सत्यमेव जयते

Goverment Of India

NATIONAL GLACIAL LAKE OUTBURST FLOODS (GLOF) RISK MITIGATION PROGRAMME

(NGRMP)

PHASE-1

National Disaster Management Authority (NDMA)
Government of India

Contents

<u>**Executive Summary**</u>

Background

The receding and melting of mountain glaciers, the expansion of existing glacial lakes, and the formation of new glacial lakes are among the most recognizable impacts of global warming in the Indian Himalayan Region. As glaciers retreat, melt waters occupy depressions earlier occupied by glacier ice leading to the formation of glacial lakes or ice 'dams'. Because of the inherent instability of such "dams," they are prone to sudden failure or breach, which can be caused by various factors such as earthquakes, GLOFs, avalanches, overtopping, rock-fall, and slope failure. Such outbursts, which can discharge millions of cubic metres of water and debris in a few hours and cause catastrophic devastation and flood up to hundreds of kilometres downstream, are considered Glacial Lake Outburst Floods (GLOFs). The states and union territories of Jammu and Kashmir, Ladakh, Arunachal Pradesh, Sikkim, Himachal Pradesh, and Uttarakhand are particularly susceptible to GLOF hazard.

Objectives of the Programme

The primary objectives of the programme are:

- Prevent loss of life and reduce economic loss and damage to critical infrastructure due to GLOF and similar events.
- Strengthening the early warning and monitoring capacities based on last mile connectivity.
- Strengthen scientific and technical capabilities in GLOF risk reduction and mitigation at local levels through strengthening local level institutions and communities.
- Use of indigenous knowledge and scientific cutting-edgemitigation measures to reduce and mitigate GLOF risk.

Approach

This is essentially a National Programme, and it is the responsibility of the states to identify lakes, to plan mitigation, execute and implement the projects successfully at the regional and ground level. This programme also meets the risk reduction goals of the Sendai Framework for Disaster Risk Reduction (2015-2030). The national programme will be implemented in phases as GLOFs are site-specific, and their vulnerability varies according to the geographical, geological and geodynamic conditions and vulnerability of people and assets (infrastructure, settlements etc.) in the downstream areas. Four Himalayan states and two union territories have been identified for project implementation in Phase-I viz. Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Jammu & Kashmir, and Ladakh.

Components

In the National Programme on GLOF Risk Reduction and Mitigation, four components have been identified:

Component 1:GLOF Hazard and Risk assessment (elaboration of standardized assessment method and a lake inventory): A comprehensive risk and vulnerability assessment of GLOFs is of utmost importance in managing the risk of GLOFs. Creation of glacial lake inventory and recognizing their risks adopting a standardized method (Aligned with the NDMA GLOF guidelines 2020)is required for monitoring and to assess GLOF risks for all involved agencies, hazard susceptibility assessment of vulnerable glacial lake and risk evaluation of dangerous glacial lakes are the priority task under this component to prioritise the early warning system.

Component 2: GLOFMonitoring and Early Warning System (including remote sensing data, community involvement for monitoring, alerting/ dissemination): This component will harness the complementary strengthsof remote sensing techniques, with advanced technologies like seismometers to detect tremors at an early stage, water level sensors, cameras, trigger lines etc.,to monitor risk prone glacial lakes, design and implement codified warning system using smartphones and siren towers placed at strategic downstream locations of the risk prone lakes to avoid loss of life and property. The activities will also include promoting and implementing acommunity-centric glacial lake monitoring and early warning system.

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Component 3:GLOF Mitigation Measures (Site-specific interventions combining technical expertise and community involvement): Based on field assessments undertaken for high-risk glacial lakes, and leveraging the indigenous knowledge, appropriate mitigation measures such as reinforcing or strengthening of unsafe moraine dams, draining of lake waters through siphoning, controlled blasting, excavation of artificial drainage channels, etc. may be designed and implemented.

Component 4: Awareness Generation & Capacity Building (involving stakeholders at multiple levels): This componententails raising awareness among relevant stakeholders about GLOF hazard, risk, and potential hazard mitigation measures. Comprehensive Community Based GLOF Risk Awareness Programme,Preparation of Contingency Action Plan to Reduce GLOF Risk and research and development are the major activities that are covered under this component.

Budget

The First Phase of the Programme will be implemented with a budget of ₹150 crores (comprising Rs. 135 crores from NDMF and 15 crores as States' share, excluding UTs budget) during April 2023 to March 2026 (Table A).It will be funded by NDMF for States whereas it will be funded by regular Union Territory (UT) Grants for two UTs. States' share will be applicable as per extant NDMF guidelines. Details of allocation for components of the programme are given in the following Table A:

Table A:Component and Activity-wise budget allocation for Phase-1 (FY 2023-24 to 2025-26):

	Component	Activities	Ratio in %	Budget (Ratio in %)
1	GLOF Hazard and Risk Assessment	A.Creation and Updation of glacial lake inventory and Classification	20	15
		B. Hazard, Vulnerability and Risk Assessment of Glacial Lakes	80	
2	Glacial Lake Monitoring &	A.Glacial Lake Monitoring	20	

			80	35
	GLOF Early Warning System	B. Early Warning System	80	35
3	Site Specific Intervention	A.Structural measures	70	40
		B.Non-Structural Measures	30	
4	Awareness Generation and Capacity Building	A.Community Based GLOF Risk Awareness and Preparedness Programme	25	10
		B. Preparation of Contingency Action Plan to Reduce GLOF Risk	25	
		C. Research & Development (R&D) (Small Grant Window)	50	
	Total			100

Allocation of funds among components/sub-components have been mentioned in terms of percentage of gross allocation. State-wise distribution of funds is indicated in Table B. States will divide allocated fund among components and sub-components as per ratio shown in Table-A. There could be flexibility for re-allocation of fund across sub-components of a component by States as per respective requirement; however, the fund allocation across components may be inter-changeable only with approval of NDMA on reasonable ground shown by the State.

NRSC has identified total 7570 glacial lakes within Indian territory under National Hydrology Project funded by MoJS in 2017 (Table-1). Out of these lakes, though some risky glacial lakes have been identified NRSC, CWC, SDC (as mentioned at Para 1.3, 1.4, 1.5), this activity was done based on remote sensing. Also, this data does not cover all of 7570 glacial lakes. Hence, this data needs ground validation before taking up any mitigation activity for these risky lakes. Hence, total number of glacial lakes has been considered for budget allocation under this programme rather than number of risky glacial lakes in each State/UT (Table-11).

The state wise details of allocations for the period from FY 2023-24 to 2025-26 (Phase - 1) is given in Table B:

Table-B: State-wise Distribution of Budget

Sl. No	State/UT	Number of Glacial Lakes*	Centre share (Rs. in crore)	State share (Rs. in crore)	Total Budget
1	Himachal Pradesh	537	31.5	3.5	35
2	Uttarakhand	347	27	3	30
3	Sikkim	733	36	4	40
4	Arunachal Pradesh	2,188	40.5	4.5	45
	Total	**7570**	**135**	**15**	**150**
5	Jammu & Kashmir (UT)	546			15
6	Ladakh (UT)	3,219			15

[* Source of data – NRSC-ISRO (Table-1)]

Project appraisal, approval and monitoring

The technical, financial and social aspects of the DPRs of the mitigation project will be appraised and reviewed by the Technical Advisory Committee (TAC) and Project Appraisal Committee (PAC), which are constituted at the NDMA and SDMA levels. TAC will be established to appraise projects from the technical and social point of view; conduct a technical review of projects sanctioned from mitigation funds and recommend improvement. After the TAC has completed its technical evaluation, the Project Appraisal Committee (PAC) will appraise the project from an administrative and financial standpoint. NDMA will provide technical assistance to any project approved under NDMF/ SDMF and publish the finding on the mitigation portal.

NATIONAL GLACIAL LAKE OUTBURST FLOODS (GLOF) RISK MITIGATION PROGRAMME (NGRMP)

1. Background

1.1. **Glacial Lakes:**Glaciers are a common geomorphological feature in the snow-capped high mountain regions of the world. The Indian Himalayan region is home to over 5160 glaciers (WWF, 2009). Siachen, Gangotri, Zemu, Milam, Bhagirathi Kharak and Satopanth are some important mountain glaciers in the Indian Himalayan region.Glaciers are sensitive to changes in climate and are apparent indicators of climate warming (Zemp, 2019). The Indian Himalayan Region (IHR) is facing important challenges in view of coping with the adverse effects of climate change. Like many other mountain regions worldwide, the IHR is particularly sensitive to changes in global climate from both a physical and societal perspective (Allen et al. 2020). Physically, the disappearance of mountain glaciers and the expansion of large glacial lakes are amongst the most recognizable and dynamic impacts of climate warming in this environment.Across the IHR, the numbers and areas of glacial lakes have rapidly increased due to a warmer climate during the last century (Ives et al. 2010; Gardelle et al. 2013; Zhang et al. 2015; Carrivick and Tweed 2016). According to Nie et al. (2017), the number and area of glacial lakes in IHR have increased by approximately 8.8% and 14%, respectively, between 1990 and 2015.In the catchment area of the Himalayan region, there are 503 glacial lakes and 1525 water bodies with a water spread area of more than 10 ha situated between 500 and 4000 meters above mean sea level. The receding and melting of mountain glaciers, the expansion of large glacial lakes, and the formation of new glacial lakes are among the most recognizable impacts of global warming in the Indian Himalayan Region.

1.2. **High Risk Glacial Lakes:**As glaciers retreat, meltwater occupies the depression earlier occupied by glacier ice leading to the formation of glacial lakes or ice 'dams'.Because of the inherent instability of such "dams," they are prone to sudden

failure or breach, which can be caused by various factors such as earthquakes, GLOFs, avalanches, overtopping, rock-fall, and slope failure.Such outbursts, which can discharge millions of cubic metres of water and debris in a few hours and cause catastrophic devastation and flood up to hundreds of kilometres downstream, are consideredGlacial Lake Outburst Flood (GLOF). The GLOF can be formed either underneath, at the side, in front, within, or on the surface of a glacier and related dam structures and can be composed of ice, moraine, or bedrock, that can seriously damage the life, property, agriculture, livestock, forests, ecosystems and livelihoods of downstream communities of the glacial lake.
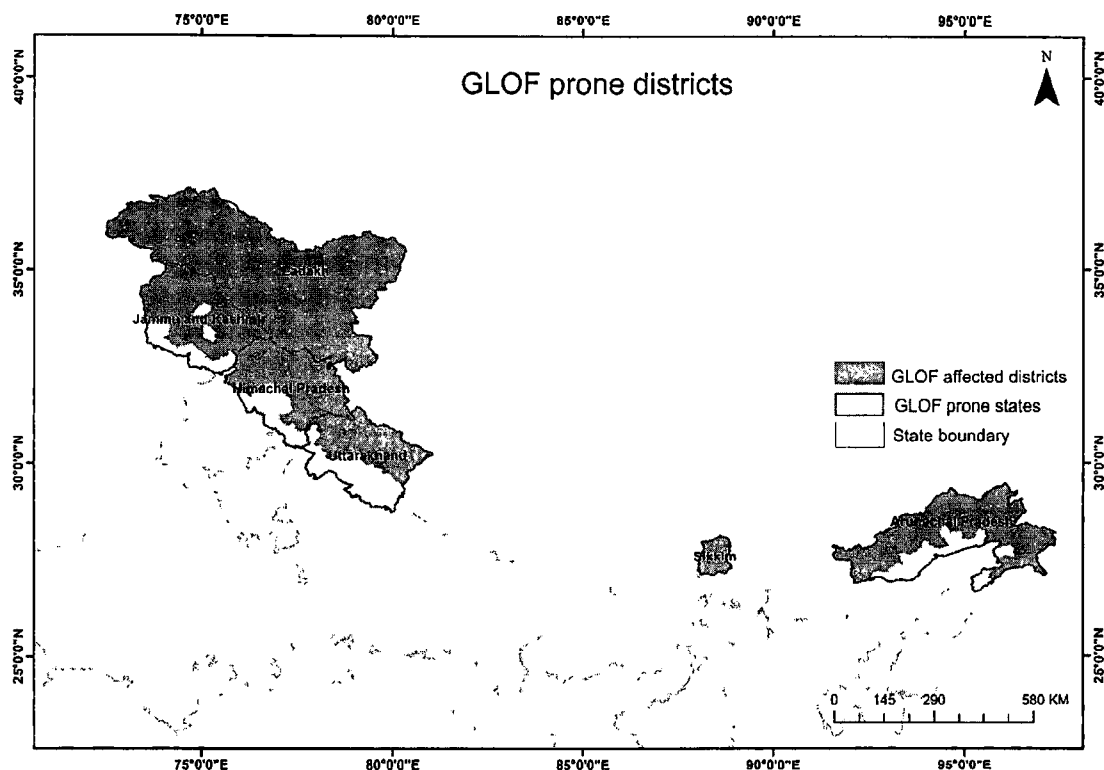
Figure 1: GLOF Prone areas

1.3. Inventory&Risk Ranking of Glacial Lakes under National Hydrology Project, 2017 by NRSC-ISRO:

A. Inventory

During 2017, NRSC has taken up National Hydrology Project (NHP) sponsored by Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga

Rejuvenation (DoWR, RD&GR), Govt. of India. As part of NHP, NRSC carried out inventory of Glacial Lakes of size ≥0.25ha for entire catchment area of Indian Himalayan River Basins (Indus, Ganga and Brahmaputra) covering ~9.6 lakhs sq.km using high resolution Resourcesat-2 LISS4 MX satellite data of (majorly from 2016-2017 period) and mapped 28,043 glacial lakes. Using the glacial lake database, basin-wise Glacial Atlases for Indus, Ganga and Brahmaputra Rivers and Integrated Atlas of Indian Himalayan River Basins were brought out and are web published for access & download (https://www.nrsc.gov.in/Atlas_Glacial_Lake). The atlases present the details of glacial lakes in terms of area, type and elevation and administrative unit wise (within India & Trans-boundary). Out of 28,043 glacial lakes inventoried in entire catchment area of Indian Himalayan River Basins (Indus, Ganga and Brahmaputra), about 7,570 glacial lakes are present within Indian administrative region and 20,473 glacial lakes are located in trans-boundary region.

Table 1: State/UT-wise list of Glacial Lakes in Indian Territory (NRSC, NHP, 2017)

S.No	State/UT	Number of Glacial Lakes
1	Arunachal Pradesh	2,188
2	Sikkim	733
3	Himachal Pradesh	537
4	Uttarakhand	347
5	Jammu & Kashmir (UT)	546
6	Ladakh (UT)	3,219
	Total	7,570

B. Ranking of Glacial Lakes (in descending order of **GLOF risk**)

The inventoried glacial lakes were ranked by NRSC based on the risk profile in two-step process, i.e. preliminary screening and ranking.

- Preliminary screening of glacial lakes was carried out based on four parameter criteria sequentially comprising lake type (moraine, ice-dammed & cirque-erosion types are considered), area of lakes above one ha, lakes associated with glacier and lakes with settlements enroute river reach.

- After preliminary screening, ranking is done based on the following set of parameters of glacial lakes:

  o Lake type

  o Lake area

  o Distance between glacier snout and glacial lake inlet

  o Slope between glacier snout and glacial lake inlet

  o Distance between glacial lake outlet and the nearest settlement/infrastructure

  o Slope between glacial lake outlet and the nearest settlement/infrastructure

  Using above parameters, weights were calculated and using statistical approach (unequal weight method) glacial lakes were ranked in descending order of risk.

- The above ranking process is completed for Indus and GangaRiver basins and for Brahmaputra Riverbasin it is in progress.

- The following 2 tables provide a list of ranked glacial lakes in Indus and Ganga River basins and their details (rank, coordinates and lake area) are given in AnnexureB. It is also mentioned that the same work for Brahmaputra Basin is under process.

Table 2:List of 614 ranked Glacial Lakes in Indus River Basin

S.No	State/UT	Ranking
1	Himachal Pradesh	90
2	Uttarakhand	1
3	Jammu & Kashmir (UT)	75
4	Ladakh (UT)	263
5	Transboundary Region	185
	Total	614

Source: NRSC

Table 3:List of 864 ranked Glacial Lakes in Ganga River Basin

S.No	State/UT	Ranking
1	Uttarakhand	61
2	Transboundary Region	803
	Total	864

Source: NRSC

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A detailed list of the district-wise distribution of glacial lakes in India is enclosed in **Annexure-A.** A detailed list of the distribution of 614 risky glacial lakes in Indus River Basin and 864 risky glacial lakes in Ganga River basin is enclosed in **Annexure-B.**

1.4. High Risk Glacial Lakes– Collaborative Study by NDMA and Swiss Development Cooperation (SDC)

Govt. of India signed a Memorandum of Understanding for cooperation in disaster management with Govt. of Switzerland. Under this MoU, a report 'Synthesis Report on GLOF Hazard and Risk across the Indian Himalayan Region' has been prepared by University of Zurich, Switzerland. In this report, 56 glacial lakes have been identified as critical lakes in the country. The distribution of these high-risk glacial lakes is shown in Table-4. As per the report Sikkim has the maximum number of high-risk lakes (25) followed by Jammu & Kashmir (18). The details of the state-wise high-risk glaciers are annexed as Annexure-C.

Table 4. State-wise distribution of high-risk glacial lakes

States	No. of High-Risk Lakes
Jammu and Kashmir	18
Himachal Pradesh	8
Uttarakhand	4
Sikkim	25
Arunachal Pradesh	1
Total	**56**

Source: SDC
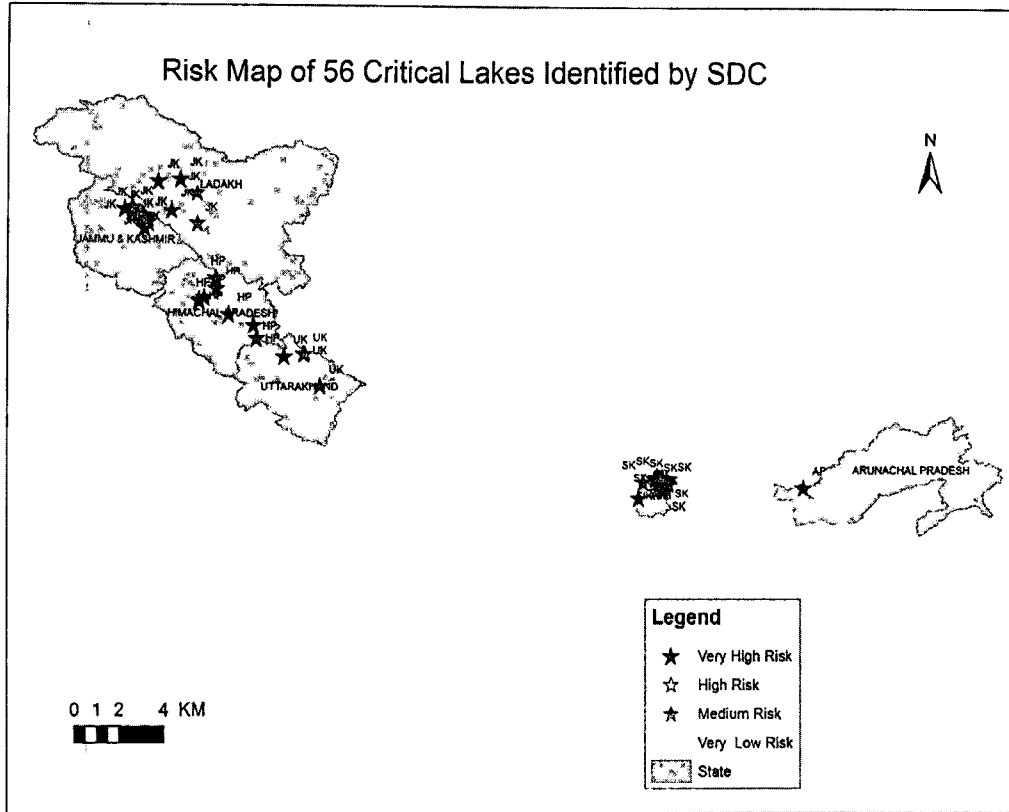
Figure 2: Map showing Risk Map of 56-Critical Lakes Identified by SDC

1.5. Assessment of Eight Glacial lakes by CWC:

As mentioned at Para 1.4, wherein 56 lakes in the 6 States/UTs in Indian Himalayan Region (IHR) have been identified as high priority lakes by Swiss agency for Development and Co-operation (SDC), these lakes are being monitored through remote sensing by CWC from 2022. The monitoring reports for the month of June-2022, July-2022 and August-2022 have already been shared on CWC website.

