Lessons from the 2013 Kedarnath Floods

Department of Disaster Management and Rehabilitation
Government of Uttarakhand

16-17 June, 2013 Kedarnath - Cloudburst

- Monsoon arrived early in 2013 (13 June), and rainfall was 440% above the normal (71.3 mm)
- 05 districts were worst affected – Pithoragarh, Rudraprayag, Chamoli, Uttarkashi and Bageshwar.
- On 15-16 June 2013 Meteorological stations near Chorabari glacier recorded 325 mm rainfall.
- Rambara en-route to Kedarnath was washed away in the evening of 16 June 2013.
- Moraine dammed Chorabari Lake bursted on 17 June 2013 around 6:45 AM, flooding and devastating Kedarnath town.
- Heavy flooding downstream resulting in washing away of roads and bridges.

Rainfall in excess of 100 mm in 08 districts on 16 -17 June 2013

Sl. No.	District	14 June 2013	15 June 2013	16 June 2013	17 June 2013	18 June 2013
1.	Almora	9.6	0.5	24.2	63.7	110.1
2.	Bageshwar	29.1	11.6	83.0	183.0	73.1
3.	Chamoli	2.30	22.6	61.48	113.1	85.23
4.	Champawat	0.0	0.5	18.5	98.0	226.0
5.	Dehradun	54.7	48.75	178.45	202.6	9.9
6.	Pauri	5.33	3.0	60.33	41.66	39.3
7.	Tehri	1.1	10.2	113.35	149.15	51.4
8.	Haridwar	5.0	12.5	79.3	182.5	14.5
9.	Nainital	9.6	10.53	71.0	204.1	210.5
10.	Pithoragarh	2.0	12.5	27.6	85.3	96.1
11.	Rudraprayag	14.5	41.4	105.2	100.2	62.1
12.	US Nagar	0.0	32.5	3.8	46.55	74
13.	Uttarkashi	13.7	38.8	113.6	117.4	38.4

Note: *There was no rain on the corresponding dates during 2012 except 0.5 mm in Chamoli on 17 June 2012.*

16-17 June, 2013 Kedarnath - Cloudburst

Pictorial glimpse of damages

Embankment on the left bank collapsed

Before

After

16-17 June, 2013 Kedarnath - Cloudburst

River Alaknanda at Rudraprayag

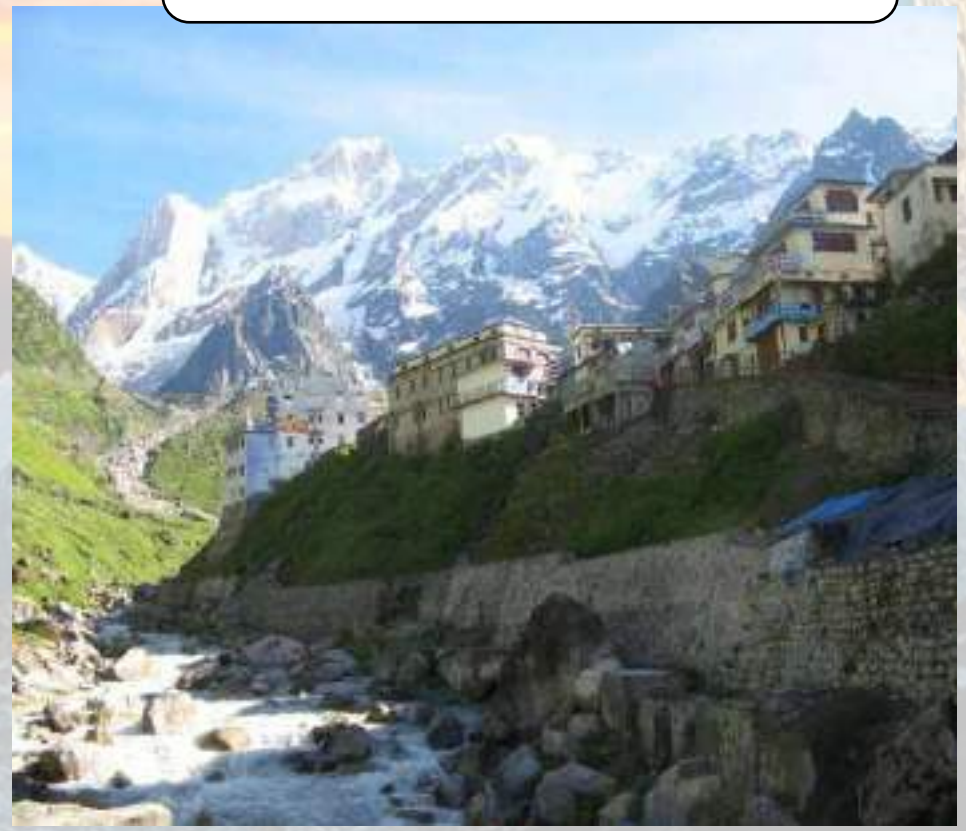
March 2013

16 June 2013

17 June 2013

Devastation along Mandakini at Kedarnath

Before disaster



After disaster

Devastation

Bhagirathi at Uttarkashi

Kali valley

Loss of fertile land (near Okhimath)

Debris flow at Dharali near Harsil

16-17 June, 2013 Kedarnath - Cloudburst

Losses due to heavy rain and cloud burst

- **Human Loss – 4023**
- **House Damaged – 3077**
- **Animal Loss – 17700**
- **Electricity Supply –**
  - **Tentative Cost of Losses- 2662.6 (INR million)**

Utility	Description
UJVNL	17 small hydro projects with an aggregate installed capacity of 66.1 MW
UREDA	41 small hydro projects with aggregate installed capacity of 5294 kW
UPCL	Damages to 33kV, 11kV and LT lines - 60.92 km, 195.53 km and 220.18 km respectively Distribution transformers affected -377

Losses

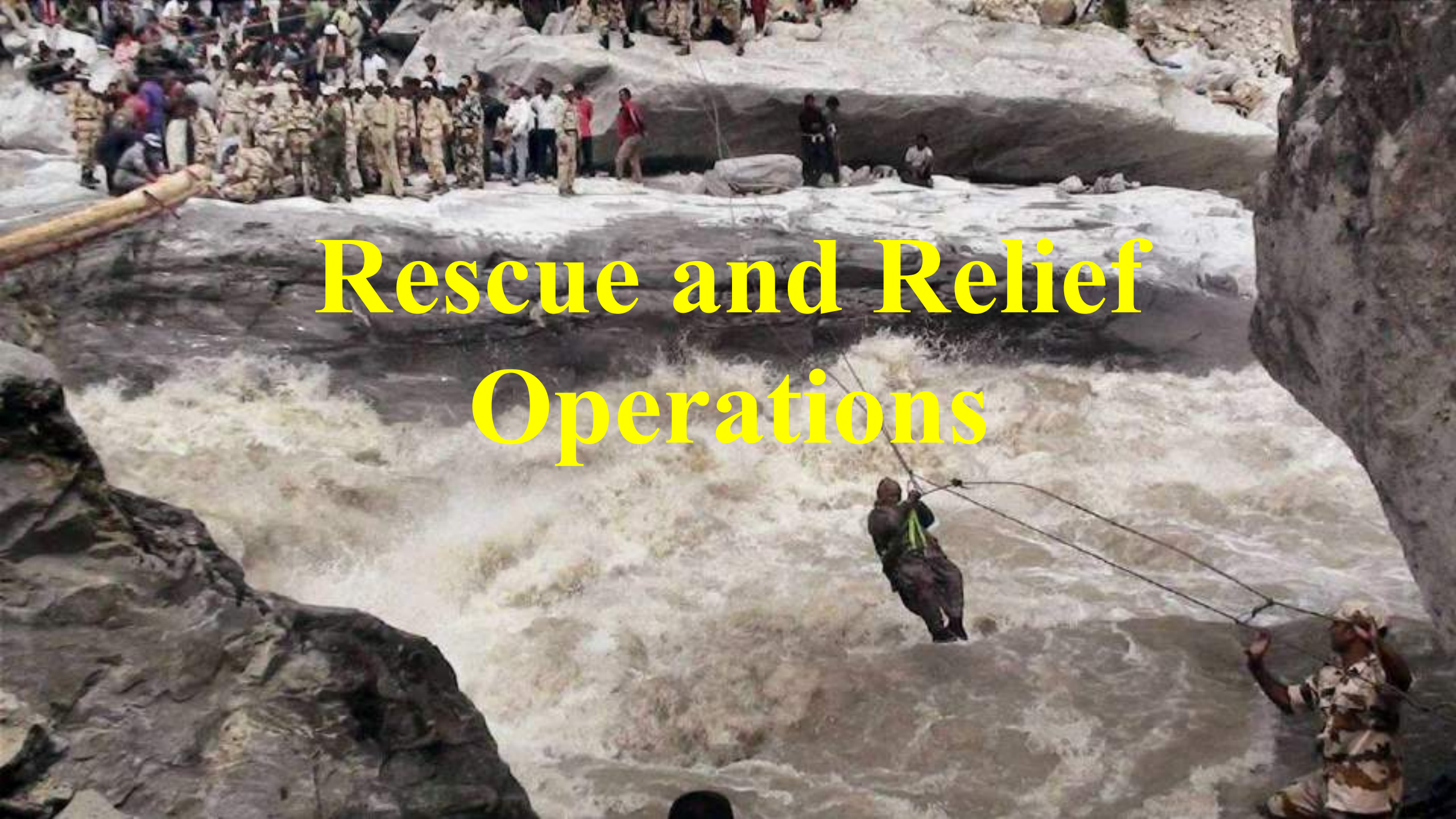
Infrastructure and Livelihood

Departments	Cost (INR million)
Housing	1505.0
Public Buildings	1029.0
Roads and Bridges	27102.5
Urban (Water Supply and Sanitation)	1268.5
Rural (Water Supply and Sanitation)	1304.5
Livelihoods(Agriculture, Livestock, Fisheries,Tourism linked livelihoods, Microenterprisesandother)	1668.0
Irrigation	1393.0
Tourism	1166.5
Energy/Power	2663.5
Forest and Biodiversity	546.5
GRAND TOTAL	39,647.0

