar and Ocean Research and IIT Bombay joined the expedition to study the glacier's response to climatic changes. NCPOR conducted a bathymetric survey for volumetric analysis, while the Jal Shakti Vibhaag collected turbidity samples from," he said.

Officials inspect Gepang Gath Lake in Lahaul and Spiti. TRIBUNE PHOTO

Glacial lakes in Sangla, Kashang to be surveyed

KINNAUR, JULY 27

The District Disaster Management Authority (DDMA), Kinnaur, conducted a meeting at the Deputy Commissioner's office to discuss the survey of glacier lakes in Sangla and Kashang regions.

During the meeting, DC Amit Kumar Sharma announced that a survey of glacier lakes will be carried out with a team from the Central agency C-DAC arriving in Kinnaur on August 1. The team will be accompanied by members from NDRF, SDRF police, Home Guards, Dogra Scouts, ITBP, Health Department doctors, and other members.

He said the main objective of this survey is to conduct a thorough study of these lakes from various perspectives. The survey aims to assess potential future threats that these lakes might pose to the surrounding areas. He directed the relevant departments to take appropriate measures to ensure the success of this mission.

Among others present at the occasion were Superintendent of Police Abhishek Si, ITBP Commandant Basant Negi, Kalpa Sub-Divisional Magistrate Major Shashank Gupt, Home Guards Commandant Pankaj Sharma, District Health Programme Offic Anvesha Negi and disast management officials. — OC