Further to assess the potential impact from these lakes in the downstream area, a first order hazard assessment has been undertaken by CWC. The methodology adopted is similar to that of SDC. Initially, eight lakes have been analysed on a 30m DEM (SRTM) in four States/UTs. The State-wise simulated flow propagation path from these lakes, which has been overlaid on

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population density layer may be obtained from CWC. A summary of this assessment is attached as Annexure-D.

1.6. Glacial Lake Monitoring:

National Remote Sensing Centre (NRSC)/ISRO, Hyderabad carried out inventory of glacial lakes & water bodies of size greater than 10 hectares using Resourcesat-1 Advanced Wide Field Sensor (AWiFS) of 56 m spatial resolution satellite data of 2009 and 2,028 were mapped. Glacial lakes and water bodies of size > 50 ha(477 number) were monitored using AWiFS satellite data for the months of June to October from 2012 to2016. During 2015, NRSC imparted necessary training & technical handholding to Morphology & Climate Change Directorate, Central Water Commission (CWC)for monitoring of glacial lakes using satellite data. Since 2016, CWC is internally carrying out the monitoring Glacial lakes (>50ha) using satellite data and periodic monthly reports are web published (http://www.cwc.gov.in/glacial-lakeswater-bodies-himalayan-region). Now the Central Water Commission has reviewed its strategy and it ismonitoring glacial lakes of ten hectares and above.

1.7. Threat to Local People:

The presence of glacial lakes in the Himalayan region makes them a potential threat to the inhabitants of the Himalayas, particularly in the states and union territories of Jammu and Kashmir, Ladakh, Arunachal Pradesh, Sikkim, Himachal Pradesh, and Uttarakhand. The Indian Himalayan region has seen some of the worst events of disasters due to glacier and ice melt in the recent years, profoundly affecting the lives and livelihoods of people living in these regions. Despite these losses, disaster risk management related to GLOFs has not been mainstreamed into development policies and programmes.

1.8. Purpose of aMitigation Programme:

Currently, no Ministry or Department of the Government of India has any scheme for mitigating GLOF risks. Because of the rapidly growing number of glacial lakes, there is a need to prepare a comprehensive inventory of glacial lakes and catalogue all mass movements that can play a crucial role in hazard and risk assessment. Such an inventorization can be undertaken by selected institutions at the State / UT level, such as the Department of Geoinformatics, Kashmir University and DGRE-DRDO for J&K and Ladakh, HIMCOSTE for Himachal Pradesh, Uttarakhand Space Application Centre (USAC) / IIRS and NIH-Roorkee for Uttarakhand, Department of Science and Technology for Sikkim, NESAC and State Remote Sensing Application Centre (SRSAC) for Arunachal Pradesh to prepare a

comprehensive database of glacial lakes at State / UT level on GIS platform by taking inputs from work done by the NRSC-ISRO and Central Water Commission (CWC). Identification of vulnerable and potentially dangerous glacial lakes through remote sensing technology can be undertaken based on the condition of lakes, dams, associated parent glaciers, and topographic features around the lakes and glaciers. The methodology used to identify the vulnerable lakes may be based on field observations, processes, and records of past events, geomorphologic and geotechnical characteristics of the lake/dam and surroundings, and other physical conditions.

Due to a lack of initiative and resource crunch, most states have not undertaken any programme/ scheme for GLOF Risk Management as suggested in the Guidelines issued by NDMA on GLOF. As a result, the Government of India must take proactive measures since the problem of GLOF is focused primarily in backward and mountainous areas in North and North-Eastern India and states under special categories. Invariably, they do not have the resources to formulate GLOF risk management projects under the State Plan. Central agencies like BRO carry out mitigation activities regarding GLOF on their border roads. Similarly, individual Central Public Sector Units (CPSUs) of the power sector only take up mitigation projects in areas prone to GLOF within the power project area.

This programme has taken a holistic approach to mainstream GLOF Risk Reduction and Mitigation for implementation through identifying drivers/project proponents. This program is proposed to be driven by science and technology with local-level initiatives to strengthen the state machinery. It aims to provide all the necessary support to the concerned states and UTs for holistically and sustainably addressing the risk associated with GLOF. Participation of the local community is essential for the overall project's success and enhances ownership of outcomes and infrastructure generated under the program.

The National Programme on GLOF Risk Reduction and Mitigation attain and addresses all elements of prevention, preparedness and mitigation to avert or soften the GLOF risk. It covers institutional mechanisms, disaster prevention strategy, early warning system, disaster mitigation, preparedness, and human resource development for GLOF risk mitigation and management.

1.9. Causes of GLOF Occurrence in India

The presence of glacial lakes in the Himalayan region makes them a potential threat to the inhabitants of the Himalayas, particularly in the states and union territories of Jammu and Kashmir, Ladakh, Arunachal Pradesh, Sikkim, Himachal Pradesh, and Uttarakhand. The Indian Himalayan region has seen some of the worst events of disasters due to glacier and ice melt in the recent years,profoundly affecting the lives and livelihoods of people living in these regions.Despite these losses, disaster risk management related to GLOFs has not been mainstreamed into development policies and programmes.

Like other mountain ranges throughout the world, the Indian Himalayan Region (IHR) is currently facing the most serious risks from climate change and global warming, which are causing mountain glaciers to melt and resulting in the expansion of glacial lakes as well as the formation of new glacial lakes.Most of the Hindu Kush Himalaya is experiencing glacial retreat and melting as a result of global warming, which has resulted in the construction of numerous new glacial lakes with the potential to cause catastrophic glacial lake outburst floods.IHR is located in Seismic Zones IV and V, which makes the area extremely vulnerable to earthquakes. This leaves the glacial lakes vulnerable to breaches, releasing rapid, potentially deadly floods affecting the downstream communities. The most prevalent type of moraine Dam Lake in the Himalayan region is particularly susceptible to weakness and unexpected breaches, which might release millions of cubic metres of water and debris.This is accompanied by other disturbances like avalanches and falling boulders, making the glacial lakes vulnerable to breaches, unleashing sudden, potentially disastrous floods in the nearby communities. People who live downstream of unstable glacial lakes are at a serious risk of losing their lives and possessions.

The most common reasons for GLOF occurrences are rapid slope movement into the lake, heavy rainfall and snowmelt, cascading processes, earthquakes, melting of ice and forming the dam, obstruction of subsurface outflow tunnels, and long-term dam degradation. Other factors that exacerbate the dangers and risks associated with moraine-dammed glacial lakes include their enormous volume, narrow and high dams, stagnant glacier ice inside the dams, etc.

1.10. Occurrences of GLOF and their Impacts in India

Historically, GLOF has created much massive destruction in the Himalayan region. Since 1900, 150 GLOF events have been documented in the Himalayas. Incidents of flash

floods and cloudbursts have become quite frequent in all Himalayan states and UTs. In the past also, GLOF occurrences have occurred in these states and UTs, where they had a significant physical impact. However, their socio-economic impact was minimal because they occurred in sparsely populated terrain. There are quite a few reported events in Himachal Pradesh and Sikkim of GLOFs/flash floods/GLOF-induced river damming outbursts. Nevertheless, with increasing population and tourist destinations, the socio-economic impacts of GLOFs are increasing. Table 5 shows details of some of the GLOF occurrences and their impacts.

Table 5: Major GLOF disaster occurrence in the country

S. No.	Incident	Year	District	State	Loss & Damage
1	Shyok glacier GLOF	1926	Reasi district	Jammu & Kashmir	-
2.	Nyoma GLOF	1971	Leh	Ladakh	13 to 16 fatalities
3	Shaune Garang glacier GLOF	1981,1988	Kinnaur	Himachal Pradesh	-
4	Flash floods and cloud bursts	2000	Kinnaur	Himachal Pradesh	-
5	Domkhar GLOF	2003	Leh	Ladakh	Destroyed farmland and infrastructure
6	Parechu outburst flood	2005	Sutlej Valley, Kinnaur	Himachal Pradesh	Considerable damage to livelihoods, houses, roads, and bridges
7	Kedarnath Disaster	2013	Rudraprayag	Uttarakhand	5000 people killed & ~70,000 homeless
8	Gia	2014	Leh	Ladakh	damaged several agricultural terraces, a concrete bridge, & few houses

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| 9 | Chamoli flash floods | 2021 | Chamoli | Uttarakhand | - |

In the past, GLOF occurrences have occurred in Ladakh as well, where they had a significant physical impact.However, their socio-economic impact was minimal because they occurred in sparsely populated terrain. There are quite a few reported events in Himachal Pradesh and Sikkim of GLOFs/flash floods/GLOF-induced river damming outbursts.

1.11. Objectives of the Programme

The primary objectives of the programme are:

- Prevent loss of life and reduce economic loss and damage to critical infrastructure due to GLOF and similar events.
- Strengthening the early warning and monitoring capacities based on last-mile connectivity.
- Strengthen scientific and technical capabilities in GLOF risk reduction and mitigation at local levels through strengthening local-level institutions and communities.
- Use of indigenous knowledge and scientific cutting-edge mitigation measures to reduce and mitigate GLOF risk.

1.12. Approach

This is essentially a National Programme, and it is the responsibility of the states identified to plan, execute and implement the programme successfully at the regional and ground level. This programme also meets the risk reduction goals of the Sendai Framework for Disaster Risk Reduction (2015-2030). The national programme will be implemented in phases as GLOFs are site-specific, and their vulnerability varies according to the geographical, geological and geodynamic conditions and vulnerability of people and assets (infrastructure, settlements, etc.) in the downstream areas. Six Himalayan states and one union territory have been identified for project implementation in phase-1.

1.13. Project Partners

The concerned ministries, institutes/ organisations, and stakeholders will provide technical and implementation support to the programme. NDMA will explore the possibility of a partnership with the following:

Ministries:
1. Ministry of Mines (MoM)
2. Ministry of Earth Science (MoES)
3. Ministry of Roads Transport & Highways (MoRTH)
4. Ministry of Panchayati Raj (MoPR)
5. Ministry of Rural Development (MoRD)

Government Organizations:
1. Central Water Commission (CWC), MoWR
2. Geological Survey of India (GSI)
3. India Meteorological Department (IMD)
4. National Remote Sensing Centre (NRSC)
5. Indian Institute of Remote Sensing (IIRS)
6. North-Eastern Space Application Centre (NESAC)

Academic, Research and Training Institutes
1. National Skill Development Cooperation (NSDC)
2. National Institute of Hydrology (NIH), MoWR
3. National Centre for Polar and Ocean Research (NCPOR), MoES
4. Centre for Development of Advance Computing (CDAC)
5. Defence Geoinformatics Research Establishment-Defence Research and Development Organisation (DGRE-DRDO)
6. National Institute of Disaster Management (NIDM)

This proposal envisages a programme-based approach. Proposals from the states, organizations, institutions, departments, etc. will be appraised technically and financially at the state and national level before being approved by the competent authority.

2. Components of the National Programme on GLOF Risk Reduction & Mitigation

Recognizing that GLOF hazard is relatively new and emerging, holistic risk reduction strategies have not been formulated. Only a limited set of activities to mitigate the risks posed by the hazard have been implemented. In order to address this emerging hazard, comprehensive mitigation strategies are needed. In the National Programme on GLOF Risk Reduction and Mitigation, four components are incorporated:

- GLOFRisk and Vulnerability Assessment.
- Development, Integration & Dissemination (DID) of GLOF Early Warning System (EWS)and Monitoring.

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- Adopt site-specific mitigation measures with community involvement.
- Awareness Generation and Capacity Building.

2.1. Component –I: GLOF Hazard and Risk assessment

National Remote Sensing Centre (NRSC) had completed a project during 2011-15 on **"Inventory and Monitoring of Glacial Lakes / Water Bodies in the Himalayan Region of Indian River Basins"**, sponsored by Climate Change Directorate, Central Water Commission (CWC), New Delhi, Govt. of India. Under this project, glacial lakes and water bodies located in all three major river basins viz., Indus, Ganga, and Brahmaputra including trans-boundary region were mapped with a water spread area of size greater than 10 ha.Glacial lake extent change monitoring for lakes of size greater than 50 ha (477 glacial lakes and water bodies) has been carried out by NRSC from 2011 to 2015 during monsoon period of June to October on monthly basis. Since 2016, the CWC has continued the monitoring of 477 glacial lakes on a monthly basis.

A comprehensive risk and vulnerability assessment of glacial lakes is of utmost importance in managing the risk of GLOFs. Identifying potentially dangerous glacial lakes and recognizing their risks, including the ranking of the critical lakes, has become a priority task. The Geological Survey of India (GSI) and Defence Research & Development Organization (DRDO) carried out a risk assessment for South Lhonak Glacier Lake in Sikkim, incorporating various remote sensing techniques and field investigation. The NDMA Guideline on GLOF (https://ndma.gov.in/sites/default/files/PDF/Guidelines/Guidelines-on-Management-of-GLOFs.pdf) includes the mapping the current status of the glacial lakes, identification of new glacial lakes, identification of vulnerable and potentially dangerous glacial lakes, the nature of susceptibility of the lake and the modelling of the flood scenario, arrival time, inundation depth, discharge estimation etc.TheIndus, Ganga and Brahmaputra Rivers and Integrated Atlas of Indian Himalayan River Basins were brought out and were web published by NRSC-ISRO (https://www.nrsc.gov.in/Atlas_Glacial_Lake) (para 1.3). States may work upon this data. Further the report 'Synthesis Report on GLOF Hazard and Risk across the Indian Himalayan Region, prepared by NDMA and SDC may also be referred to (para 1.4).

A. Creation and updating glacial lake inventory and classification-

A1. Inventory:A glacial lake inventory is a comprehensive record of the location and characteristics of all the glaciated lakes. Preparing a comprehensive inventory of all glaciated lakes is a prerequisite for understanding the location and possibility of GLOF events. Due to many lakes' remote and inaccessible locations and their widespread geographical coverage, advanced spatial technologies can be used to generate the inventory. Based on the condition of the lakes, dams, associated parent glaciers, and topographic features surrounding the lakes and glaciers, various remote sensing technologies can be used to identify vulnerable and potentially dangerous glacial lakes.It is also possible to use advanced remote sensing techniques to identify glacier lakes, particularly for supraglacial lakes and small glacial lakes (less than 100 sq. m), which are typically found in distant locations and are challenging to monitor manually. The updated status (increased size, risk profile etc.) of the lakes, which are already included in the inventory, can be added. Furthermore, high-resolution satellite images can be used to classify glacial lakes and associated glaciers by combining manual, semi-automatic and automated classification methods. It is also possible to use methods for analysing remote sensing data using the Object-Based Image Analysis (OBIA) method. Identification of GLOF lake Outburst Flood (LLOF) potential sites along the river is also important and can be done during the project implementation.It will be necessary to incorporate and update the historical GLOF locations mentioned in earlier research reports and journal articles for identifying potential glacial lakes. This enables the early identification of potential hazards and can support risk management strategies and mitigation plans. Creating a GIS-based GLOF System and interactive, user-friendly glacial lake risk maps will be the primary outputs. Remote sensing techniques can be used to identify crucial glacial lakes and predict the possibility of future outbursts and glacial lake outburst floods by taking into account a variety of glacial lakes, glaciers, and local physical conditions and accordingly can be classified.

A2. Lake Classification: The glacial lakes should be classified according to different factors responsible for GLOFs, such as the lake area, lake growth, glacier and lake proximity, dam characteristics, the effect of mass movements and impact on the downstream locality. These factors play a significant role in identifying and evaluating the risk of potentially dangerous glacial lakes.The lake classification can be done based

on the size, stability and hazard proneness. Updated lake information and classification will help prioritize the preparedness or mitigation strategies.

States will build an inventory of glacial lakes in consultation with CWC, NRSC, and GSI. States may also appoint any Institute/University/Agency for this purpose. In this regard standard data set format, suggested by CWC may be followed, with local modification, as required. Required satellite images may be taken from NRSC. State may conduct field visit for necessary field validation of the satellite data.

Drawing upon these databases of States/UTs andalso on the existing database of NRSC/CWC, a national database may be built by CWC. This database may be improved further as a GIS-based Glacial Lake Information System with user-friendly features, interactive, and fieldvalidated data.

B. Hazard susceptibility assessment of vulnerable glacial lakes and risk evaluation:

Susceptibility ofvulnerable lakes includeselements such as the rapid expansion of glacial lakes, size of glacial lakes, strength of morainebarriers,seepages from the lakes, active slides in the morainic barriers and probability of rock and snow avalanches.The first level of hazard potential assessment can be done using remote sensing techniques; followed by detailed field investigation for high-risk glacial lakes. Various remote sensing techniques can be used to generate spatial information of glacier lakes, which has the potential to outburst floods. The Normalized Difference Water Index (NDWI) and Normalized Difference Snow Index (NDSI) are automated methods for detecting water bodies, including glacier lakes, using satellite imagery.Although the automatic classification approach can more quickly identify glacial lakes, it cannot be used throughout the entire region because of the uncertainties brought on by climatic and physical processes. In such circumstances, a manual delineation method based on visual image interpretation can be used to map alongside other physical features.Digital Elevation Model (DEM) can be used to extract topographic information about glacial lakes and their associated terrain and to understand the physical characteristics of glaciers, moraines, and surrounding places. High-resolution Digital Elevation Models can provideinformation like Lake Boundary delineation and other accurate surface information.The mapped glacial lakes should be checked, validated, and modified using reference imageries like Google Earth Imageries, aerial photographs and through field surveysfor better spatial accuracy. Field surveys,geotechnical andgeological investigations

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and slope stability assessments can be done to understand the physical aspects. Attribution of the glacial lake inventory needs to be done based on physical and other characteristics of the glacier. The details like area, elevation,type of lake (moraine-dammed, ice-dammed, or bedrock-dammed) etc. can be updated in glacial Inventory. The stability survey of the lateral and terminal moraines would also help evaluate the risk of GLOFs.

Risk evaluation of GLOF can be done by bringing in vital information in areas downstream of the glacial lakes. The downstream flood path and maximum downstream travel distance for each GLOF path can be determined using empirical models. Risk evaluation can be done by combining sophisticated hazard modelling and mapping with the on-ground assessment of vulnerability and exposure of different asset types, mainly in the lakes' downstream areas. Large-scale data that can be used to characterize exposure to GLOFs with vulnerable elements includepopulation, village locations,forest areas, cultural heritage sites, tourism sites and hotels, agricultural land areas, wetland areas, transport infrastructure, and hydropower stations.The risk evaluation can be done using the satellite imageries like Sentinel imageries (10m spatial resolution) and LANDSAT imageries (30m spatial resolution). Categorization of the potentially dangerous lakes would be an additional benefit to strategize monitoring and EWS. Augmenting Information on extreme rainfall/snowfall events may help to the GLOF risk and vulnerability Assessment.