The indirect losses were mainly in the form of lost milk production which were estimated at INR 4.50 million. Indirect losses were not calculated for fisheries subsectors

Deployment of Resources

- **Besides 17 civilian choppers hired by State Government**
  - **54 IAF choppers and fixed wing crafts,**
  - **07 Army Aviation choppers and**
  - **04 choppers of other states were pressed into service**
  - **69 permanent and temporary helipads were activated to evacuate the stranded persons**
- **586 buses and 1,440 taxies / jeeps were requisitioned for evacuation**



Rescue and Relief Operations

Relief On-Site

- 71 relief camps were organised across the state at different places
- 1,51,629 persons were provided food, shelter, medical care and other facilities for different durations
- More than 772 metric ton supplies were airlifted by IAF alone
- 1,306 trucks were requisitioned for transporting relief supplies
- 43 medical teams comprising 313 doctors and 4977 para-medical staff was deployed
- GoI also supplemented with 80 doctors, 11 psychiatrists and 5 public heath teams besides certain equipment such as water purifiers

Rescue Operations – Helicopter landing on road side, Gaurikund

Rescue operations at River bed

Vehicles burried in debris at Dharali (near Harsil) in Uttarkashi

Devastation by Asiganga in Rudraprayag

Mandakini at Rudraprayag

Normal water level

Water level on 17th June, 2013

Rescue – Attempt to cross river at Augustmuni

Installing Temporary Bridge over Alaknanda - Govindghat

Livestock rescue in Govindghat Valley

Food Supply (Joshimath)

Road Restoration work at Kund Rudraprayag

Archaeological Survey of India working on repair / retrofitting of Temple and Platform

Reconstruction and Restoration of Kedarnath


ॐ

The Emergence of UDRP

Uttarakhand Disaster Recovery Project (UDRP), with the assistance from the World Bank emerged as a ray of hope for the victims of the disaster in their gruesome time. As the project prioritized investment in disaster prevention and post – disaster investments with the objective –

"Strive to Build Back Better ,Safer & Stronger Uttarakhand"

Estimated cost on Reconstruction and Recovery after Kedarnath 2013 disaster

Components	Total (INR M)
1: Resilient Infrastructure Reconstruction	1950.52
2: Road Connectivity	9752.6
3: Technical Assistance and Capacity Building for Disaster Risk Management	2390.96
4: Financing Disaster Response Expenses	755.04
5: Implementation Support	880.88
6: Contingency Emergency Response	1950.52
Total Project Cost	**17680.52**

Work done by USDMA under DRR

1. Hydro- Meteorological Early Warning System

1a. Meteorological Early Warning System

1b. Flood Early Warning System

1c. Flood Early Warning System

1d. Monitoring of Glaciers and glacial lakes

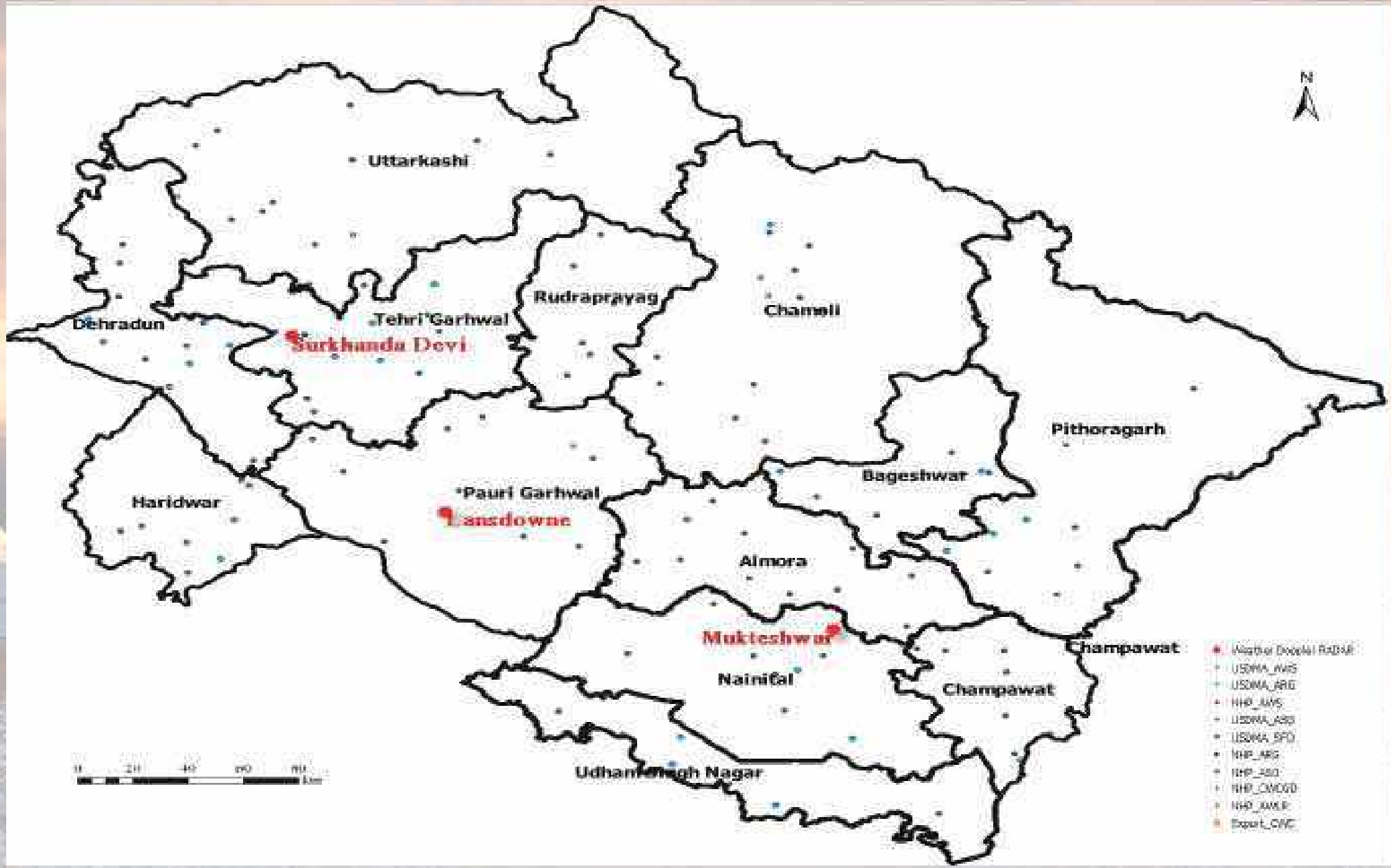
1e. Avalanche Early Warning System

1f. Multi-Hazard Early Warning System

1a. Meteorological Early Warning System

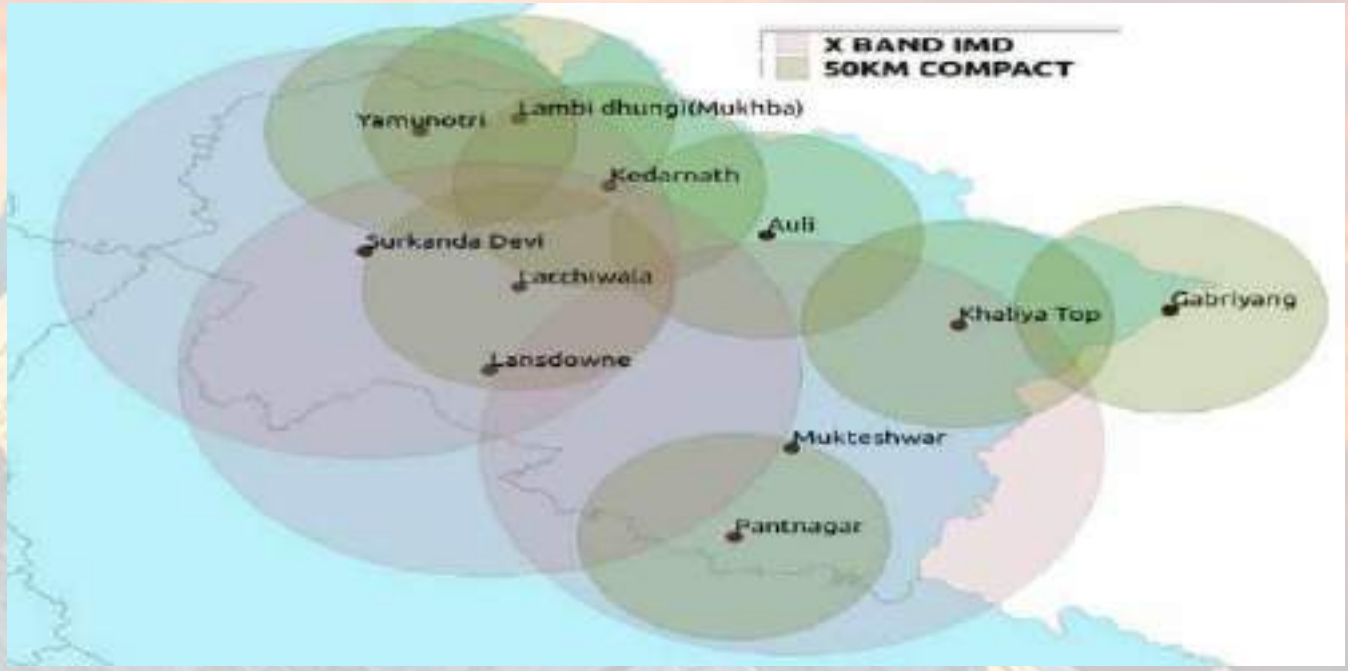
- 03 Doppler Weather Radars (DWR) installed by IMD and essential services such as land, electricity, road, water etc., facilitated by state government;
  - ✓ 02 DWR are operational at Mukteshwar, & Surkanda Devi.
  - ✓ 01 DWR is in testing phase at Lansdowne.
- Integration of IMD Forecast /Nowcast through API to IDMS/DSS in SEOC;

Instruments	Installed Meteorological Sensors				Proposed Meteorological Sensors			
	USDMA	IMD	CWC	Total	NHP	DGRE	USDMA	Total
Meteorological Sensors *(AWS/ ARG/ SFO/ ASG)*	**176**	**80**	**112**	**368**	**64**	**74**	**136**	**274**
Doppler Weather Radars	-	**03**	-	**03**	-	-	-	-


N
Uttarkashi
Dehradun
Tehri Garhwal
Rudraprayag
Chamoli
Surkhanda Devi
Pithoragarh
Bageshwar
Pauri Garhwal
Haridwar
Lansdowne
Almora
Mukteshwar
Champawat
Nainital
Champawat
Udhamsingh Nagar
0 20 40 60 80
Km

❖ Proposal to densify meteorological Network for precise and location specific information-

- 108 Automated Weather Stations (AWS)
- 18 Automated Snow Stations (ASG)
- 07 Compact Doppler Weather Radars



- Subscribing hydro-met forecast services provided by the reputed private service providers to fill the existing gaps.

Automatic Weather Stations

Kedarnath

Gangotri

Badrinath

AUTOMATIC SNOW GAUGE (CHAKRATA)

Surface Field Observatory (Kalsi)

1b. Flood Early Warning System

Instruments	Installed Hydrological Sensors					Proposed Hydrological Sensors
	CWC	THDC	NTPC	JAYPEE	Total	NHP
AWLR	**28**	**07**	**06**	**01**	**39**	**59**
AWVR			**06**	**6**		

- Siren system for warning in the downstream habitations
  - ✓ Sirens and speakers are installed by THDC at 8 locations

Integration of Flood warning System with SEOC

- Warning system of THDC, NTPC and Jaypee has already been integrated with USDMA through API
- Shadow control point of their siren system has installed in SEOC
- Installations of sensors and siren systems in rest of the 12 dams 15 barrages are under process
- Integration will be completed before March .

1c. Monitoring of Glaciers and Glacial Lakes

The Uttarakhand State Disaster Management authority has roped in organizations Wadia Institute of Himalayan Geology (WIHG) and Indian Institute of Remote Sensing (IIRS) for the monitoring of the glacier/glacial lakes in the higher Himalaya.

- **Satellite Based Mountain Hazard Assessment and Monitoring (MHAM) In Uttarakhand – IIRS**
  - ✓ IIRS has completed preparation of glacial inventory maps and the database of the same is uploaded for visualization on Spatial Decision Support System (SDSS) which is designed by IIRS as a pert of this project (https://geohim.iirs.gov.in), which is updated every 15 days.
  - ✓ Regular snow cover monitoring is beingcarried out by MODIS satellite data of 500m resolution.
  - ✓ Integration of glacial thematic layers of Mandakini, Rishiganga and Bhagirathi valleys are in progress.
- **Long term Monitoring of Gangotri Glacier, Garhwal Himalaya, Uttarakhand - WADIA**
  - ✓ WADIA has completed the field reconnaissance survey and satellite data study in and around the Gangotri glacier region.
  - ✓ Has stationed two watch and ward at Bhojwasa base camp to monitor the site periodically
  - ✓ The installation of 2 Automatic Weather Stations, 1 Automation Water Level Recorder and 2 Broadband Seismometers are under progress.

1d. Avalanche Early Warning System

- To strengthen the avalanche early warning system DGRE (DRDO), Chandigarh proposed 74 Automated Weather Stations :
  - 05 AWS is already installed
  - Installation work is being carried out by DGRE (DRDO), Chandigarh
  - Disaster Management Department facilitating the logistic supports and essential services
  - The real time data will be integrated in SEOC

1e. Multi-Hazard Early Warning System

- A project worth Rs.118 Cr. has been finalized under WB funded UPREPARE project
- Under this project integrated DSS, 250 omni siren system, video monitoring system in vulnerable areas in terms of crowd, flash flood & landslide, end-to-end connectivity and multi faceted warning dissemination system

2. Disaster Risk Database for DRR

2a. DRDB- Disaster Risk Database

- 23 lakhs buildings in 2 lakhs clusters were surveyed
  - Surveyed household -**27158**
  - Critical buildings – **28798**

2b. URMIS-Uttarakhand River Morphology Information System

- River morphological study was carried out along the 04 major rivers (Alaknanda, Bhagirathi, Mandakini & Kali river)
- Cross-section were taken more then 200 locations

2c. Initiatives for Disaster Risk Mapping

- LIDAR mapping , geo-technical and geo-physical investigation are being carried out in all hill towns to assess vulnerability and prepare construction guidelines

Disaster Risk Mapping by Uttarakhand Landslide Mitigation and Management Centre

- **Geo-investigation of major hill townships to prepare a digital database on a large scale gridded layer in GIS platform**
  - ✓ 14 hill cities are being taken up in the first phase
  - ✓ 3D Topographic mapping using LiDAR/Drone Survey
  - ✓ Engineering Geological Investigation
  - ✓ Geophysical Investigation
  - ✓ Geotechnical Investigation

- **Landslide Risk Assessment of Major Hill Townships**
  - ✓ Slope stability analysis of vulnerable areas
  - ✓ Landslide Inventory Atlas of Alaknanda, Bhagirathi and Mandakini Valleys
  - ✓ Ground deformation study of landslide potential areas using Remote Sensing InSAR data
  - ✓ Landslide monitoring and early warning through instrumentation and real time data
  - ✓ Scheme of possible mitigation measures

List of major hill townships and the related study application in 1st phase

Major hill townships	
Joshimath	**New Tehri**
Srinagar	**Almora**
Nainital	**Uttarkashi**
Pauri	**Gopeshwar**
Karnprayag	**Dharchula**
Champawat	**Rudraprayag**
Chamoli	**Gairsain**

The study applications proposed for implementation in these selected major hill townships in 1st phase:

- Suggestive plans for rehabilitation
- Town Planning (Master Plan)
- Drainage and Sewerage Plan
- Construction Guidelines

DISASTER RISK DATA BASE (DRDB)

Uttarakhand State Disaster Management Authority
Government Of Uttarakhand

State Emergency Operation Centre:
0135-2710334, 1070 (Toll Free)
District Emergency Operation Centre: 1077

HOME | RISK DATA | RISK ATLAS | DOCUMENTS | HELP | WELCOME: GUEST | LOGIN

Uttarakhand Risk Database

The online Uttarakhand Risk Database provides maps, data, and documents that support disaster risk reduction activities and planning throughout Uttarakhand.

It allows the exchange and update of information relating to ***HAZARDS***, ***EXPOSURE***, ***VULNERABILITY***, and ***RISK*** across the state. The database is administered by USDMA. Contact USDMA for more information.