Risk identification is essential to plan mitigation. Considering emerging threat of GLOF hazard, risk assessment needs to be completed in a time bound manner. State may choose lake for risk evaluation. They may appoint any agency for such assessment in consultation with CWC, GSI. CWC may prepare an SOP for all the states for conducting such risk evaluation.

States may use data from sources like NRSC, CWC and SDC (as mentioned at Para 1.3, Para 1.4, 1.5). However,it is noteworthy that these data had beenacquired by remote sensing. Therefore, suitable field verification needs to be carried outbefore initiating any mitigation activity. States may appoint any agency for such assessment in consultation with CWC, GSI.

Table 6: Component 1 - Expected Output – Outcome, and Success Indicator

Sl. No.	Activity	Output	Outcome	National Budget (22-5) & Success Indicators
A.	Creation and updation of glacial lake inventory and classification	• Develop template/format of the database. • Classify Glacial Lakes based on the severity, size and volume of debris generated by a particular GLOF. • Compilation of Glacial Lake data. • Update existing data.	A standard glacial Lake database with risk classification.	Budget – 4.5 cr Each State/UT will prepare its database, which may be integrated by CWC for a pan India Database
B.	Hazard susceptibility assessment of vulnerable glacial lakes and risk evaluation	• Identify risky Glacial Lakes. • Study of an identified Glacial Lake, its moraine characters, geotechnical assessment. • Mapping all other causative factors for GLOF occurrence. • Conduct a detailed risk assessment of downstream elements at risk. • Prepare GLOF modeling of lakes. • Design model flood wave run-outs. • All critical infrastructures in high-risk areas are mapped. • Compile and evaluate data on risk scenarios. • Evaluate the geotechnical GLOF resilience of major infrastructures. Design model flood wave runouts • Conduct a detailed risk assessment of downstream elements at risk. • Identify various elements exposed to GLOF risk.	Multi-hazard risk maps of study area on the GIS platform and GLOF modelling of lakes.	Budget – 18 cr All Risky Lakes are identified

2.2. Component II: GLOFs Early Warning System (including remote sensing data, community involvement for monitoring, alerting/ dissemination)

Effective monitoring of hazard and early warning systems are an important part of disaster preparedness; they have the potential to greatly reduce loss of life and property. The four critical elements for a successful EWS for GLOF are Risk Knowledge, Site-specific risk assessment, Monitoring and Warning Services, Dissemination and communication, and Response capability(NDMA GLOF Guideline, 2020).The key challenges of establishing effective Early Warning for glacial lakes in the Indian Himalayan Region include remote

locations, unstable terrain, and limited information regarding the risk scenario.The system must be installed in the lake basin, which needs to be technically sound, simple to operate, easy to maintain or replace, and reliable to give accurate and timely warnings. This system includes sophisticated interconnected techniques such as remote sensing techniques, seismometers to detect tremors at an early stage, water sensors and a codified warning system using smartphones and siren towers placed at strategic locations of the lake downstream. Maximum efficacy is most likely achieved if local communities are involved in the various stages of the operation of the system.

The Component involves two sub-components:

A.   Glacial Lake Monitoring:

Monitoring of glacial lakes involves remote sensing, aerial observations, and field study at particular intervals. Moreover, monitoring critical lakes may require direct periodic observation. This should be carried out with all stakeholders: communities, government departments, institutions, agencies, broadcasting media, and others. As many of these processes are more likely to occur during the monsoon months, cloud cover can prevent the use of optical remote sensing. In order to overcome this situation, microwave remote sensing techniques like RADAR and LIDAR can be employed, which work in all weather conditions.

Unmanned Aerial Vehicles (UAV), or drone-based images have gained attraction in recent years due to their advantages over traditional remote sensing platforms in glaciological studies to overcome the disadvantages associated with satellite remote sensing. UAVs can produce regular, low-cost aerial photographs of glacial zones in high resolution. Synthetic-Aperture Radar (SAR) imagery and LiDAR techniques are also used to monitor glacial lakes. Recent hardware and software developments have resulted in accurate 3D mapping and ortho-images with preferred spatial and temporal resolution in various glacial studies.

Field investigations, including topographical and bathymetric mapping, hydro-meteorological observations, and geological, geophysical and glaciological surveys, may be carried out for high-priority/vulnerable lakes. Drones and other unmanned aerial vehicles (UAVs) provide powerful tools for efficiently combining on-site fieldwork and remote sensing techniques.

B. Early Warning System:

There may be two kinds of early warning system:

(i)   Community-based Early Warning System -

Citizen Science application for environmental monitoring can also be appropriately harnessed for GLOF monitoring. It is essential to design an application for smartphones allowing citizens to record critical environmental parameters, such as lake water levels, fragments of ice/debris from moraines in the river waters, unusual turbid nature of water, damming/ blockage of the river body by mass wasting, cracking sounds from the glaciers upstream, etc. Engaging communities in scientific monitoring makes them more likely to respond positively to any warnings or alerts. In addition, guides and porters employed by private/ semi-government agencies are regular visitors to the glacial lakes. Hence, human resource can be amalgamated into the monitoring after suitable training and registration for effective surveillance and reporting of the glacial lakes.

Community participation in early warning systems is crucial for preventing fatalities and minimizing injuries and ecological damage caused by disaster events. It is the process of including communities in collecting, assessing, monitoring, and disseminating hazard risk information. Community orientation and community-based systems need to be seamlessly integrated into the administrative information dissemination mechanisms. Guidelines should be developed to promote better understanding and response to warnings generated at the community level especially the population residing along the major rivers. The communities will be provided with technical assistance installing the early warning system's operation and integration. Mock drills can be conducted in consultation with line departments for various scenarios using the installed EWS to ensure its usability by involving relevant stakeholders. The warning dissemination protocols should ensure last-mile connectivity or community ownership as, more often than not; the people living in remote and hazard-prone areas have to withstand the worst of these disasters. Efforts must also be undertaken to document and build on traditional warning dissemination techniques within communities and include them in the proposed EWS. Furthermore, the EWS must address local communities' key concerns and needs.

The effectiveness of EWS can be gauged from the speed of community response. It must be imparted that greater community orientation and community-based systems need to be seamlessly integrated into the administrative information dissemination mechanisms. Guidelines to promote better understanding of and response to warnings generated at community level should be developed.

Involvement of local community in the EWS process could help in many ways like, the shepherds and others can inform rest of the people if any unusual things are noticed.

This kind of involvement will developa sense of ownership for the installed EWS infrastructure.

(ii) Sensor Based Early Warning System-

Early Warning systems consist of different instruments like water level gauges, cameras, trigger lines, integrated with sirensystems, and distributed hand mikes to the local task force and the downstream communities. Automatic Weather Station and GLOF sensors in the lake area, audio GLOF sirens, and siren nodes and services for upstream are part of the GLOF early warning system. Water level recorders for continuous or distinct measurements of water levels, automated devices such as pressure sensors and contact-less sensors can be used for water level measurements and recording and can be incorporated into an automated monitoring system. Water level sensors installed along the banks of the river channel immediately downstream of the lake outlet can be used to detect the onset of a breach of glaciated lakes. Integration of dual sensors (pressure based and radar-based) for water level may be more practically useful. The real-time data transmission is the backbone of EWS, however, real-time data transmission has some issues especially in bad weather conditions, therefore, a backup system may be kept. In addition to the traditional methods of water level sensors, the satellite altimeter and LIDAR can also be used for basin-level water level monitoring of glacier lakes and downstream rivers.

States will identify risky glacial lakes and its basin area on priority basis. In this regard they can refer to data on risky lakes as mentioned at para 1.3 as identified by Scientists of NRSC-ISRO, and as mentioned at para 1.4/Para 1.5, as identified by Scientists of University of Zurich and Scientists of CWC. Accordingly, after risk analysis, States may prioritize sites for early warning and/or site-specific intervention for mitigation. State may call for Expression of Interests (EoI) from universities/institutes/agencies and may engage them for preparing DPR and implementing EWS following due procedure. The EWS may be integrated with Common Alert Protocol (CAP) of NDMA for dissemination of alert message.

Further, it may be noted that early warning at any site is a continuous process until the lake bursts or vulnerable people and existing infrastructure is shifted to a safer place. Therefore, a long-term plan and budget support for maintenance is required. Hence, the implementation contract needs to have a long-term perspective for maintenance. The

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implementing agency needs to have the capacity to support it for a longer period. The extant NDMF/SDMF guideline is applicable for repair and maintenance of the instruments.Always a cost-benefit analysis should be carried out before taking up any mitigation activity especially a EWS or other costly structural mitigation measures. Rehabilitation may be a simpler and cheaper solution sometimes.

Table 7: Component II-Expected Output, Outcome and Success Indicators

Sl. No.	Activity	Output	Outcome	Budget (52.5 cr) and Success Indicators
A.	Glacial Lake Monitoring	• Ensure near real-time monitoring of lake • Site suitability analysis for installation of AWS & AWLR • Utilize InSAR for repeated monitoring • Prepare Alarm & Evacuation Protocol by involving existing Hydro-power project	A comprehensive monitoring system in the State	Budget – 10.5 cr. Each State/UTdevelops a comprehensive monitoring system
B.	Early Warning Systems	• A low-cost, and simple technology community based EWS is set up • A few sensor based EWS are set up • Ensure last-mile connectivity through SMS and sirens • Establish rainfall database locally	An EWS is set up in each State/UT Last mile connectivity is ensured	Budget – 42 cr. A community based EWS and at least one sensor based EWS is set up for each State/UT

2.3. Component III: Site Specific Intervention

Site Specific mitigation measures for can be divided broadly in two parts, such as A. Structural Measures and B. Non-Structural Measures.

A.   Structural Measures:

Adopting appropriate structural measures is the most direct physical way to reduce the risk of glacial lake outburst floods. This typically involves building remediation structures on the lake itself and improving slope stability or lowering the water level to reduce potential peak discharge, and hydrostatic pressure on the dam is included in structural measures (Shrestha et al., 2012).

Most of the Risk Mitigation measures are not viable and feasible because of high cost and poor understanding of the local community about the measure. Risk mitigation measures need to be properly evaluated and assessed from the point of view of their efficacy to contribute towards risk mitigation in the identified areas/communities. Detailed assessment of the valley terrain, community settlements, width and topographical ingredient of the river/water channel should be made. Some simple mitigation measures which can be in the form of informal embankments or creation of natural barriers like plantations, boulders, spurs etc. for protection of precious assets. However, care must be taken to ensure that plantations do not begin to act as barriers obstructing the smooth flow of water and debris during a GLOF or flash flood event. Nevertheless, they should be planned to break the force, thrust and devastation potential of water body towards human habitations or other precious socioeconomic and development infrastructure as well as religious and cultural monuments of national heritage. This plantation activity should be through community participation to increase the sense of ownership among the communities.

Geo-Engineering measures such as reinforcing or strengthening dangerous moraines are the most effective in relieving or controlling the risk of GLOF disasters. *Artificial dams* can be built to strengthen the loose moraines and holdback the lake water. Further *artificial drainage channels* can be excavated to channelize the water to the nearby localities to solve their potable water issues or water need for other household or agricultural purposes through *artificial exit tunnels, concrete steps and pipelines*.This is an artificial way of lowering the water level of from vulnerable glacial lakes through *controlled breaching*. Installation of an **outlet control structure**, and tunnelling through the moraine barrier or beneath an ice dam. The impact of snow avalanche on glacial lakes can be protected through some engineering measures like **avalanche galleries, tunnels, Wedge like structures**. These lake waters can also be channelized and utilized for **hydroelectric power generation**. Pipes can be used to channelize the water to the required places. In case of open channels, concretization of both the sides of the channel is required. The concrete steps can help reduce the speed of the water flow on the steep terrains.

Artificial lowering of water level from vulnerable glacial lakes by controlled breaching, installation of an outlet control structure, pumping or siphoning out the water from the lake, and tunnelling through the moraine barrier or beneath an ice dam are some indicative measures.

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Moreover, structural mitigation measures are also needed to be applied downstream to protect infrastructure and settlements from unexpected floods. In order to choose appropriate structural mitigation measures, a detailed investigation should be done. Thus, choosing an appropriate method for each lake will be based on detailed geological, geomorphological, glaciological, and geotechnical investigations.

B.   Non-Structural Measures:

Some site-specific non-structural measures for GLOF risk Reduction can be as following. For Example -**First**is to reduce the melting rate of the ice sheets, **second is**to reduce the water level of the lake, and **third**is to strengthen the lake surrounding moraines.

The first objective of reducing the snow water-meltingrate can be achieved by *growing Moss or Algae cover on the glaciers*. Normally it is seen that, if the ice or snow surface is covered with any dark material it enhances the melting. Normally the englacial or supra glacial debris and black carbon is known for inducing the glacial melt. However, the Moss colonies can reduce the temperature of the substrate up to 2 degree centigrade. Therefore, growing the moss colonies on the ice and the surrounding rocks can help reduce the ambient temperature and consequently melting rates of the ice sheets.

The second objective is to lower the lake water level can be done through siphoning. *Pumping and siphoning out water* from the lakes on regular basis especially during the summer months can help maintain the lake water level and reduce the spilling risk. This low cost adopted measure can lower the lake water level.

For millions of years, evolution has allowed life to develop a broad variety of slime, gooey substances that provide animals and plants with the ability to survive, adapt, and reproduce. Secretion of some of the plants and animals can work as the adhesives. Some of the *ectotherms, barnacles, mussels and corals* can act as the rock-binding agents. In addition, these have capabilities to thrive in the extreme temperatures at the mountain glacial lakes. If these are planted on moraines of the glacial lakes, they can create the cementing effect on loosemoraines. This will help to stabilize the end moraines naturally, which can ultimately create a natural dam for the glacial lakes.

Land Use Planning to Identify the Risks: It is essential to introduce concepts and practices related to land use planning and management at community and local administration level. This will help identify hazard-prone and vulnerable areas and prevent location of high value individual, community and development assets in these areas. Common people should be able to recognize the hazard zones easily and develop an understanding of the importance of land use planning concepts and practices in their day-to-day lives. The risks posed by GLOFs, for example, to what level the water could reach, what are the vulnerable structures in the path of a potential flash flood etc. need to be factored into the development planning process in vulnerable valleys. Promoting land use management is also critical in safeguarding socio-economic assets and development projects, which constitute the mainstays of economies of many of the mountain areas.

Mainstreaming DRR into Development Planning: Countries in the Himalayan region have been investing vast resources for developing socioeconomic and infrastructural assets like dams, hydel projects, bridges etc. With increasing hydro-meteorological hazards due to the impact of climate change, incorporating risk reduction elements into the development planning process will ensure their safety and sustainability. The development plans, national and/or local, formulated for mountain areas, must seek to mainstream risk reduction concerns to insulate the development process from recurrent GLOF hazards. For example, it is important to use the principles of land use planning while making plans on where exactly to lay the highways and bridges in the GLOF shadow areas and ensure incorporation of risk reduction elements to make them hazard resistant. Incorporating DRR into developmental planning forms an essential component of sustainable development and must also be communicated and established at community level.

Sustainable Natural Resource Management: Afforestation and Sustainable natural resource management including water/watershed management must be incorporated into risk mitigation strategies to protect the Himalayan ecosystem. It is well known that mountain communities are overwhelmingly dependent upon natural resources. Their lives and livelihoods are closely related to and intimately dependent upon the natural resources available in their vicinity. Connecting risk mitigation measures with natural resource management efforts will also help secure stronger buy-in and interest from the communities and make them more sustainable.

In order to choose appropriate mitigation measures, for each lake, detailed geological, geomorphological, glaciological, and geotechnical investigations are necessary. States will identify risky glacial lakes and its basin area for such investigation. In this regard they can refer to data on risky lakes as mentioned at para 1.3 as identified by Scientists of NRSC-ISRO, and as mentioned at para 1.4/Para 1.5, as identified by Scientists of University of Zurich and Scientists of CWC. Accordingly, after risk analysis, States may prioritize sites for early warning and/or site-specific intervention for mitigation.

States may appoint agencies for preparing DPR, implementing the mitigation measures etc. following due process. At the same time, States should ensure enactment of necessary land use regulations, building codes and compliance thereof.It is expected that in first phase of this programme States will take up at least ten risky glacial lakes for mitigation activity.

Table 8: Component III-Expected Output, Outcome and Success Indicators

Sl. No.	Activity	Output	Outcome	Budget (60 cr) and Success Indicators
A.	Adopt Site-specific Structural Mitigation Measures	• Slope stability of moraine dams • Controlled breaching • Construction of an outlet control structure (concrete steps & pipeline) • Construction of Artificial Drainage Channels • Artificial Exit Tunnel through the moraine barrier or under an ice dam. • Avalanche galleries & other avalanche preventing structures beside the lakes • Hydroelectric power stations	GLOF risk mitigated for the glacial lake.	At least 10 Critical Lakes are mitigated in each State/UT
B.	Adopt Site-specific Non-Structural Mitigation Measures	• Reduced ice melting • Controlled lake water level • Stable end moraines • Land Use Regulation • Compliance of Building Codes • Mainstreaming DRR in developmental activities		

1.4. Component IV: Capacity Building and Awareness Generation

The awareness and capacity building concept's fundamental goal is to provide a comprehensive education and training programme that is geared towards communities, stakeholders, scientists, and academic institutions. It deals with launching awareness of GLOF hazard and risk reduction and sensitizing all stakeholders on hazard mitigation. This involves raising awareness about glacial lakes, their characteristics, the level of hazards, and the required responses during and after GLOF events.Sensitization of GLOF risk information and early warnings to individuals and communities threatened by hazards will be essential to the awareness programme. The local community members in the catchment and downstream areas need to be sensitized to GLOF risk and early warning systems.

Experience has shown that hazards in one country have the potential to create a disaster in a downstream one. For example, a GLOF event in Bhutan or Nepal could have an impact in India and Bangladesh downstream. This is especially true in the context of the fact that disasters do not recognize boundaries as evidenced during the Kashmir earthquake in 2005 and Kosi floods in 2008 in the region. These incidents require greater cooperation between countries in the region in terms of monitoring, sharing data and disseminating timely warnings to countries/communities likely to be impacted. Satellite observations indicate that GLOF in one country have the potential to cause considerable devastation in neighbouring Himalayan countries, including the countries in riverine plains. Hence, it necessitates greater coordination between countries in the region in terms of joint monitoring, sharing of data, developing risk mitigation and preparedness strategies. Administrative integration among government departments, public sector agencies, NGOs and civil bodies should be given special attention to integrating activities related to creating awareness and preparedness.

A. **Community Based GLOF Risk Awareness and Preparedness Programme-** Community-level awareness programmes should be undertaken on a regular basis to sensitize people to the threat of GLOF.An awareness drive should be conducted to specific target groups, including communities in the downstream areas,and vulnerable groups, including women, children and senior citizens.Simple tools can be applied to encourage and make communities awareof GLOF hazard awareness. It includes awareness songs and movies on disaster risk reduction in the local language, painting and debate competitions on flash floods

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in local schools, the use of traditional and folk mediums on hazards, etc.A culture of risk reduction and resilience can be significantly cultivated by making easy efforts to lower risks and improve preparedness for disasters during local fairs and festivals.This can also be done through extensive awareness creation and mock drills, including on the Early Warning System related to GLOF. This will help to enhance the confidence level of the communities in GLOF. Administrative integration among government departments, public sector agencies, NGOs and civil bodies should be given special attention to integrating activities related to creating awareness and preparedness. A holistic and collaborative approach towards trainingand awareness building should be adopted to develop action plans to spread awareness andpreparedness measures to the last mile.

NIDM will prepare detail scheme of such training/capacity building programme in consultation with stakeholders. States may conduct this sensitization and awareness generation programs with the support of identified SIDM/other agencies/institutes/NGOs at the regional and local levels. One such training programme has to be conducted in each identified GLOF risk prone village area annually. Also State may create a community village taskforce in those areas converging it with 'Aapda Mitra' Scheme of NDMA.

B. Preparation of Contingency Action Plan to Reduce GLOF Risk:

Preparing a contingency action plan for susceptible glacial lakes and collaborating with concerned local bodies/communities and other stakeholders can reduce and minimize GLOF risk. Communities must be sensitized, orientated, and trained to build participatory disaster management plans that define what needs to be done before, during, and after a disaster. Creating task forces to handle particular needs must also be a part of the contingency planning procedure. The identification of tasks for certain members, as well as their capacity building, to accomplish those activities must be considered in the plan. Emergency evacuation routes and shelters need to be identified and should be ingrained into the minds of the people. These could be done by simple tasks like painting the village map along the emergency evacuation routes and shelters onto the walls of community building where everyone can see it on a regular basis. States will prepare a contingency action plan involving community and stakeholders.

C. Research and Development (R&D) (Small grant window):

This programme also aims to invest for research and development activities to promote

in-house innovation.Research grant will be provided to Universities/Institutes to promote innovations in GLOF risk mitigation.

Activities should be related to the following:

    a. GLOF Modelling and Prediction
    b. Early warning system,
    c. Network telemetry
    d. Development/improvement of BIS codes,
    e. Bio Restoration
    f. Bio-engineering
    g. Engineering Solution
    h. Risk assessment
    i. Application of remote sensing in DRR,
    j. Capacity building in DRR
    k. Application of Information Technology in DRR
    l. Non-Structural Measures
    m. Recent Progress in glacial lakes and GLOF patterns due to climate change
    n. GLOF triggers and GLOF susceptibility indicators
    o. GLOFs and human dimension context

NDMA will prepare detailed terms of reference in this regard. After circulation of the said terms of reference, Universities/Institutes may send proposal to NDMA for appraisal. NDMA may request the state, where the University/Institute is situated to release the fund as per extant NDMF guidelines. In case the fund is insufficient from the State, NDMA may ask any other State, having highest amount of balance fund for this sub-component, to release the fund from NDMF as per extant NDMF guidelines.

Table 9: Component IV-Expected Output, Outcome and Success Indicators

Sl.N o.	Activity	Output	Outcome	Budget (15 cr) and Success Indicators
1.	Community-Based GLOF Risk Awareness & Preparednes sProgramme	• Training modules/manuals for different target groups • Capacity building and local community awareness for local-level interventions to reduce GLOF risk. • Community participation is ensured. • Identified target participants among the elected members from Panchayat Raj Institutions (Local bodies)	• Enhanced adaptive capacity and create awareness in GLOF risk management	Budget: 3.75 cr One such training programme is conducted in each identified village/muni

				cipality annually.
		• Regular training sessions for specific skill development • NGOs/institutes for facilitation of training programme are identified • Recognized role and responsibilities of different stakeholders • A village task force in each village • Villagers are sensitised about the hazard, vulnerability and elements at risk in their respective villages and surroundings. • Ensured effective and prompt action to rescue and respond in the event of a disaster. • Skill development of the community through Indigenous knowledge and methods • Prepare contingency action plan • Training of stakeholders as per this plan		
2	Preparation of contingency action plan to reduce GLOF risk	• Prepare contingency action plan • Training of stakeholders as per this plan	A contingency Action plan prepared	Budget – 3.75 cr A contingency Action plan prepared by each State/UT
3.	Research and Development	• Supported individual scientific studies on GLOF or related subject • Facilitated the creation of knowledge sharing, networking and publication on GLOF risk reduction	Some indigenous measures developed	Budget – 7.5 cr Some indigenous and measures are developed

3. <u>Coverage of States & UTs</u>

The program will be focused on Himalayan States and Union Territories (UTs) in a phase-wise manner. Four states and two Union Territories are the country's vulnerable areas prone to GLOF. Two states, Uttarakhand, Himachal Pradesh,and two Union Territory, i.e. Jammu Kashmir and Ladakh, have been selected from the Western Himalaya. From

easternHimalaya, two states, Sikkim and Arunachal Pradesh, have been selected. Each of these vulnerable states mayhave prioritized districts for the project implementation-based vulnerability of the districts.
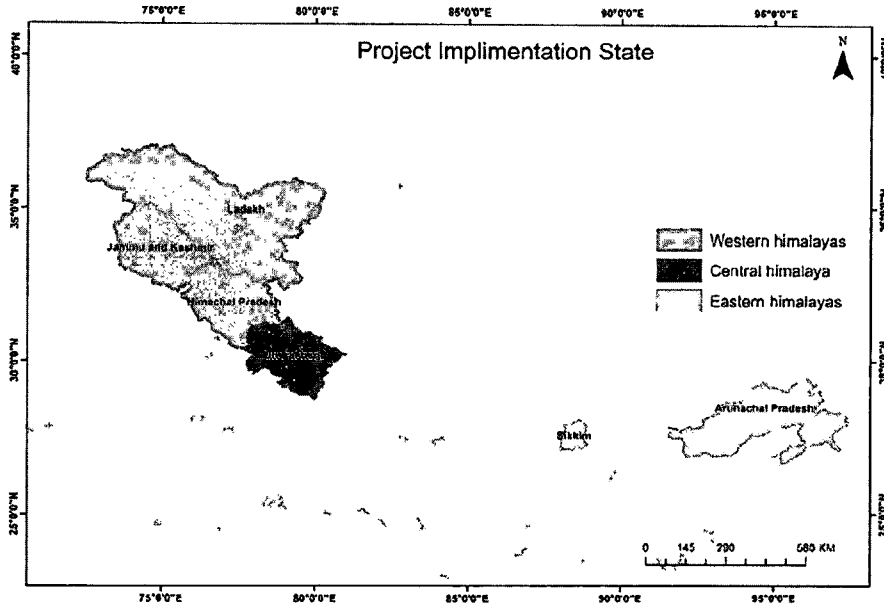
Figure 3: Project Implementation States

4. <u>Budget</u>

4.1. The Government of India has a policy commitment to reducing disaster risk by mitigation strategy. The 15th Finance Commission has recommended setting up Mitigation Funds at the national and state levels as the National Disaster Mitigation Fund and State Disaster Mitigation Fund consisting of 20% of the National Disaster Risk Management Fund (NDRMF) and State Disaster Risk Management Fund (SDRMF), respectively. The Finance Commission has allocated resources for the National Disaster Mitigation Fund and State Disaster Mitigation Fund. In addition,the 15th Finance Commission (XV-FC) has recommended Rs. 32,031 crore (20 % of the State Disaster Risk Management Fund (SDRMF) of Rs. 1,60,153 crore) for SDMF of States.

The total budget for all activities for the National GLOF Risk Mitigation Programme (NGRMP) in Phase-I is proposed to be ₹150 crores (comprising Rs. 135 crores from NDMF and 15 cr as States' share, excluding UTs budget) for three years from April 2023 to March

2026 (Table-10). The programme will be funded by NDMF for States whereas it will be funded by regular UT grants for UTs. States' share will be applicable as per extant NDMF guidelines.

This programme is also proposed to be implemented for UTs of Jammu & Kashmir and Ladakh as well. All components may be extended to them. An amount of Rs. 15 cr may be allocated to each of them.

Table 10: Component and Activity-wise budget allocation for Phase-1 (FY 2023-24 to 2025-26):

	Component	Activities	Ratio in %	Budget (Ratio in %)
1	GLOF Hazard and Risk Assessment	A.Creation and Updation of glacial lake inventory and Classification	20	15
		B. Hazard, Vulnerability and Risk Assessment of Glacial Lakes	80	
2	Glacial Lake Monitoring & GLOF Early Warning System	A.Glacial Lake Monitoring	20	35
		B. Early Warning System	80	
3	Site Specific Intervention	A.Structural measures	70	40
		B.Non-Structural Measures	30	
4	Awareness Generation and Capacity Building	A.Community Based GLOF Risk Awareness and Preparedness Programme	25	10
		B. Preparation of Contingency Action Plan to Reduce GLOF Risk	25	
		C. Research & Development (R&D) (Small Grant Window)	50	
	Total			100

Allocation of funds among components/sub-components have been mentioned in terms of percentage of gross allocation. State-wise distribution of funds is indicated in Table-11. States will divide allocated fund among components and sub-components as per ratio shown in Table-10.There could be flexibility for re-allocation of fund across sub-components of a component by States as per respective requirement; however, the fund allocation across

components may be inter-changeable only with approval of NDMA on reasonable ground shown by the State.

NRSC has identified total 7570 glacial lakes within Indian territory under National Hydrology Project funded by MoJS in 2017 (Table-1). Out of these lakes, though some risky glacial lakes have been identified NRSC, CWC, SDC (as mentioned at Para 1.3, 1.4, 1.5), this activity was done based on remote sensing.Also, this data does not cover all of 7570 glacial lakes. Hence, this data needs ground validation before taking up any mitigation activity for these risky lakes. Hence, total number of glacial lakes has been considered for budget allocation under this programme rather than number of risky glacial lakes in each State/UT (Table-11).

Accordingly, The state wise details of allocations for the period from FY 2023-24 to 2025-26 (Phase - 1) is given in Table-11:

Table-11: State-wise Distribution of Budget

Sl. No	State/UT	Number of Glacial Lakes*	Centre share (Rs. in crore)	State share (Rs. in crore)	Total Budget
1	Himachal Pradesh	537	31.5	3.5	35
2	Uttarakhand	347	27	3	30
3	Sikkim	733	36	4	40
4	Arunachal Pradesh	2,188	40.5	4.5	45
	Total	**7570**	**135**	**15**	**150**
5	Jammu & Kashmir (UT)	546			15
6	Ladakh (UT)	3,219			15

[* Source of data – NRSC-ISRO (Table-1)]

In addition, there will remain scope for further allocation of funds from NDMF based on States' performance. States are encouraged to utilize resources from SDMF also to enhance the scope of GLOF risk mitigation in line with this national programme.

Allocation from NDMF will be made at a proportion of 20%, 40%, and 40% of the total allocation in three FY 2023-24 to 2025-26. This allocation has been shown at Table 12. In addition to the budget, the fund flow for the project activities will be linked to outputs and

released in tranches as agreed by implementing partners. Subsequent installments may be released on utilization of 75% of funds released earlier. NDMA will have the authority to take all the financial decisions concerning unspent allocation or extension of projects with the approval of the Ministry of Home Affairs (MHA).

Table 12:State-wise details of the annual allocation

S. No.	States/UTs	ND MF (Cr)	State Share (Cr)	Total Budget (Cr)	FY 23-24			FY 24-25			FY 25-26		
					ND MF (Cr)	State Share (Cr)	Total Budget (Cr)	ND MF (Cr)	State Share (Cr)	Total Budget (Cr)	ND MF (Cr)	State Share (Cr)	Total Budget (Cr)
1	Uttarakhand	27	3	30	5.4	0.6	6	10.8	1.2	12	10.8	1.2	12
2	Himachal Pradesh	31.5	3.5	35	6.3	0.7	7	12.6	1.4	14	12.6	1.4	14
6	Arunachal Pradesh	40.5	4.5	45	8.1	0.9	9	16.2	1.8	18	16.2	1.8	18
	Sikkim	36	4	40	7.2	0.8	8	14.4	1.6	16	14.4	1.6	16
	Total	**135**	**15**	**150**									
16	Jammu & Kashmir	-	-	15	3			6			6		
17	Ladakh	-	-	15	3			6			6		

The release of the funds shall be subject to the submission of the following documents:

- Utilization Certificate for the funds released earlier, quarter-wise in the form prescribed.
- A Certificate regarding the requisite physical completion of works.
- A certificate that the grant released to the Scheme will be used for non-relief works only.
- A certificate that the state has a necessary budget provision in its plan to incur 25% of the expenses for the Scheme. The State share shall not be met out of funds available under SDMF

4.2. Account and Audit

a. The state NDMF account should distinctly show the source of receipt in the fund's name
- Central share of NDMF
- The state share of NDMF
- Returns on investment
- Redemption of investment
- Contribution from reconstruction bond/CSR/implementing partners/community, etc., if any
- Panel Interest (at bank rate or overdraft rate as the case may be)
b. The actual expenditure out of NDMF should be booked under respective Minor Heads within Major Head 2245

c. The detailed accounts of funds and investment thereof shall be maintained by the Account General in charge of Accounts of the State

d. The account of NDMF shall be audited annually by Comptroller & Auditor General. The State Government shall furnish a copy of the audit report of CAG to the Ministry of Finance and Ministry of Home Affairs

The States/institutes will ensure that the accounts are audited by a CAG / Chartered Accountant selected from a panel approved by the CAG. This account will be supported by a statement of reconciliation from the competent authority.

Based on the scale and nature of the projects, all the projects are taken up for financial and social audits as decided by the Disaster Management Authority

- **Financial Audits** – A financial audit of the funds received and expenditures made will be carried out by the Comptroller and Auditor-General (CAG) of India
- **Technical Audit-** National Disaster Management Authorities identify technical experts to conduct technical audits of all mitigation projects. The authority will decide the number of required audits as per the size and complexity of the projects. The mid-term reviews and projects-end evaluation should be undertaken by experts included in the roster for this purpose
- **Social Audit-** Since most of the mitigation measures require community participation during its process, the social audit will be conducted during the project cycle to review how the project has sought to involve the people at risk and deliver the results to communities, as prescribed by the authority.

5. Project Appraisal, Approval, Implementation, and Monitoring

5.1. Project Preparation

The implementing SDMA will be responsible for identification and conducting a pre-feasibility study for the project, which includes both structural and non-structural aspects.

For project proposals submitted by Central Government Ministries/Departments/Agencies, they need to follow the guidelines outlined in the NDMF guidelines issued by MHA on February 28, 2022. This involves using a specific template for the pre-feasibility check as provided in the NDMA Guidelines. Additionally, they will be responsible for preparing the project proposal and identifying the type of intervention needed for the project.

The NDMA or SDMA (as prescribed above) will review the project's financial viability and technical feasibility within 30 days of getting the proposal. If a project has a budget under Rs 1 crore, it only needs to submit a basic concept note and does not require a detailed feasibility study. NDMA/SDMA will assess the proposal and inform the organization responsible for implementing the project about any necessary changes or recommendations.

A mitigation project may be local community-based interventions that reduce the risk and promote environment-friendly settlement and livelihood practices. The three procedures that mitigation initiatives pass through during the project preparation phases include Project identification, a project feasibility check, and preparation of a detailed project proposal:-

a. **Project identification:** A GLOF mitigation project may be identified based on GLOF risk and their impacts. It should cover the characteristics of the area's GLOF proneness, evaluate the risk magnitude, analyze the GLOF impacts, and recommend mitigation solutions. A mitigation project can be proposed based on a rationale for mitigation investment based on expected impacts and a cost-benefit analysis. Project proposal needs to be prepared in the template prescribed for the pre-feasibility check (as prescribed in Guideline for NDMF)

b. **Pre-feasibility check:** The pre-feasibility check would be conducted to understand the relevance of the project, its financial viability and technical feasibility. The pre-feasibility check would be conducted to understand the relevance of the project, its financial viability and technical feasibility.

c. **Preparation & Appraisal of Detailed Project Report (DPR):**

Once the project passes the initial feasibility check, the organization responsible for implementing it needs to provide a Detailed Project Report (DPR). This report should include in-depth technical and financial details, as well as information about the project's social aspects. The format for this report is specified in the NDMF Guideline issued by NDMA.

The DPR for a State's disaster mitigation project will be reviewed by the Technical Appraisal Committee (TAC) at SDMA. This committee looks at projects from both technical and social angles. They also review and suggest improvements for projects that are funded through the NDMF/SDMF.

Once the State TAC reviews the DPR, the State's Executive Committee (SEC) approves it. The SEC examines the proposal from all angles, including administrative aspects. This review process by the TAC and SEC should be completed within 30 days of receiving the DPR. After the SEC's approval, the landslide project is submitted to NDMA for final approval.

The DPR for disaster mitigation projects proposed by Central Government Ministries, Departments, or Agencies from the NDMF will be reviewed by the TAC at NDMA. The TAC evaluates mitigation projects from both technical and social perspectives.

The DPR lays the project goals, activities, cost estimates, and intended impacts in adequate detail. ·

The formulation of DPR would require several steps
- A risk assessment of the GLOF, risk exposure and accompanying vulnerabilities
- Analysis of the context- socio-economic, governance/regulatory and environmental
- Analysis of the stakeholder's capacities- technical, organizational, and financial

- Activities planned under the project and the outputs
- Cost-benefit analyses
- Budget for the project activities
- Implementation plan and the timeline for the completion of the project
- Reporting and monitoring arrangement

5.2. Appraisal/Advisory Committees

Technical Advisory Committee (TAC): The TAC for SDMA and NDMA are formed by technical experts. It includes specialists like Geologists, Soil Conservation Officers, Geographers, Civil Engineers etc.

Appraisal at NDMA by Project Appraisal Committee (PAC): After receiving the DPRs from both the State and any Central Government Department or agency, the Project Appraisal Committee (PAC) at the NDMA will review them. The PAC, which includes Members and officials of NDMA, officials from the relevant Ministers/Departments, and disaster management experts, will assess the projects in terms of administration and finances. The PAC at NDMA may refer the DPR for a further technical review through the NDMA's TAC. This review process, carried out by PAC, will be finished within 30 days of receiving the DPR.
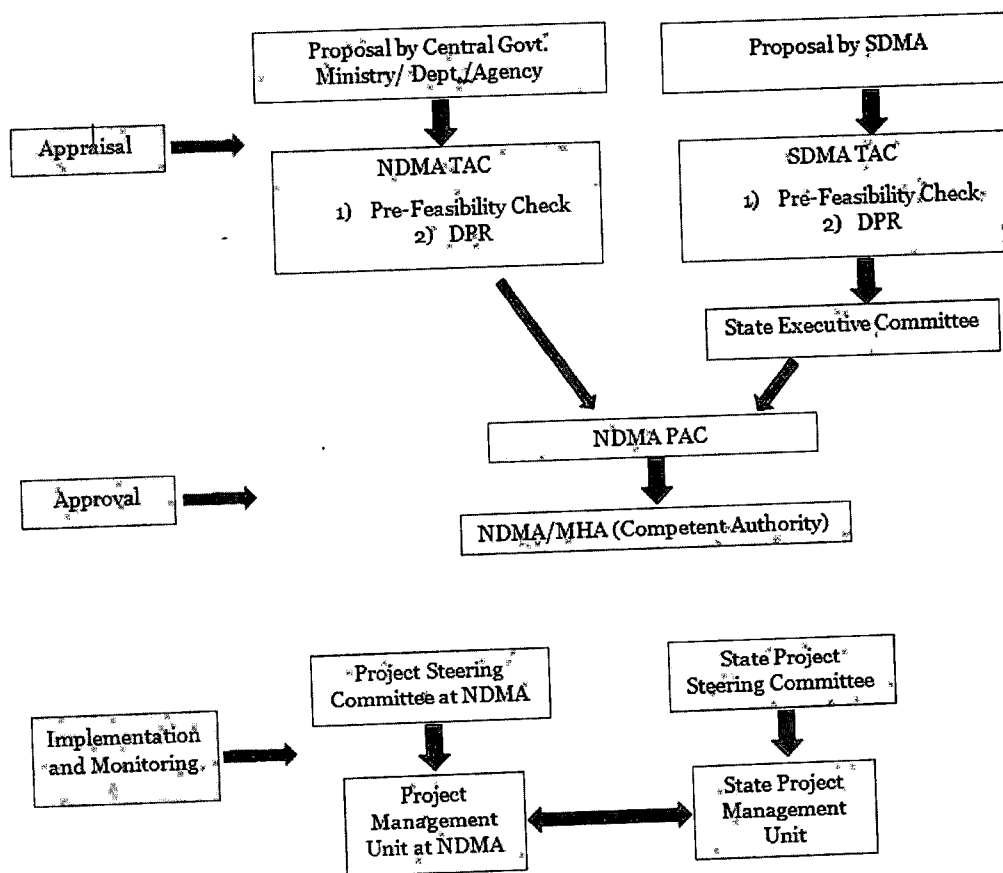
Figure 4: Project Appraisal, Approval, Implementation and Monitoring Mechanism

5.3. Project Approval

After approval by HLC on the programme as a whole, States will prepare proposal and submit each of them to NDMA for appraisal. If the Pac at NDMA approves a proposal and it falls within the financial power of the NDMA, the proposal gets the final sanction, and the funds are released by the NDMA. However, if the proposal exceeds NDMA's budget authority, it will be sent to the MHA with NDMA's recommendation for approval and funding by the appropriate authority.