CAPRA Probabilistic Risk Assessment Platform

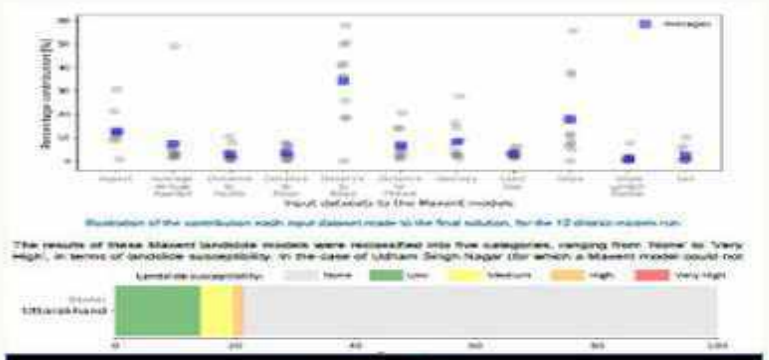
The Risk Database shows risk assessments from R-CAPRA

RISK DATA

Explore and download data on Exposure, Hazard, Vulnerability and Risk in GIS format. Compatible with ArcGIS and QGIS.

RISK ATLAS

The Risk Atlas gives you static maps from State to Block level for printing or including in your own reports. The maps are in PNG format for compatibility.

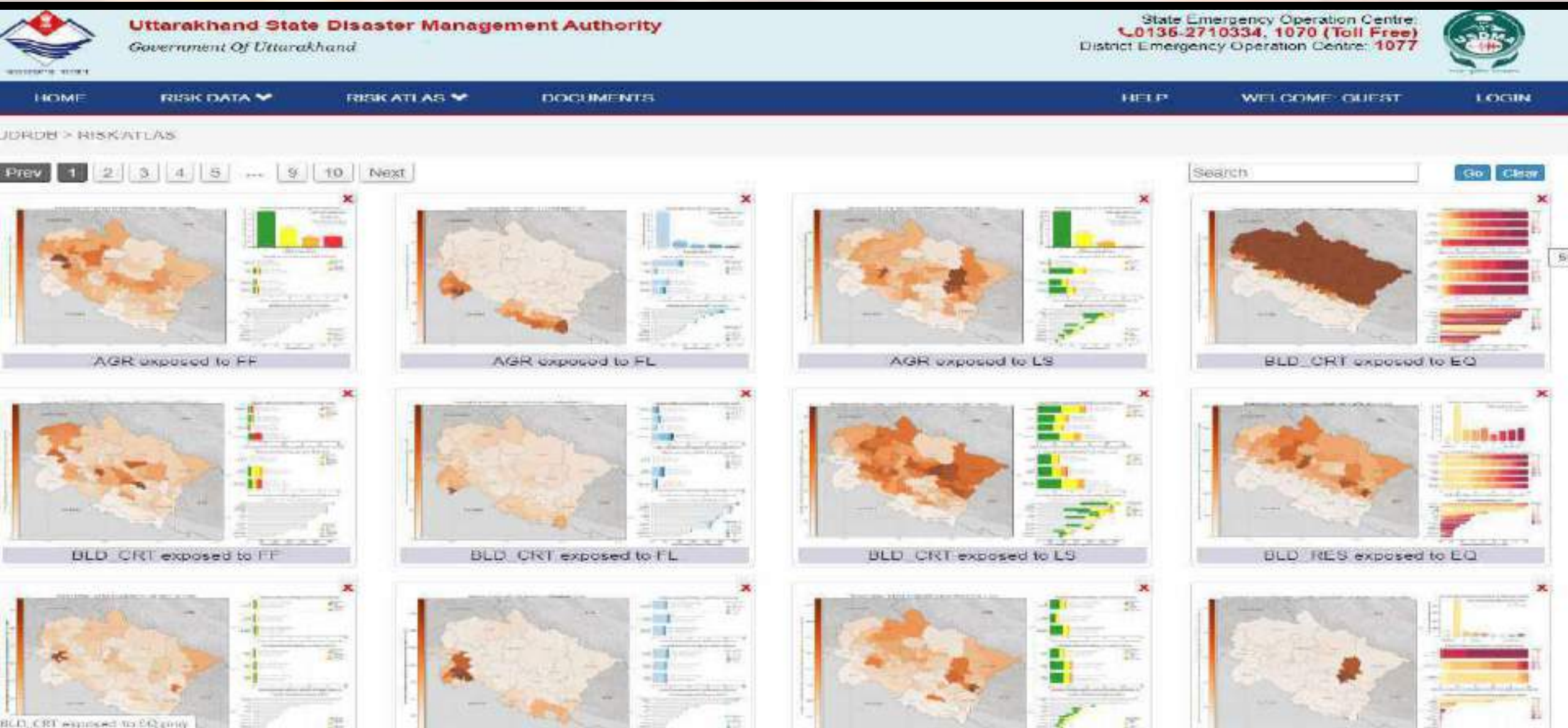


DOCUMENTS

Includes the Disaster Risk Assessment (2016 to 2018) project reports, key references, and the full Risk Atlas of Uttarakhand in PDF format.

Register to Use the Risk Database

HRVA ATLAS OF UTTARAKHAND



HRVA ATLAS UPTO BLOCK LEVEL

Uttarakhand State Disaster Management Authority

Government Of Uttarakhand

State Emergency Operation Centre
0135-2710334, 1070 (Toll Free)
District Emergency Operation Centre: 1077

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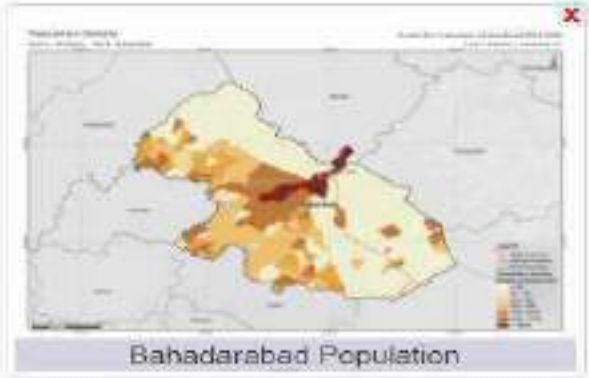
UDRDB > RISK ATLAS

Prev 1 2 3 4 5 6 ... 110 111 Next

Search Go Clear


Bahadarabad Landslide Susceptibility


Bahadarabad Lifeline Buildings

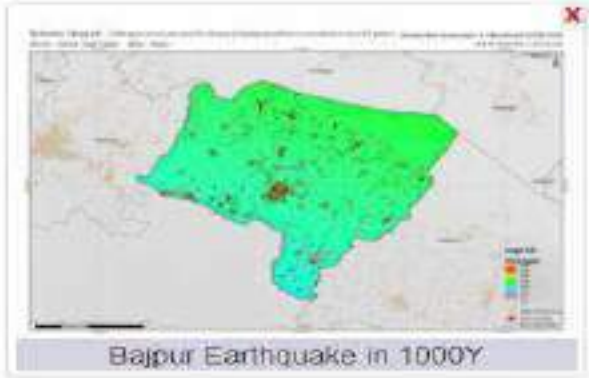

Bahadarabad Population


Bahadarabad Settlements

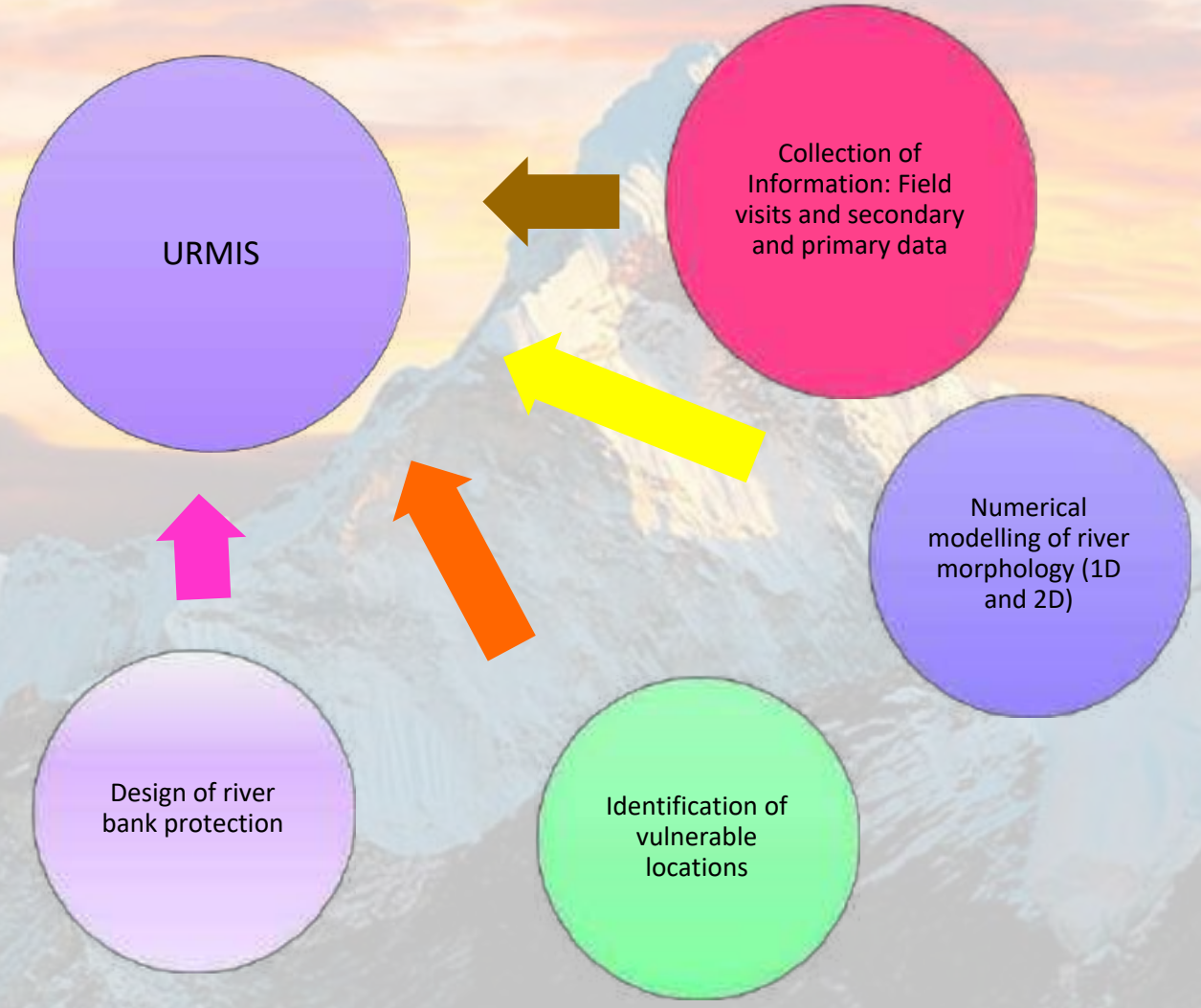

Bahadarabad Tourism


Bahadarabad Transport


Bajpur Agriculture


Bajpur Earthquake in 1000Y

Development of Uttarakhand River Morphological Information System (URMIS)

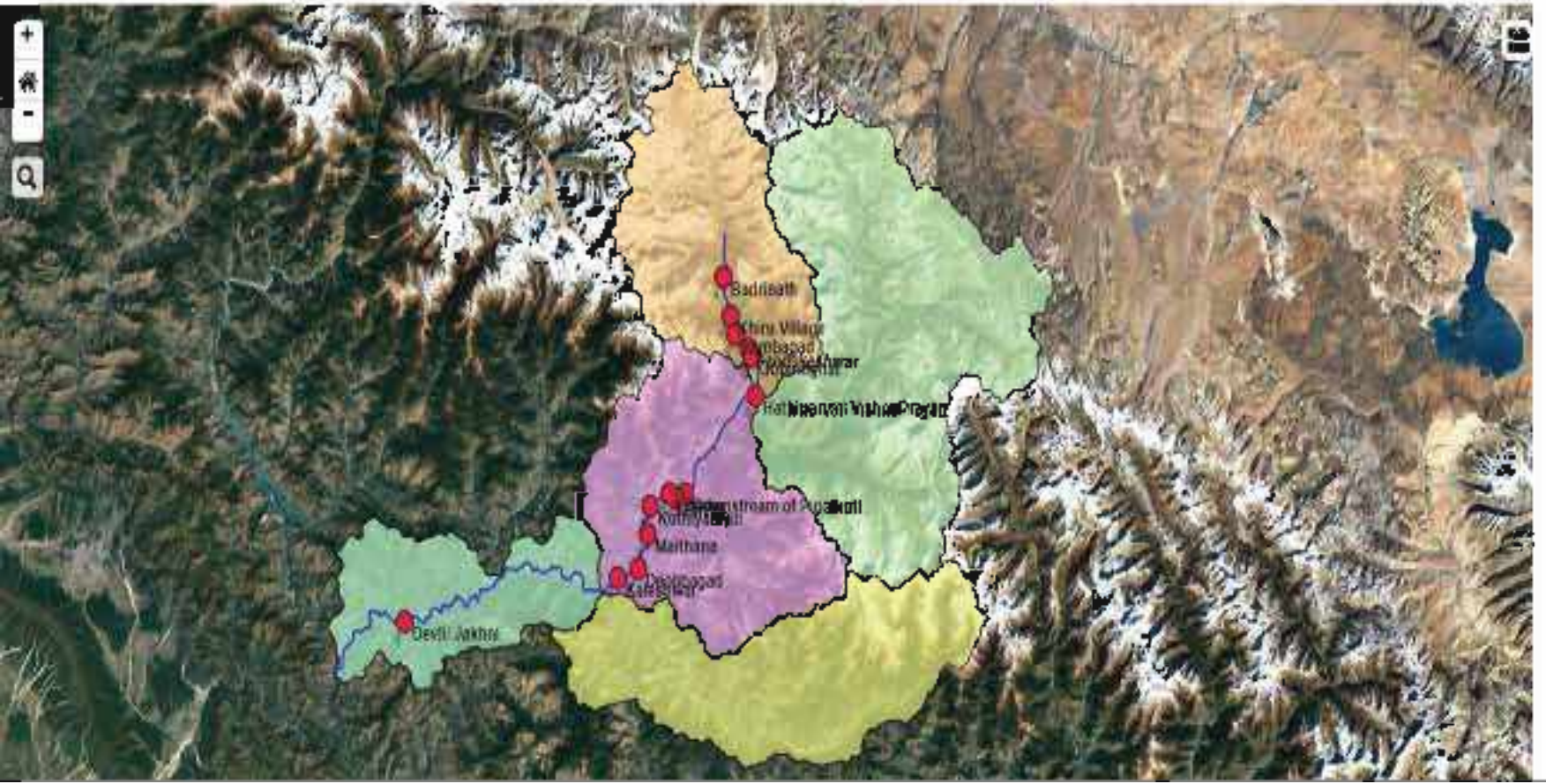


Uttarakhand River Morphology Information System

उत्तराखंड शासन

Home | GIS Layers | Data | Vulnerable Locations | Documents | Projects | Modelling | Gallery | Feedback | Help | Admin

URMIS > Alaknanda Water Level Results



Run Scenario | Table

Selected Feature: Badrinath

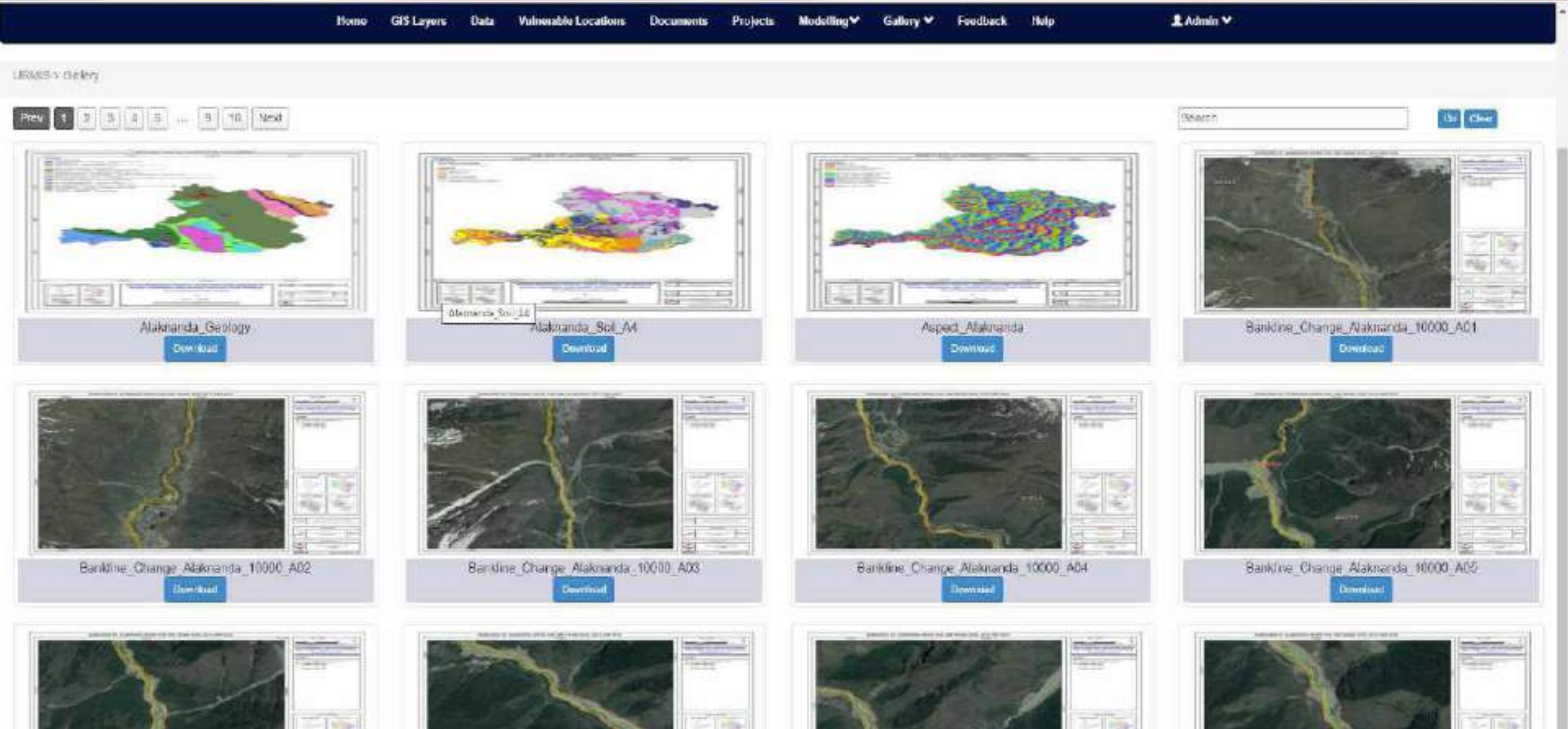
Design Flood Results

	Name	Variable	Unit
✓	ALAKNANDA 0_100Year	Water Level	m
✓	ALAKNANDA 0_25Year	Water Level	m
✓	ALAKNANDA 0_50Year	Water Level	m
✓	ALAKNANDA 0_100Year	Discharge	m^3/s
✓	ALAKNANDA 0_25Year	Discharge	m^3/s
✓	ALAKNANDA 0_50Year	Discharge	m^3/s