After approval States will implement it and States will be Approval Authority for various stages of implementation.

5.4. Implementation and Monitoring

NDMA will manage the project and have the overall responsibility for the implementation. Since the project will be carried out in different states, NDMA will take on this role at the national level, while state-level agencies will do so in their respective jurisdictions. The main

groups responsible for carrying out and keeping an eye on the project are the PMU (Project Monitoring Unit) at the national level and the SPIUs (State project Implementation Unit) at the state level.

Two-Tier Project Management Structure:

a. Project Steering Committee:

Both the PMU and SPIUs will set up a Project Steering Committee (PSC) to guide and monitor the project as a whole. The PSC at the national level will be led by the Member (Mitigation) of NDMA, while at the state level, it will be led by the respective Chief Secretaries. The State Project Steering Committees (SPSCs) will approve project investments and play an active role in expediting the implementation process.

During implementation, the National Project Steering Committee (NPSC) will provide strategic oversight. This will happen through yearly or half-yearly review meetings, where the NPSC will:

- Review and approve the annual or revised budgets,
- Assess progress based on set milestones,
- Examine important findings from audit and evaluation reports, and
- Offer necessary guidance for the project.

Likewise, at the state level, the SPSC will oversee the project strategically during implementation. Their key responsibilities will include:

- Creating and submitting annual work plans, procurement plans, and financial estimates,
- Managing and supervising overall project implementation,
- Reviewing significant findings from semi-annual and annual project progress reports, as well as audit and evaluation reports,
- Supervising, guiding, and approving proposals from different Line Departments, and
- Monitoring project progress and providing guidance to achieve project objectives and goals.

b. Project Management Unit (PMU):

A PMU (known as the Mountain Hazard Cell), will be set up at NDMA and led by an Advisor (Mitigation). This unit will oversee the project's implementation, monitoring, and evaluation. The PMU will coordinate, report, and offer technical support to State Disaster Management Authorities (SDMAs). It is headed by an Advisor (Mitigation), and supported by relevant experts.

In each state a Project Implementation Unit (SPIUs), will function (also to be known as State Mountain Hazard Cell, SMHC)). It will manage project implementation within the state. The State MHC, led by the Secretary, SDMA, will have experts from different sectors, including line departments responsible for project investments, as well as other subject specialists. State MHC will also handle tasks like submitting

completion certificates and reports and maintaining an updated database of project information.

Line departments in the states will implement the project tasks and maintain the infrastructure that has been set up. They will assign nodal officers and carry out the project through field offices.

The project activities will undergo periodic reviews: mid-term, annual, and project-end evaluations, conducted by external experts to provide an unbiased assessment of project performance. The mid-term review happens halfway through the program's implementation, considering all targets and outcomes. The annual review focuses on indicators specified in annual plans. The project-end evaluation comprehensively analyses progress and performance throughout the program's duration.

Regular progress and performance will be tracked through defined milestones, outputs, and outcomes. A manual for project implementation and monitoring will also be developed.

A Time Frame of the programme (Phase-I) has been given at ANNEXURE – E.

5.5. Implementation Set-up

Responsibility of NDMA: NDMA will assist the approved projects under NDMF/SDMF with technical guidance and share their findings on the mitigation portal. NDMA's technical assistance will involve specialized experts for different tasks, including consulting with project proponents and beneficiaries, evaluating and approving projects, overseeing implementation and progress, making mid-term corrections if needed, evaluating outcomes, and closing projects related to landslides.

NDMA will also assist States in effectively carrying out these projects, addressing technical questions from project proponents, maintaining a database of project progress alongside SDMAs and DDMAs, and conducting research to improve assessment, approval, and other procedures.

NDMA will support states in dealing with landslides and other mountain hazards, facilitate the implementation of various mitigation projects, develop location-specific mitigation solutions, and prepare technical reports onlandslides and other mountain hazards, and manage the national-level monitoring and coordination of projects and programs.

Responsibility of NIDM: NIDM will undertake research/training/capacity-building activities for the programme in partnership with the SDMAs, DDMAs,and the Panchayati Raj Institutions for adequate training and learning along with a sensitization programme for the Village-level task force at the Panchayat level.

Role of Central Water Commission (CWC):
Being the nodal agency (subject to notification) for GLOF disaster and a premier organization in the country under Ministry of Jal Shakti, CWC will have a major role of

providing technical assistance for GLOF risk mitigation. CWC is already monitoring glacial lakes, as mentioned earlier; they have also done first order GLOF impact analysis of eight critical lakes in some States. They have engineers, who are capable to provide guidance for mitigation. They have already been proposed for being nodal agency for GLOF hazard.

States will carry out hazard risk mapping, geotechnical analysis, mitigation planning in consultation with CWC, whenever required. At the same time, it is necessary to build capacity of other agencies/institutes/universities, who are working in this area, for similar kind of activities and it is necessary to utilize their knowledge base for disaster risk reduction. Engaging them will also expedite the programme. Hence, States may decide and appoint implementing agencies, for relevant activities. However, CWC may mentor all such other agencies, for their relevant activities. Therefore, CWC and Ministry of Jal Shakti are expected to extend all sorts of cooperation in this regard in a time bound manner.

Mountain Hazard Cell (MHC) at NDMA

Some of the important functions of the Mountain Hazard Cell (MHC) are:

- Undertake techno-scientific consent/ consultation of project proponents and beneficiaries, project appraisal, approval, implementation/execution, monitoring, mid-term evaluation/ correction, evaluation, project closure etc., of the projects on GLOFs.
- Provide necessary technical assistance to States for successful implementation of the projects. Respond to the technical and scientific queries from various project proponents.
- Maintains a database of all projects and their progress in coordination with SDMA/DDMA and conducts research studies to enhance the assessment, approval, and other procedures.
- Support states concerning GLOFs and other mountain hazards and facilitate for implementation of various mitigation strategies.
- Ensure the sustainability of various strategies that will be taken under the GLOF mitigation programme
- Assist NDMA in the preparation of scientific and technical reports on various mountain hazards
- Overall monitoring and coordination of projects / programmes at the national level.

Knowledge Management network:

NDMA will create an extra-vertical for inter-agency coordination and collaboration for knowledge sharing amongst stakeholders through a common platform.

MHC at NDMA, with assistance of States, will work to bring together indigenous knowledge, innovations made within the country for use in GLOF and GLOF Risk mitigation. It will strive for international collaboration and create awareness among states about global best practices. Under this activity, resource persons/organizations available in the domain will be identified for specified services. NDMA also may create a GIS platform for DRR related applications for States.

At the state level, an institution with expertise in dealing with GLOFs and mountain hazards should be identified to facilitate the technical and scientific inputs for implementing the programme. This state-level technical institute can interact with expert institutions such as

GSI on various GLOF research and knowledge-sharing activities. Strengthening the institutional capacity of higher education institutions located in mountainous areas of GLOF risk reduction is vital for facilitating GLOF knowledge management at the regional level. Establishing a GLOF risk reduction centre or similar set-up in those identified institutions can be an ideal platform for facilitating knowledge creation and research and development activities. MHC may play an important role in creating a national-level centre and its integration with other technical institutions at the State level. This centre may focus on strengthening qualitative capacities in GLOF mitigation by developing a database of local GLOF events, disaster information, experience sharing, and knowledge transfer to the local community. This can also act as liaison support between various research and development institutions.

Mountain Hazard Cell (MHC) at State Level

State may form a Mountain Hazard Cell (MHC) under SDMA in same line as described it for NDMA above. It will comprise of manpower engaged for mitigation projects funded by mitigation fund as mentioned in the guideline issued by MHA. State MHC will be responsible for the overall state-level planning and monitoring of this programme. It should have sufficient human resources with adequate technical capacity to manage the components of this programme.

The State MHC also co-ordinate site visit / inspection, monitoring, periodic-term evaluation and mid-term course correction. The site visits / inception may be conducted to assess physical progress and quality of work implemented at the respective. ·

State MHC will supervise and monitor the approved projects during implementation and will be responsible for submitting completion certificates as well as required reports, including maintaining an updated database containing information about all projects implemented with the assistance from NDMF. Mitigation activity may be done only after proper risk identification. Otherwise, all four components may be implemented simultaneously.

5.6. Convergence among Projects

This programme may also be integrated with the ongoing skill and livelihood initiatives of the Government of India like the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), National Rural Livelihood Mission (NRLM), and National Urban Livelihood Mission (NULM), Compensatory Afforestation Fund Management and Planning Authority (CAMPA), to reduce GLOF risk and its mitigation. States may converge mitigation activities under this programme with other Central Government sponsored programme or State run programme. For example:

a. Community based mitigation activities for slope stabilization, bio restoration may be converged with MGNREGA, CAMPA activities.

b. Structural mitigation activities may be converged with road development programs like PMGSY, NHAI/State highway project.

c. Creation of volunteers may be converged with Aapda Mitra Scheme.

5.7. Sustainability of the Programme

The basic purpose of NDMF is to promote investment for mitigation rather than recovery and reconstruction. Alike NDMF this is first such mitigation programme, which will address the issue of threat from GLOF. The programme will involve all aspects of GLOF mitigation comprehensively. Nevertheless, it will also encourage mainstreaming GLOF mitigation in developmental activities. Though it is proposed to be implemented with a corpus of 150 Cr. in first phase, this amount is insufficient to mitigate all GLOF prone glacial lakes within the country. At the same time there are a large number of lakes (~20000, as per NRSC data 2017 under NHP), which are trans-boundary but area under GLOF threat lies also within Indian territory. This is a critical issue, which requires special attention and multilateral cooperation as well. Hence, this programmehas to be continued until GLOF resilience is achieved fully.

Based on learning and outcomes of first phase,the Phase-II of the programme will be planned. Subsequent phases after phase-I may be funded from NDMF, granted by subsequent Finance Commissions or otherwise, having similar arrangements of funding. Thus, its financial sustainability may be ensured.

During implementation of first phase of the programme States/UTs will set up a Mountain Hazard Cell comprising subject experts. SDMAs/DDMAs also will develop institutional arrangements for planning, implementation, and monitoring of mitigation activities, as mentioned earlier. These arrangements will build institutional capacities and may be continued during subsequent phases as well. Thus, the institutional sustainability of this programme may be ensured.

There will be sufficient scope to build capacity among work force engaged during implementation of first phase of the programme. Various organizations/institutes at national/state level will get exposure to mitigation activities; they may also get technical assistance from international collaboration. Accordingly, trained work force will get ready for more intensive subsequent phases. Thus, the technical sustainability of this programme will be ensured.

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Annexure A

District Wise Distribution of Glacial Lakes in India
(Source: NRSC-ISRO, 2017)

District-wise list of Glacial Lakes in Arunachal Pradesh State

S.No	District	Number of Glacial Lakes
1	Anjaw	449
2	Changlang	9
3	Dibang Valley	669
4	East Kameng	63
5	KraDaadi	4
6	KurungKumey	75
7	Lohit	3
8	Lower Dibang Valley	6
9	Siang	13
10	Tawang	443
11	Upper Siang	87
12	Upper Subansiri	154
13	West Kameng	173
14	West Siang	40
	TOTAL	2,188

District-wise list of Glacial Lakes in Sikkim State

S.No	District	Number of Glacial Lakes
1	North Sikkim	589
2	South Sikkim	1
3	West Sikkim	59
4	East Sikkim	84
	TOTAL	733

District-wise list of Glacial Lakes in Himachal Pradesh State

S.No	District	Number of Glacial Lakes
1	Chamba	66
2	Kangra	39
3	Kinnaur	128
4	Kullu	93
5	Lahul&Spiti	185
6	Shimla	26
	TOTAL	537

District-wise list of Glacial Lakes in Uttarkhand State

S.No	District	Number of Glacial Lakes
1	Bageshwar	8
2	Chamoli	192
3	Pithoragarh	43
4	Rudraprayag	11

5	TehriGarhwal		10
6	Uttarkashi		83
		TOTAL	347

District-wise list of Glacial Lakes in Ladakh UT

S.No	District	Number of Glacial Lakes
1	Kargil	307
2	Leh	2,912
	TOTAL	3,219

District-wise list of Glacial Lakes in Jammu & Kashmir UT

S.No	District	Number of Glacial Lakes
1	Anantnag	52
2	Badgam	25
3	Bandipore	64
4	Baramula	8
5	Doda	13
6	Ganderbal	45
7	Kishtwar	197
8	Kulgam	28
9	Kupwara	1
10	Muzaffarabad	74
11	Punch	22
12	Rajauri	10
13	Reasi	4
14	Srinagar	2
15	Udhampur	1
	TOTAL	546

ANNEXURE - B
[Data Source – NRSC, NHP, 2017]

1. List of 614 ranked Glacial Lakes in Indus River Basin

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
1	32.499	77.547	128.690	Himachal Pradesh	Lahul&Spiti

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
2	34.316	80.858	232.340	Transboundary	
3	34.432	74.925	161.038	Jammu & Kashmir	Ganderbal
4	32.526	77.220	77.594	Himachal Pradesh	Lahul&Spiti
5	34.920	74.521	60.600	Jammu & Kashmir	Muzaffarabad
6	34.829	74.062	93.895	Jammu & Kashmir	Muzaffarabad
7	33.159	76.984	59.780	Ladakh	Kargil
8	34.457	78.136	95.677	Ladakh	Leh
9	30.385	81.930	59.794	Transboundary	
10	35.315	74.937	20.130	Ladakh	Leh
11	33.945	76.230	49.656	Ladakh	Kargil
12	31.523	78.383	3.834	Himachal Pradesh	Kinnaur
13	30.390	81.819	14.508	Transboundary	
14	31.459	78.369	1.067	Himachal Pradesh	Kinnaur
15	34.184	75.373	16.801	Jammu & Kashmir	Anantnag
16	35.092	76.252	24.012	Ladakh	Leh
17	32.930	76.672	4.826	Himachal Pradesh	Chamba
18	34.136	75.314	7.280	Jammu & Kashmir	Anantnag
19	31.914	78.840	18.034	Transboundary	
20	31.993	78.845	20.899	Transboundary	
21	32.736	78.726	34.789	Ladakh	Leh
22	36.025	73.933	3.647	Ladakh	Leh
23	36.348	73.524	2.479	Ladakh	Leh
24	34.005	76.722	18.322	Ladakh	Leh
25	35.239	73.742	2.406	Ladakh	Leh
26	31.661	78.168	23.202	Himachal Pradesh	Kinnaur
27	34.422	75.058	40.118	Jammu & Kashmir	Bandipore
28	34.495	75.639	7.648	Ladakh	Kargil
29	32.888	76.734	1.156	Himachal Pradesh	Lahul&Spiti
30	32.269	76.488	1.499	Himachal Pradesh	Chamba
31	31.917	77.422	2.988	Himachal Pradesh	Kullu
32	32.934	78.212	2.450	Ladakh	Leh
33	31.984	79.958	15.730	Transboundary	
34	32.505	79.476	1.633	Transboundary	
35	33.184	76.125	6.975	Jammu & Kashmir	Kishtwar
36	32.157	77.299	6.613	Himachal Pradesh	Kullu
37	35.379	76.186	2.244	Ladakh	Leh
38	31.585	78.186	4.721	Himachal Pradesh	Kinnaur
39	32.492	78.852	11.122	Ladakh	Leh
40	31.709	78.741	1.888	Himachal Pradesh	Kinnaur
41	33.027	78.481	3.630	Ladakh	Leh
42	34.158	76.009	1.772	Ladakh	Kargil
43	33.165	78.177	6.857	Ladakh	Leh
44	32.385	79.669	6.460	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
45	32.059	78.807	9.302	Transboundary	
46	33.868	76.121	39.440	Jammu & Kashmir	Kishtwar
47	32.101	79.908	1.239	Transboundary	
48	33.456	76.393	1.430	Jammu & Kashmir	Kishtwar
49	31.672	77.662	1.700	Himachal Pradesh	Shimla
50	33.174	76.056	3.993	Jammu & Kashmir	Kishtwar
51	34.398	77.983	28.024	Ladakh	Leh
52	32.577	79.487	2.297	Transboundary	
53	32.234	76.754	9.704	Himachal Pradesh	Chamba
54	33.182	76.113	2.617	Jammu & Kashmir	Kishtwar
55	35.739	73.256	18.920	Ladakh	Leh
56	36.306	73.250	9.450	Ladakh	Leh
57	33.713	76.674	1.473	Ladakh	Kargil
58	35.825	73.211	26.435	Ladakh	Leh
59	35.028	77.626	1.607	Ladakh	Leh
60	32.705	78.698	3.528	Ladakh	Leh
61	34.351	76.075	10.632	Ladakh	Kargil
62	34.381	77.243	2.113	Ladakh	Leh
63	34.040	75.844	25.262	Ladakh	Kargil
64	36.300	73.252	1.910	Ladakh	Leh
65	33.753	78.274	1.063	Ladakh	Leh
66	35.006	76.372	1.199	Ladakh	Leh
67	33.303	78.233	1.510	Ladakh	Leh
68	33.618	77.614	8.642	Ladakh	Leh
69	36.023	72.877	1.208	Ladakh	Leh
70	34.721	76.840	1.458	Ladakh	Leh
71	35.053	77.425	1.115	Ladakh	Leh
72	33.498	77.702	1.514	Ladakh	Leh
73	32.300	78.985	9.658	Transboundary	
74	34.980	75.039	9.086	Ladakh	Leh
75	34.051	76.718	15.805	Ladakh	Leh
76	34.532	75.879	1.300	Ladakh	Kargil
77	35.090	76.230	2.732	Ladakh	Leh
78	35.096	74.902	6.952	Ladakh	Leh
79	35.073	74.177	11.970	Ladakh	Leh
80	31.419	78.069	1.234	Himachal Pradesh	Kinnaur
81	32.762	77.196	5.376	Himachal Pradesh	Lahul&Spiti
82	35.343	76.302	2.968	Ladakh	Leh
83	31.035	81.513	2.868	Transboundary	
84	34.693	77.023	1.838	Ladakh	Leh
85	36.352	73.522	1.065	Ladakh	Leh
86	30.477	80.592	12.626	Uttarakhand	Pithoragarh
87	35.105	74.219	2.521	Ladakh	Leh