Scenario Results

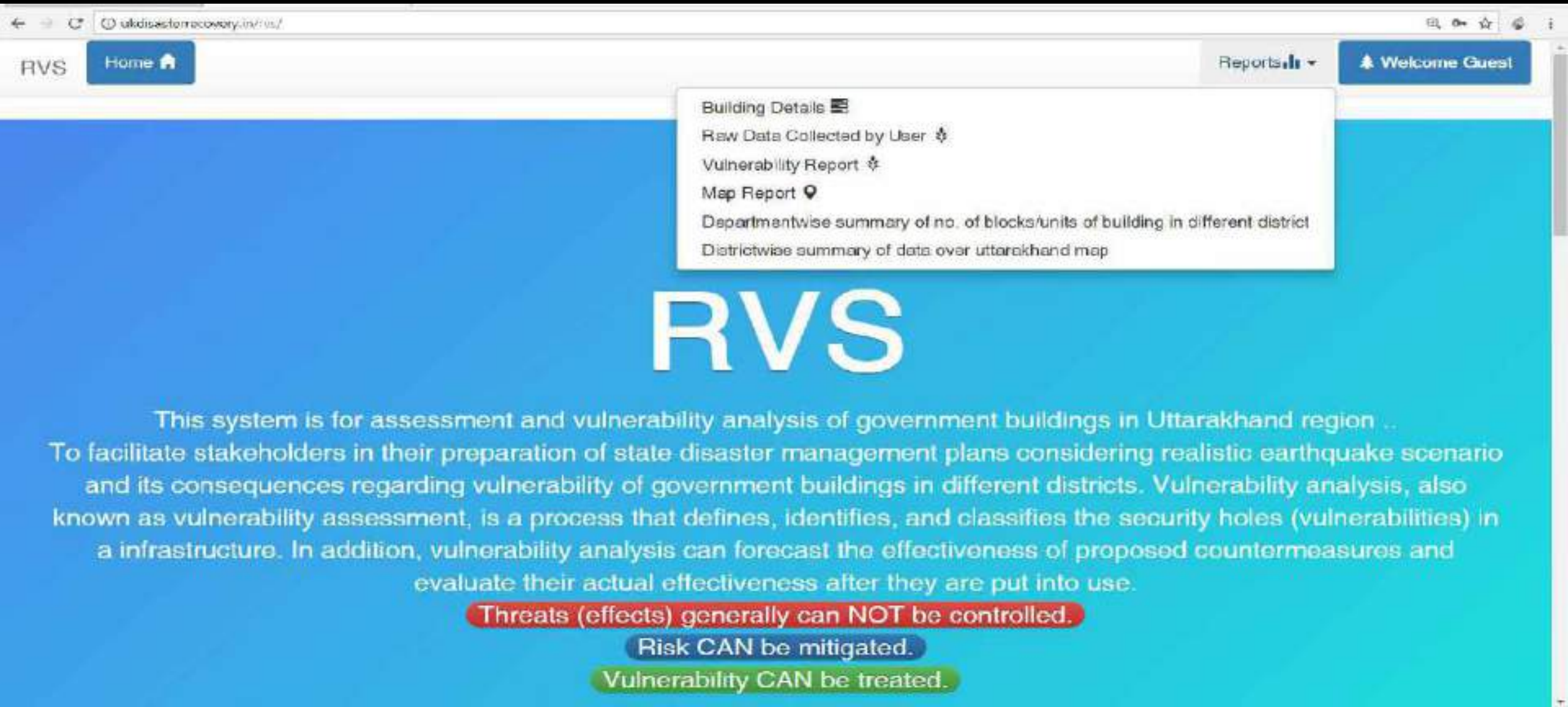
	Name	Variable	Unit
☐	ALAKNANDA 0_Case 1	Water Level	m

Morphological models available in URMIS



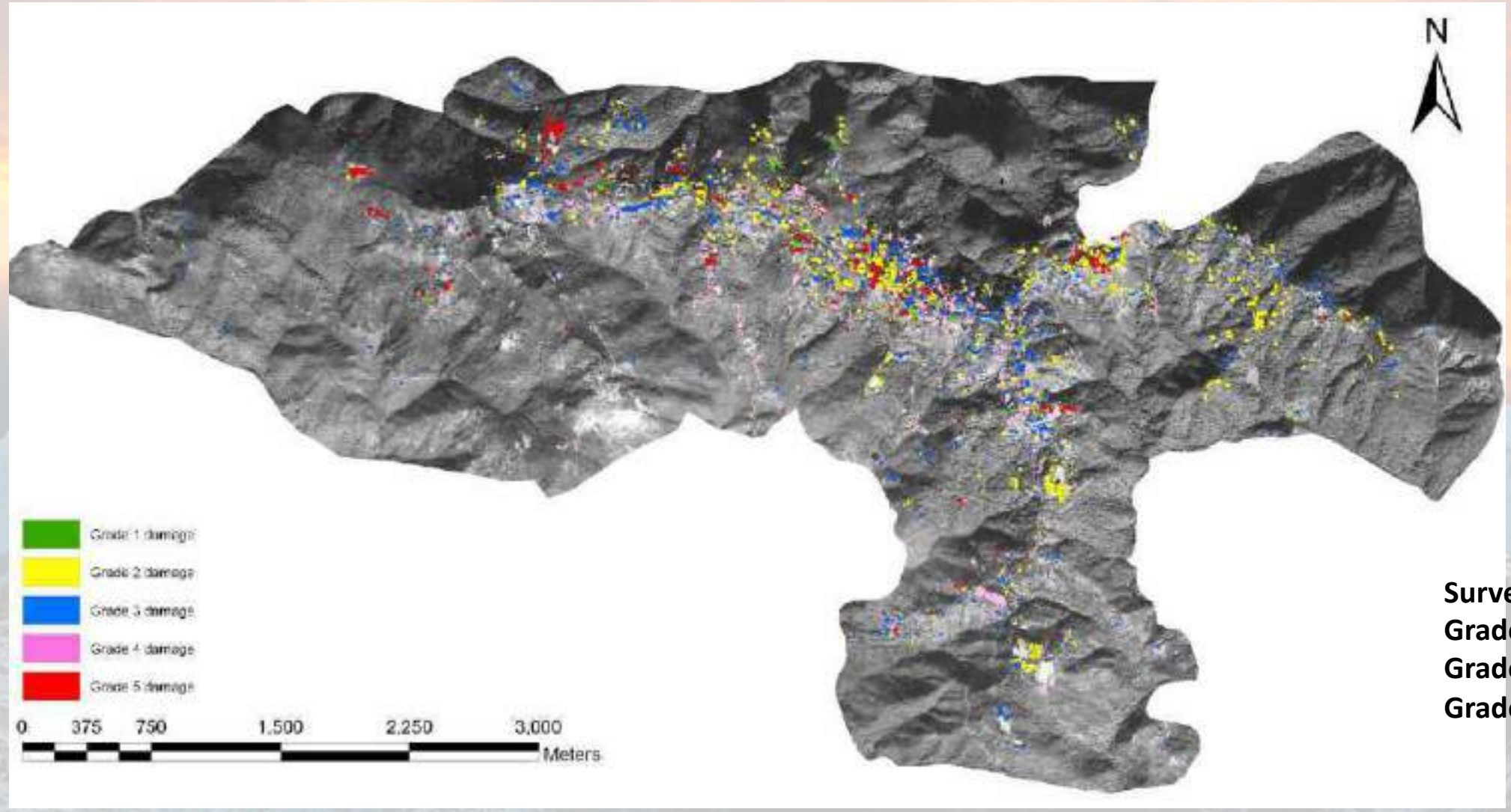
Establishment of a Decision Support System (DSS)

Rapid Visual Screening of Public Buildings of Uttarakhand State (Web based assessment system)