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
88	32.943	78.197	2.199	Ladakh	Leh
89	36.069	72.924	1.319	Ladakh	Leh
90	32.029	78.845	15.618	Transboundary	
91	33.115	78.009	9.378	Ladakh	Leh
92	31.919	78.784	13.437	Transboundary	
93	33.558	78.506	25.325	Ladakh	Leh
94	32.149	78.488	5.473	Himachal Pradesh	Lahul&Spiti
95	35.032	77.700	18.020	Ladakh	Leh
96	36.353	73.520	1.540	Ladakh	Leh
97	33.548	78.494	4.089	Ladakh	Leh
98	32.996	79.981	3.613	Transboundary	
99	32.872	80.126	1.318	Transboundary	
100	34.674	77.071	2.010	Ladakh	Leh
101	31.967	79.890	2.209	Transboundary	
102	34.606	76.725	2.349	Ladakh	Leh
103	31.915	77.526	9.711	Himachal Pradesh	Kullu
104	32.142	78.919	2.537	Transboundary	
105	31.406	78.012	4.414	Himachal Pradesh	Kinnaur
106	34.915	74.788	3.558	Ladakh	Leh
107	32.389	79.659	12.305	Transboundary	
108	34.957	76.913	1.404	Ladakh	Leh
109	32.376	79.647	1.908	Transboundary	
110	31.937	79.994	14.455	Transboundary	
111	35.076	76.358	1.408	Ladakh	Leh
112	34.398	77.257	2.639	Ladakh	Leh
113	32.965	80.202	1.747	Transboundary	
114	32.098	77.454	1.258	Himachal Pradesh	Kullu
115	35.899	73.070	6.962	Ladakh	Leh
116	33.134	76.602	4.130	Himachal Pradesh	Chamba
117	34.920	75.143	5.403	Ladakh	Leh
118	35.002	76.376	1.724	Ladakh	Leh
119	31.234	81.138	10.921	Transboundary	
120	35.880	73.577	30.858	Ladakh	Leh
121	34.476	77.046	1.994	Ladakh	Leh
122	34.450	77.060	2.520	Ladakh	Leh
123	34.156	76.063	3.833	Ladakh	Kargil
124	32.362	79.589	1.090	Transboundary	
125	35.032	77.691	7.093	Ladakh	Leh
126	34.624	76.725	1.040	Ladakh	Leh
127	33.702	78.227	3.436	Ladakh	Leh
128	32.867	76.932	2.327	Himachal Pradesh	Lahul&Spiti
129	34.006	76.788	14.145	Ladakh	Leh
130	32.576	79.447	1.621	Ladakh	Leh

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
131	31.965	78.416	4.731	Himachal Pradesh	Lahul&Spiti
132	33.671	77.606	7.626	Ladakh	Leh
133	34.560	75.707	3.219	Ladakh	Kargil
134	34.752	76.436	4.988	Ladakh	Kargil
135	32.393	77.309	1.224	Himachal Pradesh	Lahul&Spiti
136	35.086	76.733	2.709	Ladakh	Leh
137	35.030	76.323	2.731	Ladakh	Leh
138	33.024	79.955	2.042	Transboundary	
139	35.366	75.131	2.443	Ladakh	Leh
140	32.844	77.280	3.132	Himachal Pradesh	Lahul&Spiti
141	32.945	78.198	1.530	Ladakh	Leh
142	31.950	79.986	10.435	Transboundary	
143	32.363	78.272	13.590	Himachal Pradesh	Lahul&Spiti
144	32.557	79.447	4.291	Ladakh	Leh
145	33.922	75.632	4.080	Jammu & Kashmir	Kishtwar
146	31.898	78.714	1.024	Himachal Pradesh	Kinnaur
147	32.555	79.297	4.794	Ladakh	Leh
148	35.067	76.691	1.386	Ladakh	Leh
149	33.918	75.614	1.799	Jammu & Kashmir	Kishtwar
150	35.089	76.180	1.214	Ladakh	Leh
151	34.998	76.918	1.362	Ladakh	Leh
152	34.477	76.972	9.341	Ladakh	Leh
153	34.423	77.087	3.381	Ladakh	Leh
154	34.871	74.602	3.068	Ladakh	Leh
155	33.162	76.134	1.245	Jammu & Kashmir	Doda
156	34.572	76.815	1.343	Ladakh	Leh
157	31.554	78.751	10.667	Himachal Pradesh	Kinnaur
158	32.966	78.423	2.772	Ladakh	Leh
159	33.332	78.206	2.381	Ladakh	Leh
160	36.447	73.106	1.307	Ladakh	Leh
161	32.099	79.871	4.660	Transboundary	
162	36.642	73.407	14.061	Ladakh	Leh
163	34.855	76.351	2.495	Ladakh	Kargil
164	35.071	74.225	2.059	Ladakh	Leh
165	32.728	78.779	1.712	Ladakh	Leh
166	31.972	79.973	6.668	Transboundary	
167	34.905	77.616	14.509	Ladakh	Leh
168	31.898	77.526	1.948	Himachal Pradesh	Kullu
169	33.844	76.375	18.492	Ladakh	Kargil
170	32.963	78.422	2.799	Ladakh	Leh
171	32.307	77.089	2.162	Himachal Pradesh	Kullu
172	32.017	78.875	6.580	Transboundary	
173	31.960	79.936	4.101	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
174	32.356	79.704	4.077	Transboundary	
175	31.408	78.027	3.196	Himachal Pradesh	Kinnaur
176	31.102	81.417	2.167	Transboundary	
177	34.717	77.725	3.569	Ladakh	Leh
178	33.312	76.363	6.583	Jammu & Kashmir	Kishtwar
179	31.140	81.259	1.256	Transboundary	
180	35.055	76.759	1.007	Ladakh	Leh
181	32.537	79.421	5.362	Ladakh	Leh
182	32.972	79.957	1.266	Transboundary	
183	32.135	77.433	1.159	Himachal Pradesh	Kullu
184	32.409	78.900	30.440	Ladakh	Leh
185	35.962	73.761	1.017	Ladakh	Leh
186	33.942	76.019	24.045	Jammu & Kashmir	Kishtwar
187	36.630	73.751	2.941	Ladakh	Leh
188	34.527	77.157	1.363	Ladakh	Leh
189	34.674	77.754	1.574	Ladakh	Leh
190	34.559	76.925	1.094	Ladakh	Leh
191	32.410	79.604	5.922	Transboundary	
192	34.394	77.337	3.242	Ladakh	Leh
193	34.000	77.422	3.655	Ladakh	Leh
194	35.343	75.185	2.791	Ladakh	Leh
195	36.608	73.883	2.864	Ladakh	Leh
196	32.576	79.429	1.790	Ladakh	Leh
197	35.364	74.682	1.868	Ladakh	Leh
198	32.338	79.002	4.247	Transboundary	
199	34.567	76.817	4.440	Ladakh	Leh
200	34.657	77.736	3.381	Ladakh	Leh
201	35.321	75.188	4.744	Ladakh	Leh
202	36.676	73.730	1.942	Ladakh	Leh
203	31.673	77.663	2.216	Himachal Pradesh	Shimla
204	32.510	79.445	1.094	Transboundary	
205	32.180	77.493	4.688	Himachal Pradesh	Kullu
206	33.144	76.672	1.654	Himachal Pradesh	Chamba
207	31.908	78.802	1.189	Transboundary	
208	33.714	76.669	1.124	Ladakh	Kargil
209	32.855	80.134	1.272	Transboundary	
210	35.893	73.267	1.738	Ladakh	Leh
211	32.474	78.848	7.263	Ladakh	Leh
212	34.410	77.089	2.676	Ladakh	Leh
213	31.898	77.533	1.272	Himachal Pradesh	Kullu
214	33.460	76.474	6.235	Jammu & Kashmir	Kishtwar
215	32.193	79.792	2.245	Transboundary	
216	34.110	76.425	1.333	Ladakh	Kargil

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
217	34.312	77.448	2.076	Ladakh	Leh
218	35.219	75.226	1.541	Ladakh	Leh
219	34.947	74.726	4.480	Ladakh	Leh
220	35.025	77.660	4.723	Ladakh	Leh
221	31.401	78.489	2.043	Himachal Pradesh	Kinnaur
222	34.341	76.084	1.271	Ladakh	Kargil
223	35.001	74.987	1.492	Ladakh	Leh
224	35.204	75.230	1.359	Ladakh	Leh
225	34.453	76.924	3.442	Ladakh	Leh
226	32.240	77.449	2.339	Himachal Pradesh	Lahul&Spiti
227	35.062	74.223	1.743	Ladakh	Leh
228	36.294	73.116	1.547	Ladakh	Leh
229	31.964	79.899	4.754	Transboundary	
230	34.619	76.813	2.606	Ladakh	Leh
231	34.593	76.787	1.285	Ladakh	Leh
232	34.781	76.529	1.085	Ladakh	Leh
233	31.095	81.504	4.441	Transboundary	
234	34.506	77.298	1.485	Ladakh	Leh
235	34.108	76.418	1.694	Ladakh	Kargil
236	34.335	77.457	2.407	Ladakh	Leh
237	33.846	76.015	1.171	Jammu & Kashmir	Kishtwar
238	32.135	77.435	1.621	Himachal Pradesh	Kullu
239	33.088	76.701	1.648	Himachal Pradesh	Chamba
240	34.543	76.835	2.469	Ladakh	Leh
241	32.769	76.970	1.200	Himachal Pradesh	Lahul&Spiti
242	32.284	79.676	4.256	Transboundary	
243	33.009	76.757	1.470	Himachal Pradesh	Chamba
244	35.853	73.149	2.192	Ladakh	Leh
245	32.044	78.832	2.092	Transboundary	
246	32.978	76.259	2.084	Himachal Pradesh	Chamba
247	31.899	77.538	2.034	Himachal Pradesh	Kullu
248	34.532	76.951	2.304	Ladakh	Leh
249	32.842	76.538	4.590	Himachal Pradesh	Chamba
250	34.374	77.328	1.636	Ladakh	Leh
251	36.240	73.954	1.850	Ladakh	Leh
252	34.446	78.143	20.526	Ladakh	Leh
253	33.019	78.488	1.986	Ladakh	Leh
254	34.831	76.358	2.523	Ladakh	Kargil
255	36.022	73.722	1.046	Ladakh	Leh
256	34.513	77.911	3.793	Ladakh	Leh
257	34.543	77.049	2.763	Ladakh	Leh
258	32.296	79.679	2.100	Transboundary	
259	30.427	81.476	1.182	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
260	34.805	73.879	1.491	Jammu & Kashmir	Muzaffarabad
261	33.527	76.283	2.306	Jammu & Kashmir	Kishtwar
262	32.039	79.918	3.593	Transboundary	
263	34.360	75.140	9.593	Jammu & Kashmir	Bandipore
264	32.591	79.432	1.337	Ladakh	Leh
265	30.416	81.468	10.021	Transboundary	
266	31.666	77.619	4.025	Himachal Pradesh	Kullu
267	32.775	76.951	1.389	Himachal Pradesh	Lahul&Spiti
268	33.308	78.642	1.150	Ladakh	Leh
269	31.956	79.924	1.804	Transboundary	
270	34.621	76.968	1.877	Ladakh	Leh
271	32.584	79.338	1.574	Transboundary	
272	31.179	81.152	19.911	Transboundary	
273	31.845	80.480	1.117	Transboundary	
274	34.149	76.057	2.373	Ladakh	Kargil
275	31.148	81.222	7.341	Transboundary	
276	34.454	77.275	4.348	Ladakh	Leh
277	32.095	79.773	2.076	Transboundary	
278	31.916	80.449	1.189	Transboundary	
279	32.410	79.585	3.305	Transboundary	
280	34.401	78.079	20.392	Ladakh	Leh
281	32.886	76.647	2.435	Himachal Pradesh	Chamba
282	32.283	79.694	5.064	Transboundary	
283	34.530	76.833	2.562	Ladakh	Leh
284	35.193	74.616	8.040	Ladakh	Leh
285	32.367	79.652	1.265	Transboundary	
286	31.970	78.869	6.030	Transboundary	
287	32.967	80.201	1.852	Transboundary	
288	32.305	77.086	1.597	Himachal Pradesh	Kullu
289	34.907	77.609	1.185	Ladakh	Leh
290	34.510	76.971	2.196	Ladakh	Leh
291	32.258	78.978	2.287	Transboundary	
292	34.882	75.907	4.100	Ladakh	Leh
293	34.503	77.985	8.453	Ladakh	Leh
294	32.722	77.413	10.000	Himachal Pradesh	Lahul&Spiti
295	33.144	77.053	6.053	Ladakh	Kargil
296	33.033	79.937	3.319	Transboundary	
297	32.249	77.416	1.092	Himachal Pradesh	Lahul&Spiti
298	34.470	77.315	1.049	Ladakh	Leh
299	31.264	81.445	3.278	Transboundary	
300	31.886	77.537	1.473	Himachal Pradesh	Kullu
301	34.560	77.061	1.917	Ladakh	Leh
302	33.128	77.065	7.452	Ladakh	Kargil

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
303	31.694	80.664	14.112	Transboundary	
304	31.919	80.467	1.205	Transboundary	
305	32.047	79.832	3.900	Transboundary	
306	32.441	78.925	10.651	Ladakh	Leh
307	35.954	76.030	10.615	Ladakh	Leh
308	32.708	78.688	3.949	Ladakh	Leh
309	33.708	78.220	1.370	Ladakh	Leh
310	34.561	76.849	3.413	Ladakh	Leh
311	31.981	78.838	3.532	Transboundary	
312	33.503	74.833	4.033	Jammu & Kashmir	Kulgam
313	36.458	74.882	3.121	Ladakh	Leh
314	32.631	77.307	5.317	Himachal Pradesh	Lahul&Spiti
315	34.937	75.828	2.019	Ladakh	Leh
316	34.145	75.293	1.132	Jammu & Kashmir	Anantnag
317	32.246	77.448	1.858	Himachal Pradesh	Lahul&Spiti
318	34.495	77.177	2.309	Ladakh	Leh
319	34.437	77.256	9.718	Ladakh	Leh
320	32.388	78.892	1.322	Transboundary	
321	32.256	76.778	2.686	Himachal Pradesh	Kangra
322	31.964	78.812	3.936	Transboundary	
323	32.718	78.751	8.331	Ladakh	Leh
324	34.015	75.819	4.187	Jammu & Kashmir	Kishtwar
325	32.353	79.634	1.132	Transboundary	
326	32.050	79.825	1.459	Transboundary	
327	32.422	76.849	1.560	Himachal Pradesh	Kangra
328	32.317	79.638	5.072	Transboundary	
329	32.690	78.757	5.556	Ladakh	Leh
330	35.150	74.515	1.338	Ladakh	Leh
331	32.439	79.121	1.360	Ladakh	Leh
332	35.339	76.520	1.344	Ladakh	Leh
333	30.428	81.480	1.999	Transboundary	
334	32.694	78.749	1.584	Ladakh	Leh
335	32.028	78.790	1.447	Transboundary	
336	35.272	75.163	6.136	Ladakh	Leh
337	35.337	75.192	1.890	Ladakh	Leh
338	32.711	78.708	2.939	Ladakh	Leh
339	36.601	73.862	2.259	Ladakh	Leh
340	31.961	79.937	1.036	Transboundary	
341	32.228	76.776	1.464	Himachal Pradesh	Kangra
342	32.754	77.442	1.091	Himachal Pradesh	Lahul&Spiti
343	35.213	75.226	5.775	Ladakh	Leh
344	30.545	80.599	5.762	Transboundary	
345	34.282	80.090	25.662	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
346	32.137	77.915	1.440	Himachal Pradesh	Lahul&Spiti
347	32.977	79.972	2.386	Transboundary	
348	32.313	79.657	4.454	Transboundary	
349	34.613	75.400	7.387	Ladakh	Kargil
350	31.729	77.662	1.724	Himachal Pradesh	Kullu
351	32.232	76.778	2.133	Himachal Pradesh	Kangra
352	33.723	77.612	5.203	Ladakh	Leh
353	32.537	79.424	4.647	Ladakh	Leh
354	32.961	79.952	2.065	Transboundary	
355	35.829	75.740	5.997	Ladakh	Leh
356	30.400	81.853	13.909	Transboundary	
357	34.544	75.682	1.062	Ladakh	Kargil
358	32.922	77.010	1.176	Himachal Pradesh	Lahul&Spiti
359	32.043	79.901	4.577	Transboundary	
360	32.352	78.899	2.085	Transboundary	
361	32.469	78.840	1.373	Ladakh	Leh
362	31.736	80.678	3.690	Transboundary	
363	32.339	79.674	1.839	Transboundary	
364	32.721	77.384	8.519	Himachal Pradesh	Lahul&Spiti
365	36.671	73.208	4.578	Ladakh	Leh
366	32.723	77.330	4.527	Himachal Pradesh	Lahul&Spiti
367	35.239	75.475	1.409	Ladakh	Leh
368	32.722	77.377	1.586	Himachal Pradesh	Lahul&Spiti
369	32.273	76.986	1.500	Himachal Pradesh	Kangra
370	32.704	77.348	1.482	Himachal Pradesh	Lahul&Spiti
371	33.690	78.535	6.089	Ladakh	Leh
372	32.411	79.589	1.072	Transboundary	
373	34.825	75.383	22.941	Ladakh	Leh
374	34.145	75.723	2.929	Ladakh	Kargil
375	31.979	78.837	1.210	Transboundary	
376	32.871	80.072	1.534	Transboundary	
377	34.464	77.083	2.967	Ladakh	Leh
378	32.872	77.174	2.361	Himachal Pradesh	Lahul&Spiti
379	35.213	77.167	1.295	Ladakh	Leh
380	33.164	78.151	1.980	Ladakh	Leh
381	30.552	80.400	26.564	Transboundary	
382	32.283	79.680	2.730	Transboundary	
383	35.314	75.154	1.973	Ladakh	Leh
384	34.391	77.982	9.921	Ladakh	Leh
385	35.964	73.434	1.281	Ladakh	Leh
386	32.964	77.300	3.711	Ladakh	Kargil
387	30.392	81.964	20.831	Transboundary	
388	31.977	78.838	1.237	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
389	32.986	76.968	1.350	Himachal Pradesh	Lahul&Spiti
390	33.124	76.714	2.191	Himachal Pradesh	Chamba
391	31.266	81.089	5.458	Transboundary	
392	34.780	73.831	1.958	Jammu & Kashmir	Muzaffarabad
393	32.044	79.835	2.379	Transboundary	
394	31.564	78.610	1.815	Himachal Pradesh	Kinnaur
395	35.036	77.721	4.255	Ladakh	Leh
396	34.020	75.827	3.271	Ladakh	Kargil
397	36.412	72.901	11.226	Ladakh	Leh
398	33.124	76.711	1.320	Himachal Pradesh	Chamba
399	33.704	78.284	1.732	Ladakh	Leh
400	33.066	76.824	1.849	Himachal Pradesh	Lahul&Spiti
401	32.226	76.809	2.093	Himachal Pradesh	Kangra
402	34.066	75.750	3.967	Ladakh	Kargil
403	33.020	76.357	1.562	Himachal Pradesh	Chamba
404	31.277	81.029	1.100	Transboundary	
405	31.131	79.491	1.371	Transboundary	
406	31.104	81.413	1.227	Transboundary	
407	33.710	78.252	1.268	Ladakh	Leh
408	30.379	81.843	2.893	Transboundary	
409	35.265	77.176	1.044	Ladakh	Leh
410	32.935	77.165	1.245	Ladakh	Kargil
411	32.698	78.734	1.989	Ladakh	Leh
412	31.542	78.736	1.063	Himachal Pradesh	Kinnaur
413	33.183	76.530	1.004	Himachal Pradesh	Chamba
414	32.122	79.794	3.698	Transboundary	
415	32.020	78.876	1.770	Transboundary	
416	31.322	78.760	1.018	Himachal Pradesh	Kinnaur
417	35.220	75.223	2.901	Ladakh	Leh
418	34.904	77.170	2.286	Ladakh	Leh
419	34.459	78.015	5.176	Ladakh	Leh
420	30.427	81.466	2.021	Transboundary	
421	34.445	78.026	1.548	Ladakh	Leh
422	34.768	76.586	1.352	Ladakh	Leh
423	35.296	77.175	2.616	Ladakh	Leh
424	32.724	77.378	1.425	Himachal Pradesh	Lahul&Spiti
425	37.014	75.139	1.632	Transboundary	
426	34.006	76.705	1.327	Ladakh	Leh
427	31.514	80.794	4.057	Transboundary	
428	34.457	78.013	5.515	Ladakh	Leh
429	36.661	73.622	1.221	Ladakh	Leh
430	32.380	78.121	1.766	Himachal Pradesh	Lahul&Spiti
431	34.508	77.033	6.367	Ladakh	Leh

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
432	31.099	81.513	3.032	Transboundary	
433	33.738	76.636	1.015	Ladakh	Kargil
434	36.513	74.867	3.271	Ladakh	Leh
435	30.385	81.841	.12.418	Transboundary	
436	31.218	81.160	6.420	Transboundary	
437	31.285	81.032	13.535	Transboundary	
438	32.718	77.376	1.246	Himachal Pradesh	Lahul&Spiti
439	32.204	78.418	3.212	Himachal Pradesh	Lahul&Spiti
440	34.315	80.794	6.434	Transboundary	
441	35.300	77.174	2.455	Ladakh	Leh
442	32.860	80.106	2.155	Transboundary	
443	33.332	78.662	1.737	Ladakh	Leh
444	32.316	78.994	1.466	Transboundary	
445	32.245	76.787	2.704	Himachal Pradesh	Kangra
446	30.376	82.020	11.617	Transboundary	
447	34.309	77.530	1.143	Ladakh	Leh
448	31.959	79.895	2.990	Transboundary	
449	31.114	81.435	3.854	Transboundary	
450	31.195	81.138	4.754	Transboundary	
451	35.721	76.375	12.139	Ladakh	Leh
452	35.876	72.874	1.640	Transboundary	
453	30.546	81.991	1.304	Transboundary	
454	35.876	73.075	1.921	Transboundary	
455	32.604	77.618	5.279	Himachal Pradesh	Lahul&Spiti
456	35.866	75.282	3.473	Ladakh	Leh
457	31.040	79.753	3.850	Transboundary	
458	31.564	80.860	4.818	Transboundary	
459	30.478	80.569	1.904	Transboundary	
460	36.561	73.596	1.804	Ladakh	Leh
461	31.593	80.780	2.093	Transboundary	
462	35.930	72.930	7.101	Ladakh	Leh
463	35.871	75.323	1.216	Ladakh	Leh
464	34.223	78.380	2.087	Ladakh	Leh
465	32.107	79.801	1.213	Transboundary	
466	35.869	75.326	1.105	Ladakh	Leh
467	33.510	76.596	2.185	Ladakh	Kargil
468	34.292	80.824	1.005	Transboundary	
469	31.103	81.546	2.389	Transboundary	
470	35.687	75.908	2.210	Ladakh	Leh
471	32.259	79.680	2.240	Transboundary	
472	34.113	76.427	1.071	Ladakh	Kargil
473	31.618	80.732	2.973	Transboundary	
474	34.204	78.473	2.352	Ladakh	Leh

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
475	34.429	77.136	1.775	Ladakh	Leh
476	34.457	78.009	1.385	Ladakh	Leh
477	33.972	76.118	2.663	Ladakh	Kargil
478	35.937	76.026	7.287	Ladakh	Leh
479	32.560	79.332	2.556	Transboundary	
480	34.460	78.011	1.051	Ladakh	Leh
481	33.368	78.662	1.939	Ladakh	Leh
482	35.907	72.810	1.870	Ladakh	Leh
483	33.935	76.004	6.996	Jammu & Kashmir	Kishtwar
484	36.400	75.390	2.169	Ladakh	Leh
485	32.972	77.297	2.317	Ladakh	Leh
486	35.861	75.260	2.889	Ladakh	Leh
487	31.051	81.515	1.477	Transboundary	
488	36.413	74.487	1.246	Ladakh	Leh
489	34.278	78.222	6.364	Ladakh	Leh
490	35.828	72.903	1.151	Transboundary	
491	31.264	81.431	3.303	Transboundary	
492	34.024	76.310	1.354	Ladakh	Kargil
493	30.387	81.848	3.443	Transboundary	
494	30.556	80.618	1.224	Transboundary	
495	31.546	80.817	1.232	Transboundary	
496	33.163	78.145	1.047	Ladakh	Leh
497	33.642	76.007	1.570	Jammu & Kashmir	Kishtwar
498	31.774	80.537	1.711	Transboundary	
499	32.434	78.922	5.161	Ladakh	Leh
500	31.517	80.791	5.113	Transboundary	
501	32.554	79.332	1.341	Transboundary	
502	34.044	78.664	3.937	Ladakh	Leh
503	30.409	81.476	11.761	Transboundary	
504	31.207	81.019	2.173	Transboundary	
505	31.322	81.336	4.662	Transboundary	
506	35.894	73.246	2.760	Ladakh	Leh
507	32.512	79.298	1.115	Transboundary	
508	34.974	77.190	1.086	Ladakh	Leh
509	35.833	72.910	4.357	Transboundary	
510	30.390	81.895	10.273	Transboundary	
511	33.658	76.091	1.430	Jammu & Kashmir	Kishtwar
512	36.989	74.657	1.960	Ladakh	Leh
513	31.450	78.793	7.614	Himachal Pradesh	Kinnaur
514	35.856	72.927	1.556	Ladakh	Leh
515	30.399	81.866	8.536	Transboundary	
516	32.525	77.942	1.987	Himachal Pradesh	Lahul&Spiti
517	35.934	73.385	1.331	Ladakh	Leh

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
518	32.941	77.326	2.150	Ladakh	Leh
519	31.111	81.222	1.166	Transboundary	
520	31.240	81.083	4.216	Transboundary	
521	34.410	77.979	1.486	Ladakh	Leh
522	32.780	77.912	1.787	Ladakh	Leh
523	31.029	79.730	4.884	Transboundary	
524	34.350	79.542	6.603	Ladakh	Leh
525	32.435	78.866	1.384	Ladakh	Leh
526	36.841	73.920	4.440	Ladakh	Leh
527	32.445	78.903	3.635	Ladakh	Leh
528	30.381	81.830	3.022	Transboundary	
529	34.426	80.796	3.913	Transboundary	
530	35.245	77.110	2.821	Ladakh	Leh
531	33.846	76.369	1.040	Ladakh	Kargil
532	34.520	78.101	10.275	Ladakh	Leh
533	31.270	81.109	3.115	Transboundary	
534	34.779	75.492	3.845	Ladakh	Kargil
535	32.121	78.940	4.100	Transboundary	
536	31.160	81.112	1.148	Transboundary	
537	30.374	82.016	3.797	Transboundary	
538	32.457	78.473	5.249	Transboundary	
539	30.553	80.473	1.219	Transboundary	
540	31.695	80.615	1.729	Transboundary	
541	30.551	80.471	1.564	Transboundary	
542	34.415	78.069	6.526	Ladakh	Leh
543	35.723	76.389	1.954	Ladakh	Leh
544	31.129	81.228	4.301	Transboundary	
545	31.295	80.822	2.964	Transboundary	
546	32.610	77.912	2.936	Himachal Pradesh	Lahul&Spiti
547	32.408	78.976	5.270	Ladakh	Leh
548	34.281	78.156	1.052	Ladakh	Leh
549	30.606	80.293	2.783	Transboundary	
550	30.352	81.978	7.228	Transboundary	
551	34.324	80.840	13.219	Transboundary	
552	31.849	77.789	3.100	Himachal Pradesh	Kullu
553	34.457	78.148	3.061	Ladakh	Leh
554	32.607	77.989	4.210	Ladakh	Leh
555	32.377	78.923	5.543	Transboundary	
556	30.344	81.977	8.380	Transboundary	
557	33.672	76.151	1.053	Jammu & Kashmir	Kishtwar
558	31.273	81.085	1.625	Transboundary	
559	34.457	78.152	2.005	Ladakh	Leh
560	34.328	80.810	1.891	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
561	30.367	81.995	2.060	Transboundary	
562	32.476	78.303	3.251	Himachal Pradesh	Lahul&Spiti
563	34.321	80.815	1.507	Transboundary	
564	32.405	78.928	4.102	Ladakh	Leh
565	33.698	76.187	1.040	Jammu & Kashmir	Kishtwar
566	32.122	78.943	2.399	Transboundary	
567	30.376	81.878	1.391	Transboundary	
568	35.723	76.365	1.117	Ladakh	Leh
569	31.089	79.513	1.800	Transboundary	
570	34.325	80.829	1.823	Transboundary	
571	34.407	80.801	1.289	Transboundary	
572	34.325	80.833	2.353	Transboundary	
573	34.521	78.090	10.617	Ladakh	Leh
574	34.039	79.469	1.250	Transboundary	
575	32.122	78.948	1.170	Transboundary	
576	30.998	79.767	1.646	Transboundary	
577	35.495	76.618	1.135	Ladakh	Leh
578	34.311	80.884	8.391	Transboundary	
579	30.380	82.021	1.081	Transboundary	
580	32.588	79.459	2.269	Ladakh	Leh
581	35.661	76.617	1.495	Ladakh	Leh
582	34.233	79.561	2.189	Ladakh	Leh
583	35.337	77.623	2.907	Ladakh	Leh
584	35.334	77.608	1.088	Ladakh	Leh
585	31.519	78.735	3.003	Transboundary	
586	35.338	77.627	1.098	Ladakh	Leh
587	35.352	77.603	1.080	Ladakh	Leh
588	35.364	77.140	2.437	Ladakh	Leh
589	30.553	80.407	1.509	Transboundary	
590	35.728	76.281	1.578	Ladakh	Leh
591	30.598	80.404	2.323	Transboundary	
592	34.522	78.096	1.437	Ladakh	Leh
593	34.523	78.099	1.724	Ladakh	Leh
594	31.153	79.341	3.427	Transboundary	
595	35.857	75.766	1.016	Ladakh	Leh
596	35.730	76.410	13.276	Ladakh	Leh
597	35.588	76.698	2.604	Ladakh	Leh
598	35.476	77.514	21.929	Ladakh	Leh
599	31.144	79.366	3.382	Transboundary	
600	35.879	75.730	1.731	Ladakh	Leh
601	35.880	75.728	1.089	Ladakh	Leh
602	31.150	79.357	1.101	Transboundary	
603	35.431	77.066	1.374	Ladakh	Leh

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
604	35.471	77.079	5.810	Ladakh	Leh
605	35.490	77.505	2.319	Transboundary	
606	35.480	77.166	1.354	Ladakh	Leh
607	35.480	77.170	1.335	Ladakh	Leh
608	35.750	76.473	3.050	Ladakh	Leh
609	35.496	77.223	1.623	Ladakh	Leh
610	35.475	76.905	7.554	Ladakh	Leh
611	35.521	76.940	1.378	Ladakh	Leh
612	35.783	76.548	1.090	Ladakh	Leh
613	35.552	76.924	4.679	Ladakh	Leh
614	35.557	76.920	1.704	Ladakh	Leh

2. List of 864 ranked Glacial Lakes in Ganga River Basin

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
1	28.322	85.838	540.353	Transboundary	
2	28.360	85.871	463.780	Transboundary	
3	28.374	86.305	391.497	Transboundary	
4	28.691	83.852	340.210	Transboundary	
5	28.128	87.404	6.732	Transboundary	
6	27.861	86.476	158.403	Transboundary	
7	27.798	87.092	182.157	Transboundary	
8	28.638	84.016	2.392	Transboundary	
9	27.947	86.446	156.761	Transboundary	
10	27.898	86.925	139.771	Transboundary	
11	27.696	86.792	12.949	Transboundary	
12	28.358	85.538	10.825	Transboundary	
13	28.118	87.615	35.670	Transboundary	
14	27.687	86.858	31.797	Transboundary	
15	28.329	85.869	213.518	Transboundary	
16	28.488	84.486	89.444	Transboundary	
17	28.494	84.733	1.957	Transboundary	
18	27.795	86.877	1.671	Transboundary	
19	31.225	79.155	1.269	Uttarakhand	Uttarkashi
20	28.095	86.193	6.829	Transboundary	
21	28.096	86.195	1.618	Transboundary	
22	27.897	86.797	1.284	Transboundary	
23	28.798	83.186	6.304	Transboundary	
24	27.946	88.075	148.586	Transboundary	
25	28.585	85.022	11.988	Transboundary	
26	28.397	85.569	6.859	Transboundary	
27	28.799	83.978	1.163	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
28	31.191	79.150	7.893	Uttarakhand	Uttarkashi
29	27.887	86.844	4.443	Transboundary	
30	28.404	85.496	5.611	Transboundary	
31	30.267	80.591	1.774	Uttarakhand	Pithoragarh
32	27.928	88.002	113.216	Transboundary	
33	27.926	87.771	97.658	Transboundary	
34	28.230	87.591	78.900	Transboundary	
35	27.995	86.339	1.673	Transboundary	
36	28.497	84.256	11.381	Transboundary	
37	28.136	86.096	2.589	Transboundary	
38	28.135	86.531	97.854	Transboundary	
39	28.199	86.582	134.640	Transboundary	
40	28.137	87.428	25.854	Transboundary	
41	27.755	86.958	86.498	Transboundary	
42	27.894	86.913	11.276	Transboundary	
43	28.178	87.563	104.192	Transboundary	
44	27.836	86.585	1.614	Transboundary	
45	27.845	86.433	7.807	Transboundary	
46	28.482	85.302	8.496	Transboundary	
47	27.793	87.974	22.318	Transboundary	
48	28.372	85.568	3.890	Transboundary	
49	27.845	86.463	9.653	Transboundary	
50	28.393	86.379	100.112	Transboundary	
51	27.869	87.866	68.121	Transboundary	
52	28.067	86.066	32.497	Transboundary	
53	28.500	85.430	3.746	Transboundary	
54	28.148	87.469	39.585	Transboundary	
55	28.676	85.410	21.041	Transboundary	-
56	27.728	86.569	2.946	Transboundary	
57	30.003	81.554	1.105	Transboundary	
58	28.303	86.157	59.046	Transboundary	
59	30.233	81.350	26.790	Transboundary	
60	28.185	86.805	2.644	Transboundary	
61	28.335	86.192	55.000	Transboundary	
62	30.211	81.361	1.842	Transboundary	
63	28.118	86.119	5.812	Transboundary	
64	28.444	85.495	1.533	Transboundary	
65	28.170	86.060	4.433	Transboundary	
66	27.779	86.612	117.309	Transboundary	
67	28.596	84.629	22.255	Transboundary	
68	28.794	83.983	2.761	Transboundary	
69	27.816	87.749	17.165	Transboundary	
70	29.822	82.712	19.684	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
71	28.009	88.259	59.695	Transboundary	
72	27.901	86.576	2.757	Transboundary	
73	28.185	86.532	67.677	Transboundary	
74	29.205	83.848	1.887	Transboundary	
75	28.744	83.997	1.584	Transboundary	
76	28.468	85.519	43.674	Transboundary	
77	28.183	86.226	12.341	Transboundary	
78	28.313	85.948	25.055	Transboundary	
79	28.092	86.257	7.144	Transboundary	
80	27.797	88.007	1.166	Transboundary	
81	28.068	87.047	78.934	Transboundary	
82	28.195	87.641	47.425	Transboundary	
83	27.909	86.580	1.730	Transboundary	
84	30.911	78.771	3.150	Uttarakhand	Uttarkashi
85	28.136	87.416	2.852	Transboundary	
86	27.844	87.081	41.151	Transboundary	
87	27.864	87.737	13.982	Transboundary	
88	28.193	86.361	3.224	Transboundary	
89	28.033	86.500	60.855	Transboundary	
90	28.417	85.522	8.907	Transboundary	
91	28.787	83.180	1.701	Transboundary	
92	28.509	85.446	9.005	Transboundary	
93	28.973	83.743	1.225	Transboundary	
94	28.152	86.330	6.715	Transboundary	
95	28.621	84.792	2.320	Transboundary	
96	28.321	86.158	22.436	Transboundary	
97	28.553	85.424	4.339	Transboundary	
98	27.857	86.500	2.466	Transboundary	
99	27.929	86.433	31.991	Transboundary	
100	28.752	83.929	1.151	Transboundary	
101	28.420	85.532	3.002	Transboundary	
102	28.129	85.837	1.849	Transboundary	
103	28.233	85.611	2.930	Transboundary	
104	28.150	86.313	1.062	Transboundary	
105	29.354	82.739	2.488	Transboundary	
106	27.832	87.661	1.258	Transboundary	
107	28.671	83.859	1.379	Transboundary	
108	28.093	87.637	72.469	Transboundary	
109	28.377	85.167	2.284	Transboundary	
110	28.137	85.788	2.537	Transboundary	
111	28.672	83.864	2.582	Transboundary	
112	27.778	86.643	29.275	Transboundary	
113	27.874	86.586	40.185	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
114	29.798	82.671	13.701	Transboundary	
115	27.790	87.934	14.103	Transboundary	
116	30.219	81.336	3.516	Transboundary	
117	28.432	85.532	5.720	Transboundary	
118	28.833	83.471	1.050	Transboundary	
119	29.994	82.045	2.575	Transboundary	
120	30.085	81.829	1.113	Transboundary	
121	28.168	85.866	3.902	Transboundary	
122	28.044	86.514	57.941	Transboundary	
123	28.508	85.494	26.419	Transboundary	
124	28.236	87.501	20.478	Transboundary	
125	27.838	86.875	3.632	Transboundary	
126	28.114	87.655	146.343	Transboundary	
127	27.770	87.658	3.028	Transboundary	
128	28.726	83.890	14.991	Transboundary	
129	28.321	85.930	11.184	Transboundary	
130	28.974	83.740	2.009	Transboundary	
131	27.747	87.649	4.724	Transboundary	
132	28.835	84.797	1.907	Transboundary	
133	28.023	86.099	1.471	Transboundary	
134	29.109	83.070	4.274	Transboundary	
135	27.905	86.581	2.140	Transboundary	
136	29.741	81.570	5.909	Transboundary	
137	28.186	86.343	2.566	Transboundary	
138	28.140	87.417	5.717	Transboundary	
139	27.950	87.930	83.659	Transboundary	
140	28.645	84.272	1.080	Transboundary	
141	28.167	87.623	20.869	Transboundary	
142	27.757	86.888	7.009	Transboundary	
143	28.160	86.076	1.308	Transboundary	
144	30.129	81.781	75.649	Transboundary	
145	28.190	86.134	1.096	Transboundary	
146	27.743	86.844	25.727	Transboundary	
147	28.211	85.847	61.339	Transboundary	
148	28.621	84.787	1.327	Transboundary	
149	27.996	86.820	1.153	Transboundary	
150	27.725	87.619	7.536	Transboundary	
151	28.673	85.126	1.128	Transboundary	
152	27.813	87.139	9.270	Transboundary	
153	27.921	86.675	2.724	Transboundary	
154	28.193	86.351	19.871	Transboundary	
155	28.426	85.564	29.388	Transboundary	
156	28.240	86.365	24.721	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
157	30.456	80.516	3.049	Uttarakhand	Pithoragarh
158	28.310	85.633	6.071	Transboundary	
159	27.801	88.107	6.384	Transboundary	
160	27.933	86.746	7.562	Transboundary	
161	28.558	85.396	1.577	Transboundary	
162	28.520	85.436	3.944	Transboundary	
163	27.781	87.945	3.817	Transboundary	
164	28.255	87.648	1.530	Transboundary	
165	28.627	84.291	4.485	Transboundary	
166	28.172	87.479	23.907	Transboundary	
167	28.523	85.435	1.046	Transboundary	
168	27.760	86.863	6.747	Transboundary	
169	30.830	79.894	4.833	Uttarakhand	Chamoli
170	29.773	81.527	49.988	Transboundary	
171	28.996	83.755	2.432	Transboundary	
172	28.566	85.464	16.346	Transboundary	
173	27.722	87.928	3.826	Transboundary	
174	29.919	81.739	1.778	Transboundary	
175	30.964	79.386	1.283	Uttarakhand	Chamoli
176	28.830	84.223	1.179	Transboundary	
177	27.758	87.650	1.387	Transboundary	
178	27.672	87.620	1.452	Transboundary	
179	28.253	86.103	14.978	Transboundary	
180	28.011	86.412	1.030	Transboundary	
181	28.613	84.317	1.202	Transboundary	
182	28.023	86.391	1.346	Transboundary	
183	30.811	79.921	2.936	Uttarakhand	Chamoli
184	27.887	86.897	5.352	Transboundary	
185	28.347	86.225	55.904	Transboundary	
186	30.119	81.873	1.272	Transboundary	
187	28.616	84.320	2.748	Transboundary	
188	27.989	86.649	5.101	Transboundary	
189	27.958	86.661	4.835	Transboundary	
190	29.980	81.113	2.012	Transboundary	
191	30.909	79.539	5.113	Uttarakhand	Chamoli
192	27.846	87.962	8.189	Transboundary	
193	28.448	85.557	1.776	Transboundary	
194	27.933	88.066	83.349	Transboundary	
195	28.163	85.630	13.052	Transboundary	
196	28.226	87.053	17.187	Transboundary	
197	28.181	86.343	2.476	Transboundary	
198	27.997	86.835	11.547	Transboundary	
199	27.545	88.050	25.723	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
200	28.320	85.631	6.068	Transboundary	
201	29.147	83.803	2.167	Transboundary	
202	30.213	81.383	4.392	Transboundary	
203	29.113	82.716	1.072	Transboundary	
204	27.939	86.815	2.888	Transboundary	
205	27.920	86.745	2.479	Transboundary	
206	29.815	82.448	1.171	Transboundary	
207	28.166	86.807	5.214	Transboundary	
208	28.201	86.163	2.615	Transboundary	
209	28.270	86.127	1.746	Transboundary	
210	29.118	83.779	1.980	Transboundary	
211	28.278	87.661	3.763	Transboundary	
212	28.397	85.631	2.733	Transboundary	
213	28.176	86.357	1.246	Transboundary	
214	27.680	87.603	2.541	Transboundary	
215	28.398	86.487	1.144	Transboundary	
216	28.803	83.068	2.431	Transboundary	
217	28.518	85.440	4.852	Transboundary	
218	29.743	81.544	5.634	Transboundary	
219	28.817	84.333	3.988	Transboundary	
220	29.139	82.785	1.613	Transboundary	
221	27.835	86.482	2.315	Transboundary	
222	27.831	87.659	2.369	Transboundary	
223	27.956	86.806	1.261	Transboundary	
224	28.433	85.535	1.646	Transboundary	
225	28.495	85.549	1.591	Transboundary	
226	29.115	83.786	6.002	Transboundary	
227	27.783	86.957	87.280	Transboundary	
228	27.900	87.699	11.272	Transboundary	
229	27.950	86.782	3.648	Transboundary	
230	28.211	86.213	5.964	Transboundary	
231	29.790	82.460	1.951	Transboundary	
232	30.565	80.179	17.807	Uttarakhand	Pithoragarh
233	28.279	87.670	2.490	Transboundary	
234	28.236	87.659	3.588	Transboundary	
235	28.007	86.641	3.808	Transboundary	
236	30.241	81.332	8.106	Transboundary	
237	28.217	86.302	1.323	Transboundary	
238	28.194	85.871	7.377	Transboundary	
239	28.462	84.262	1.757	Transboundary	
240	28.295	86.151	16.510	Transboundary	
241	30.948	79.341	2.201	Uttarakhand	Chamoli
242	28.073	86.520	23.115	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
243	27.853	87.790	6.118	Transboundary	
244	28.022	88.355	56.288	Transboundary	
245	28.194	86.314	27.790	Transboundary	
246	28.645	84.263	1.430	Transboundary	
247	28.323	85.924	8.798	Transboundary	
248	29.693	82.240	2.824	Transboundary	
249	27.946	87.981	5.963	Transboundary	
250	30.901	79.754	22.035	Uttarakhand	Chamoli
251	28.545	85.448	1.256	Transboundary	
252	28.568	85.335	1.337	Transboundary	
253	28.013	87.611	2.194	Transboundary	
254	30.067	82.127	62.325	Transboundary	
255	28.287	85.602	2.411	Transboundary	
256	30.266	81.349	20.368	Transboundary	
257	27.833	86.565	2.688	Transboundary	
258	28.787	83.330	43.573	Transboundary	
259	27.844	87.664	3.358	Transboundary	
260	29.800	81.525	1.401	Transboundary	
261	28.273	86.103	1.251	Transboundary	
262	28.041	86.706	2.755	Transboundary	
263	27.916	86.477	14.075	Transboundary	
264	28.954	83.737	2.981	Transboundary	
265	28.063	86.520	2.789	Transboundary	
266	28.017	88.288	50.431	Transboundary	
267	28.014	86.475	1.186	Transboundary	
268	28.959	83.187	27.617	Transboundary	
269	30.991	79.359	3.292	Uttarakhand	Chamoli
270	27.736	86.876	1.159	Transboundary	
271	28.221	86.086	8.581	Transboundary	
272	30.639	79.695	1.378	Uttarakhand	Chamoli
273	27.781	87.661	3.968	Transboundary	
274	31.005	79.406	1.977	Uttarakhand	Chamoli
275	28.459	84.259	6.363	Transboundary	
276	29.085	83.748	1.789	Transboundary	
277	28.252	87.655	2.143	Transboundary	
278	27.729	87.632	3.139	Transboundary	
279	30.112	81.814	2.119	Transboundary	
280	27.823	86.571	3.789	Transboundary	
281	28.268	87.634	10.039	Transboundary	
282	28.392	86.415	20.173	Transboundary	
283	28.052	87.627	18.395	Transboundary	
284	28.294	86.131	23.993	Transboundary	
285	30.916	79.541	2.713	Uttarakhand	Chamoli