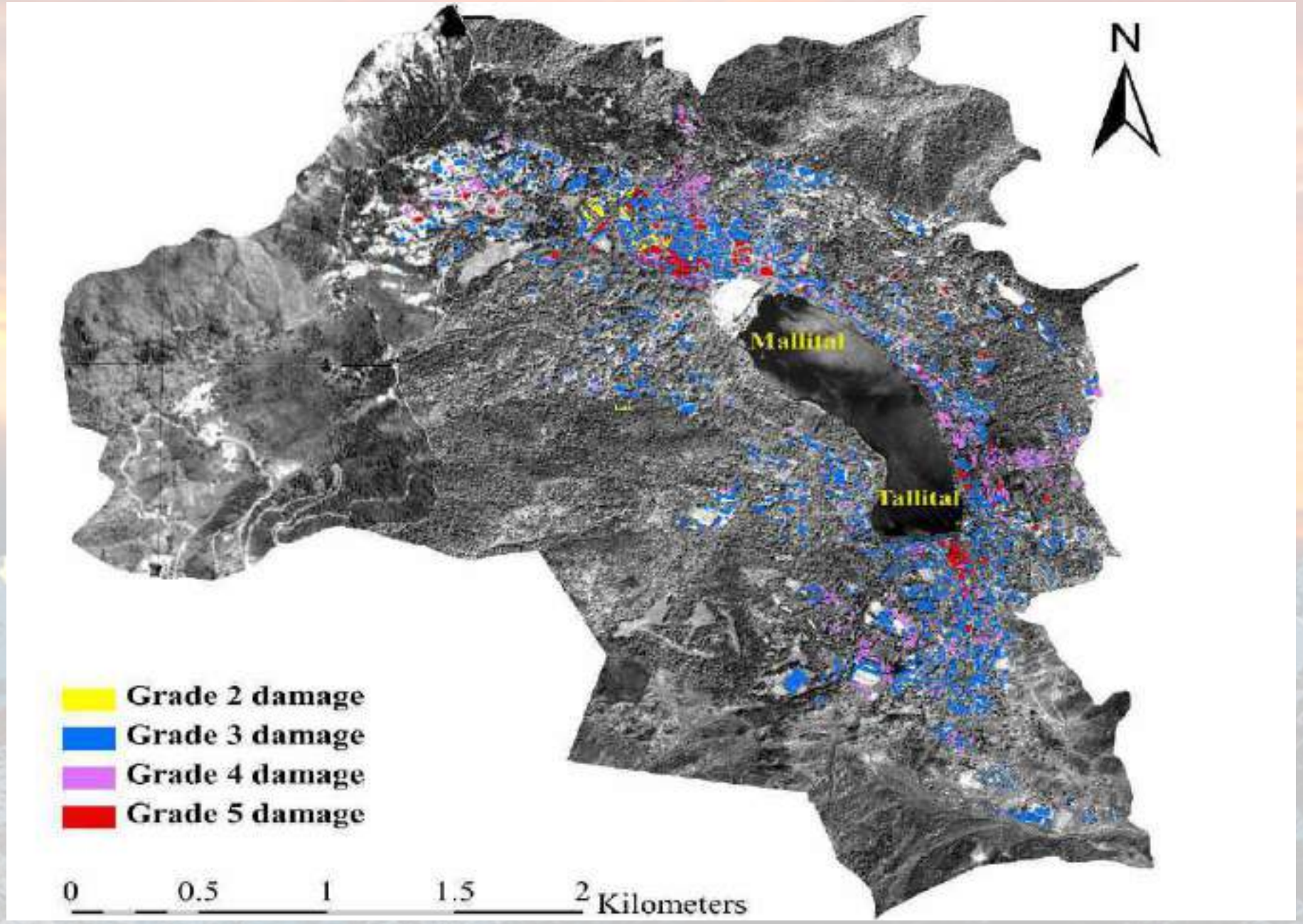
Fast Vulnerability assessment

Seismic Vulnerability Assessment of Residential Buildings



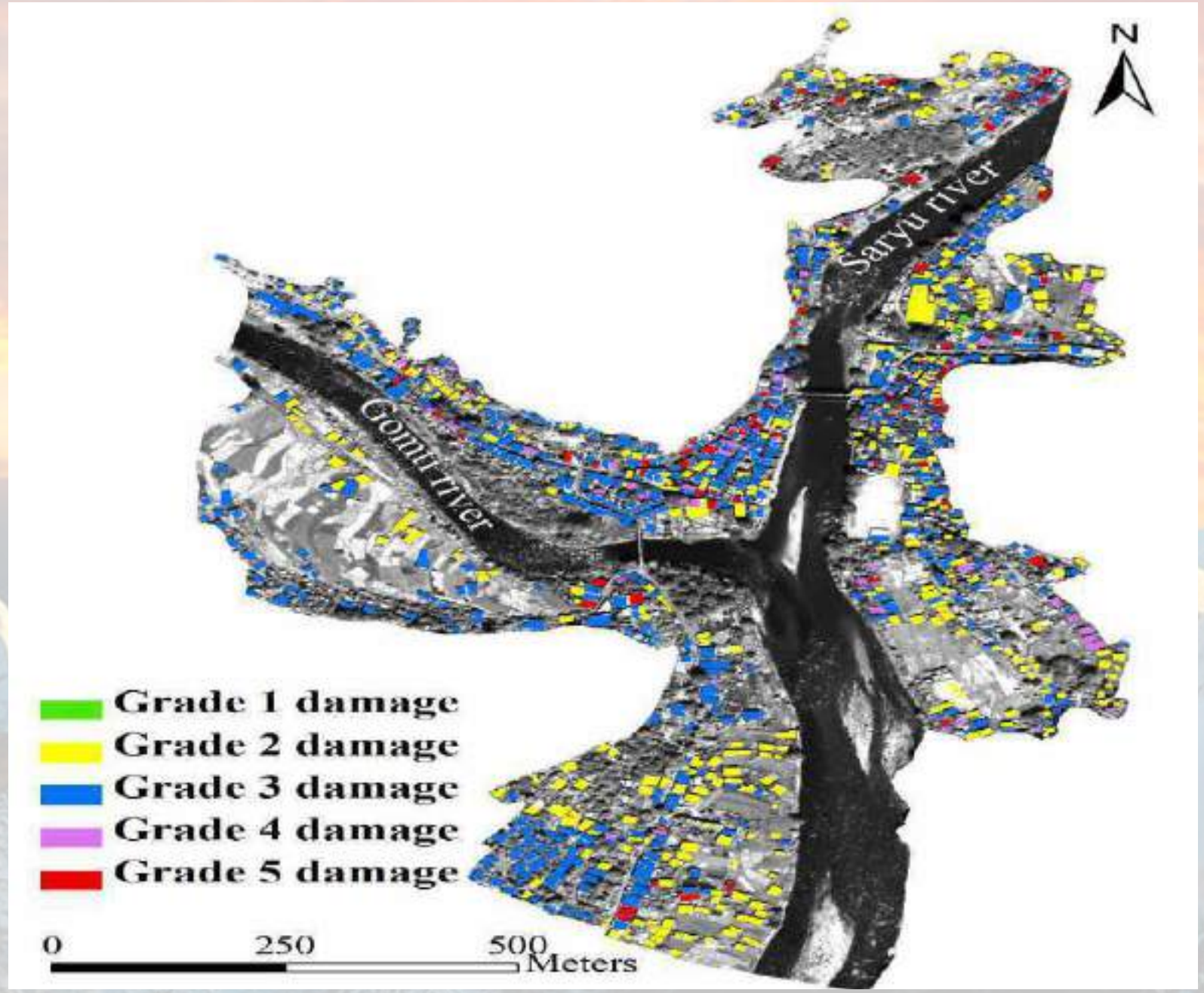
Mussoorie:
37% of 3,344 unsafe

Surveyed: 3,344
Grade 5: 615
Grade 4: 605
Grade 3: 1,697



Nainital:
37% of 2,840 unsafe

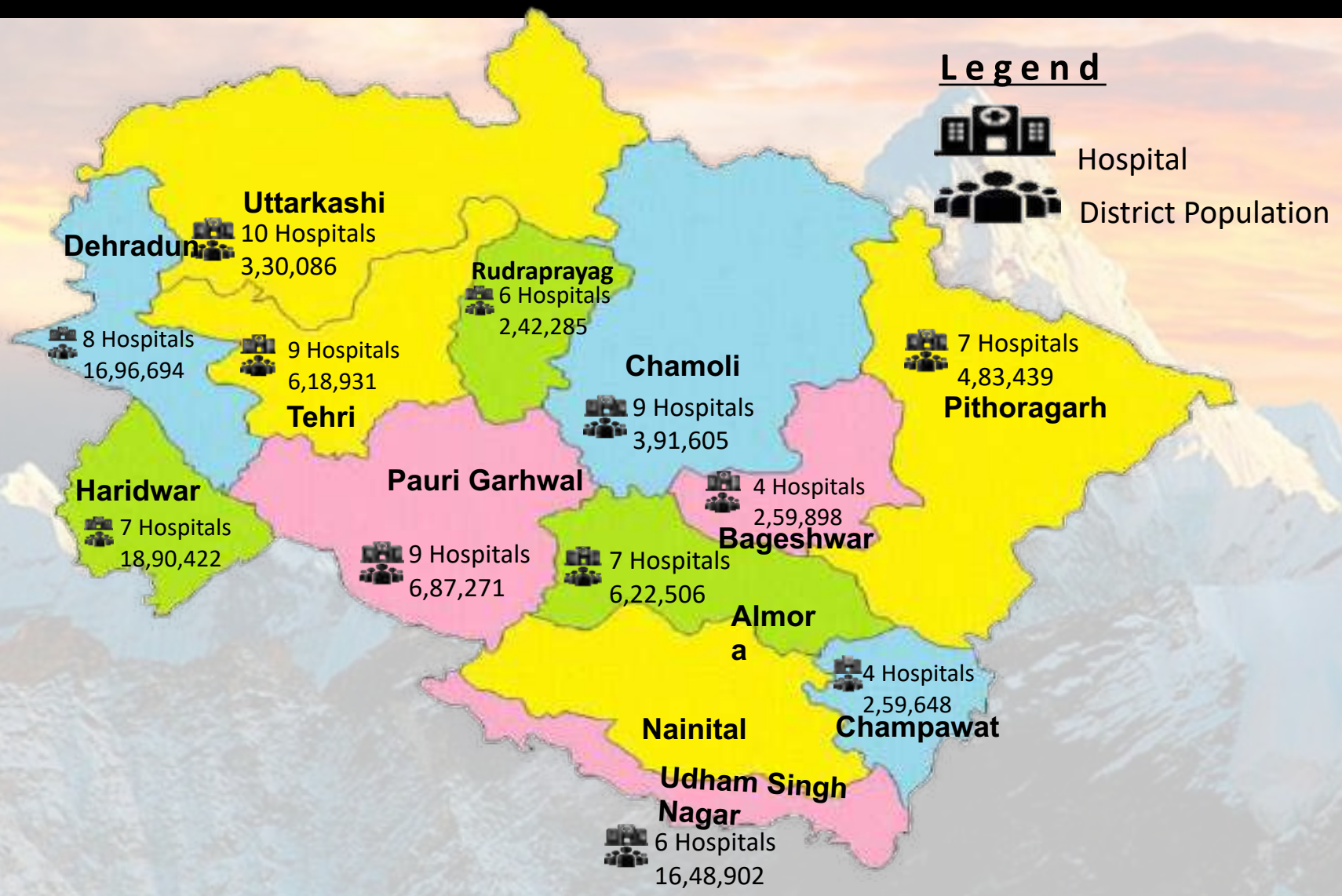
Surveyed: 2,840
Grade 5: 396
Grade 4: 643
Grade 3: 1,742



Bageshwar:
15% of 1,145 unsafe

Surveyed:	1,145
Grade 5:	88
Grade 4:	78
Grade 3:	607

SVA/DVA/ Seismic Retrofitting of Hospital Buildings



Name of District	No of Health Centres	No. of Blocks/ Units
Almora	7	12
Bageshwar	4	6
Chamoli	9	16
Champawat	4	7
Dehradun	8	18
Haridwar	7	8
Nainital	4	5
Pauri Garhwal	9	18
Pithoragarh	7	18
Rudraprayag	6	6
Tehri Garhwal	9	17
Udham Singh Nagar	6	10
Uttarkashi	10	17
	90	**150**

3. Strengthening of Response System

3a. Notification of IRS System

3b. Automated & Georeferenced Response System

3c. Response Force:

- Establishment of SDRF & Raising of NDRF
- Trained Volunteers
- Integration & Strategic Deployment of Response Manpower

3d. Strengthening of Infrastructure- USDMA & SDRF campus

3e. Strengthening of SEOC

- New SDMA Building (SEOC)
- Upgradation of both software & hardware along with integration of agencies and line departments

3f. Relief Shelters & **Community Radio Centres**

3a. Notification of the IRS team

- State-level Incident Response Team formed: **01**
- District-level Incident Response Team Formed: **13**
- Tehsil level Incident Response Team Formed: **129**

3b. Automated and Geo reference IRS introduced

- Under the bidding process

3c. Response Force:

- Establishment of SDRF- 600 manpower deployed at 39 places
- Raising of NDRF- 1100 manpower stationed at 5 places & redeployed strategically in Monsoon Season
- Trained Volunteers- 1700 Apda Mitra & 25000 other trained Volunteers