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
286	30.908	79.825	8.112	Uttarakhand	Chamoli
287	27.793	86.838	22.894	Transboundary	
288	28.701	84.124	1.120	Transboundary	
289	28.182	86.347	2.254	Transboundary	
290	30.892	78.819	3.263	Uttarakhand	Uttarkashi
291	30.746	78.987	25.560	Uttarakhand	TehriGarhwal
292	30.814	79.926	5.017	Uttarakhand	Chamoli
293	29.216	82.563	2.448	Transboundary	
294	28.666	84.528	1.001	Transboundary	
295	27.794	86.424	1.984	Transboundary	
296	30.049	80.887	2.008	Transboundary	
297	28.053	86.491	1.852	Transboundary	
298	28.228	86.204	5.145	Transboundary	
299	29.117	83.738	11.608	Transboundary	
300	28.561	85.396	4.669	Transboundary	
301	28.445	85.560	1.778	Transboundary	
302	27.759	86.875	4.836	Transboundary	
303	28.378	86.488	1.992	Transboundary	
304	28.352	85.618	4.845	Transboundary	
305	27.783	87.662	1.237	Transboundary	
306	30.967	79.362	3.084	Uttarakhand	Chamoli
307	30.041	80.878	5.961	Transboundary	
308	28.048	86.504	9.003	Transboundary	
309	29.674	82.409	3.563	Transboundary	
310	28.139	85.919	10.149	Transboundary	
311	27.911	87.816	2.443	Transboundary	
312	27.674	87.621	2.040	Transboundary	
313	28.206	86.239	1.515	Transboundary	
314	28.722	83.891	1.544	Transboundary	
315	28.057	87.622	1.088	Transboundary	
316	30.892	79.528	2.050	Uttarakhand	Chamoli
317	28.069	87.134	25.494	Transboundary	
318	28.269	86.127	1.910	Transboundary	
319	27.951	86.690	42.112	Transboundary	
320	28.292	85.170	20.328	Transboundary	
321	28.156	86.338	7.567	Transboundary	
322	28.206	87.560	15.947	Transboundary	
323	28.249	86.150	13.157	Transboundary	
324	28.172	86.518	4.127	Transboundary	
325	30.890	79.304	2.306	Uttarakhand	Chamoli
326	28.843	83.941	1.616	Transboundary	
327	28.328	85.685	3.190	Transboundary	
328	29.270	82.590	10.043	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
329	29.993	82.197	24.672	Transboundary	
330	28.064	86.456	1.774	Transboundary	
331	27.927	86.420	15.721	Transboundary	
332	28.044	87.626	3.170	Transboundary	
333	30.994	79.354	1.814	Uttarakhand	Chamoli
334	28.446	85.562	2.095	Transboundary	
335	29.195	83.735	1.657	Transboundary	
336	27.964	87.814	40.609	Transboundary	
337	28.044	86.519	1.096	Transboundary	
338	29.844	81.553	1.410	Transboundary	
339	27.884	86.891	1.380	Transboundary	
340	28.457	84.252	1.300	Transboundary	
341	30.098	81.826	3.270	Transboundary	
342	27.798	86.478	4.510	Transboundary	
343	27.847	87.970	2.390	Transboundary	
344	27.766	86.871	13.684	Transboundary	
345	29.687	82.419	2.414	Transboundary	
346	27.731	87.623	1.834	Transboundary	
347	30.976	79.460	17.016	Uttarakhand	Chamoli
348	28.065	87.193	10.783	Transboundary	
349	27.952	87.908	64.786	Transboundary	
350	28.236	86.356	8.556	Transboundary	
351	28.155	85.911	7.952	Transboundary	
352	31.060	79.414	3.168	Uttarakhand	Chamoli
353	28.163	86.067	1.637	Transboundary	
354	30.278	81.880	1.010	Transboundary	
355	27.709	86.563	2.570	Transboundary	
356	27.987	86.492	1.125	Transboundary	
357	27.942	86.816	1.391	Transboundary	
358	27.791	86.621	46.732	Transboundary	
359	28.826	84.851	3.607	Transboundary	
360	27.831	87.611	1.961	Transboundary	
361	30.297	81.388	26.147	Transboundary	
362	28.106	86.531	4.568	Transboundary	
363	28.563	85.468	8.943	Transboundary	
364	28.267	86.130	1.237	Transboundary	
365	28.194	86.220	4.689	Transboundary	
366	27.853	87.602	3.916	Transboundary	
367	27.850	87.729	1.365	Transboundary	
368	28.006	86.481	1.533	Transboundary	
369	28.871	83.493	2.102	Transboundary	
370	28.617	85.416	1.981	Transboundary	
371	28.426	85.539	1.129	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
372	28.641	83.788	8.326	Transboundary	
373	28.615	85.420	2.348	Transboundary	
374	28.179	87.478	1.010	Transboundary	
375	28.393	86.451	5.237	Transboundary	
376	27.881	87.805	34.317	Transboundary	
377	30.228	81.415	1.246	Transboundary	
378	30.294	81.375	8.724	Transboundary	
379	27.771	88.019	1.035	Transboundary	
380	30.105	81.805	1.184	Transboundary	
381	28.231	86.148	1.805	Transboundary	
382	31.025	79.363	1.537	Uttarakhand	Chamoli
383	28.970	83.640	3.051	Transboundary	
384	27.795	86.617	1.746	Transboundary	
385	30.172	81.879	1.914	Transboundary	
386	28.003	86.445	2.165	Transboundary	
387	28.583	84.084	1.654	Transboundary	
388	30.324	80.590	1.130	Uttarakhand	Pithoragarh
389	27.979	86.733	1.575	Transboundary	
390	28.547	85.445	5.876	Transboundary	
391	28.867	83.490	5.274	Transboundary	
392	27.732	87.624	1.271	Transboundary	
393	28.701	83.837	1.297	Transboundary	
394	28.004	88.241	41.798	Transboundary	
395	28.374	85.173	2.329	Transboundary	
396	28.143	87.102	2.009	Transboundary	
397	30.322	81.376	13.962	Transboundary	
398	27.860	88.054	5.793	Transboundary	
399	28.219	85.562	4.478	Transboundary	
400	28.854	84.375	2.452	Transboundary	
401	28.260	86.213	1.927	Transboundary	
402	27.918	87.725	4.391	Transboundary	
403	28.032	86.073	2.316	Transboundary	
404	31.152	79.267	4.590	Uttarakhand	Uttarkashi
405	28.404	85.605	12.012	Transboundary	
406	28.860	84.783	1.829	Transboundary	
407	27.992	86.652	2.042	Transboundary	
408	28.038	86.710	15.440	Transboundary	
409	28.010	88.373	3.132	Transboundary	
410	29.201	83.684	22.463	Transboundary	
411	28.316	85.951	6.028	Transboundary	
412	28.179	85.698	5.743	Transboundary	
413	27.929	86.446	6.528	Transboundary	
414	28.392	85.614	1.165	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
415	28.217	86.305	1.863	Transboundary	
416	28.301	85.178	5.559	Transboundary	
417	30.053	80.883	3.112	Transboundary	
418	28.173	87.562	2.332	Transboundary	
419	27.836	87.605	8.765	Transboundary	
420	28.042	86.518	2.925	Transboundary	
421	28.050	86.493	2.725	Transboundary	
422	30.214	81.758	12.120	Transboundary	
423	28.603	85.321	1.511	Transboundary	
424	30.903	79.674	1.145	Uttarakhand	Chamoli
425	27.806	87.819	1.115	Transboundary	
426	28.192	86.326	1.993	Transboundary	
427	27.838	87.936	1.194	Transboundary	
428	30.264	80.713	2.266	Uttarakhand	Pithoragarh
429	27.835	88.078	16.475	Transboundary	
430	27.796	88.105	2.460	Transboundary	
431	27.828	86.573	3.971	Transboundary	
432	28.824	84.418	1.138	Transboundary	
433	28.151	86.535	18.482	Transboundary	
434	27.951	86.777	3.672	Transboundary	
435	28.634	84.752	1.835	Transboundary	
436	28.202	86.309	6.573	Transboundary	
437	31.054	79.407	2.097	Uttarakhand	Chamoli
438	28.243	86.196	17.695	Transboundary	
439	28.769	83.036	2.776	Transboundary	
440	30.981	79.488	5.599	Uttarakhand	Chamoli
441	28.747	84.600	8.455	Transboundary	
442	28.886	83.527	30.918	Transboundary	
443	31.053	79.412	1.585	Uttarakhand	Chamoli
444	28.538	85.488	2.350	Transboundary	
445	28.821	84.875	1.034	Transboundary	
446	28.141	86.553	1.271	Transboundary	
447	27.809	87.701	2.907	Transboundary	
448	31.024	79.361	3.336	Uttarakhand	Chamoli
449	27.944	86.549	5.501	Transboundary	
450	27.982	86.782	1.155	Transboundary	
451	27.945	87.789	2.073	Transboundary	
452	27.888	87.722	2.338	Transboundary	
453	27.975	86.737	2.813	Transboundary	
454	28.664	84.558	1.096	Transboundary	
455	27.834	88.067	2.940	Transboundary	
456	30.315	81.360	4.155	Transboundary	
457	28.374	86.259	27.538	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
458	28.412	85.600	1.039	Transboundary	
459	31.024	79.356	1.045	Uttarakhand	Chamoli
460	28.015	86.503	1.921	Transboundary	
461	27.945	86.818	1.543	Transboundary	
462	30.079	82.119	1.376	Transboundary	
463	30.222	81.777	9.093	Transboundary	
464	28.405	85.588	10.508	Transboundary	
465	29.169	83.765	1.750	Transboundary	
466	28.232	86.412	8.598	Transboundary	
467	28.136	86.264	3.384	Transboundary	
468	28.019	86.733	3.449	Transboundary	
469	28.275	85.798	1.921	Transboundary	
470	28.826	84.150	10.737	Transboundary	
471	28.083	86.503	1.161	Transboundary	
472	30.353	81.351	1.768	Transboundary	
473	28.142	87.105	16.525	Transboundary	
474	31.061	79.410	3.280	Uttarakhand	Chamoli
475	30.904	79.747	11.055	Uttarakhand	Chamoli
476	28.230	86.146	1.718	Transboundary	
477	29.961	82.084	2.522	Transboundary	
478	27.781	86.589	1.106	Transboundary	
479	28.211	86.743	1.286	Transboundary	
480	27.711	86.599	7.730	Transboundary	
481	27.805	87.749	1.161	Transboundary	
482	29.297	82.705	10.034	Transboundary	
483	27.936	86.713	1.359	Transboundary	
484	27.788	86.632	4.679	Transboundary	
485	30.290	81.364	7.574	Transboundary	
486	28.858	83.473	1.269	Transboundary	
487	28.776	85.122	5.676	Transboundary	
488	27.820	87.672	2.406	Transboundary	
489	28.252	86.218	9.075	Transboundary	
490	29.051	83.605	3.064	Transboundary	
491	27.674	87.625	4.203	Transboundary	
492	28.552	85.414	1.396	Transboundary	
493	27.719	86.910	14.932	Transboundary	
494	30.139	81.789	1.795	Transboundary	
495	30.402	80.784	43.347	Transboundary	
496	28.738	85.146	1.238	Transboundary	
497	31.142	79.260	1.706	Uttarakhand	Uttarkashi
498	27.994	88.402	18.970	Transboundary	
499	28.065	88.543	7.307	Transboundary	
500	28.151	85.905	12.596	Transboundary	

Rank	Latitude	Longitude	Area (ha)	State/Transboundary	District
501	28.210	86.654	1.131	Transboundary	
502	28.968	83.208	8.336	Transboundary	
503	31.138	79.309	1.078	Uttarakhand	Uttarkashi
504	28.239	86.158	1.053	Transboundary	
505	29.039	83.669	7.883	Transboundary	
506	30.312	81.409	13.272	Transboundary	
507	28.277	87.588	5.349	Transboundary	
508	28.389	85.856	3.746	Transboundary	
509	29.007	83.503	1.011	Transboundary	
510	28.363	86.487	4.974	Transboundary	
511	28.224	85.804	4.640	Transboundary	
512	28.035	87.858	2.103	Transboundary	
513	29.072	83.645	3.907	Transboundary	
514	28.202	86.549	6.188	Transboundary	
515	30.021	81.367	1.215	Transboundary	
516	27.993	86.838	1.675	Transboundary	
517	27.855	87.753	4.858	Transboundary	
518	27.829	87.095	12.058	Transboundary	
519	28.617	84.912	10.082	Transboundary	
520	28.348	86.493	34.510	Transboundary	
521	27.943	86.554	1.387	Transboundary	
522	30.392	80.532	11.212	Uttarakhand	Pithoragarh
523	27.814	87.632	1.374	Transboundary	
524	30.057	81.941	13.872	Transboundary	
525	31.379	79.014	4.004	Uttarakhand	Uttarkashi
526	28.778	83.046	5.964	Transboundary	
527	27.938	86.711	9.829	Transboundary	
528	29.459	82.394	7.419	Transboundary	
529	28.229	86.320	8.202	Transboundary	
530	30.901	79.746	11.407	Uttarakhand	Chamoli
531	28.265	86.413	1.137	Transboundary	
532	27.647	87.981	2.215	Transboundary	
533	30.898	79.754	1.691	Uttarakhand	Chamoli
534	28.640	84.789	3.538	Transboundary	
535	28.178	86.322	3.803	Transboundary	
536	30.302	81.399	11.680	Transboundary	
537	30.277	81.877	5.456	Transboundary	
538	28.133	86.548	3.669	Transboundary	
539	30.314	81.399	9.474	Transboundary	
540	28.771	83.032	1.098	Transboundary	
541	28.962	83.633	2.151	Transboundary	
542	28.237	86.227	1.218	Transboundary	
543	28.780	83.042	1.393	Transboundary	