- Integration & Strategic Deployment of Response Manpower

3d. Upgradation of SEOC

- A project worth Rs. 54 Cr is under bidding process to construct a state of the art SEOC
- Likewise all DEOCs are being upgraded for seamless information flow from central technical agencies & SEOC to people and other stake holders

3e. Integration of all line departments of state government and armed forces in the SEOC for coordination and response during disaster situations – Char dham Yatra & Monsoon season

- Both soft and hard integration with all line departments
- 24-line departments (State govt. and armed forces, including NDRF)
- Working hours and Odd hours Disaster response plan introduced.
- Golden Hours SOPs for activation of SEOC introduced

3f. Multipurpose Disaster Relief shelter

- Will be constructed in Char Dham routes and other vulnerable areas under WB project
- US $ 10 million has been earmarked in the first phase

Special Policy for strengthening of Community Radio Centres

Approved CRC:-14

4. Recovery and Reconstruction initiative

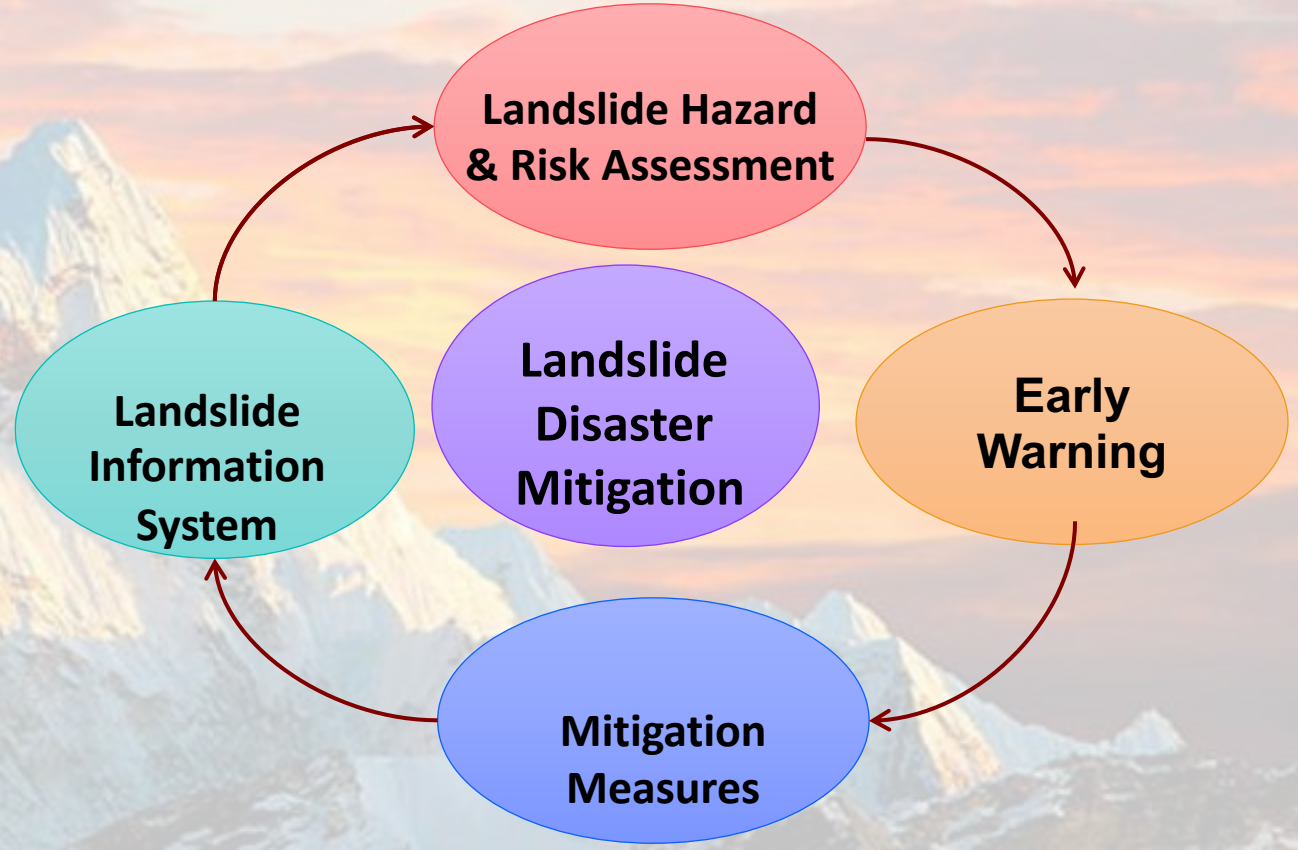
- Training on Post Disaster Needs Assessment (PDNA) conducted by ATI, Nainital
  - Total training conducted: 04
  - Officers trained till date: 196

- State Rehabilitation Policy introduced for affected community
  - Total Villages : 85
  - Total No. of Families : 1483

5. Mitigation

Uttarakhand Landslide Mitigation and Management Centre - established in 2022

- To act as Centre of Excellence for landslide management, slope stabilization and provide consultancy & knowledge sharing at State and National level.
- To identify the potential and chronic landslide hotspots and delineation of hazard and risk zones
- To adopt a holistic approach for landslide mitigation and management
- To work in collaboration with other Specialized/Technical/ Research institutions/ Universities and Statutory Authorities.

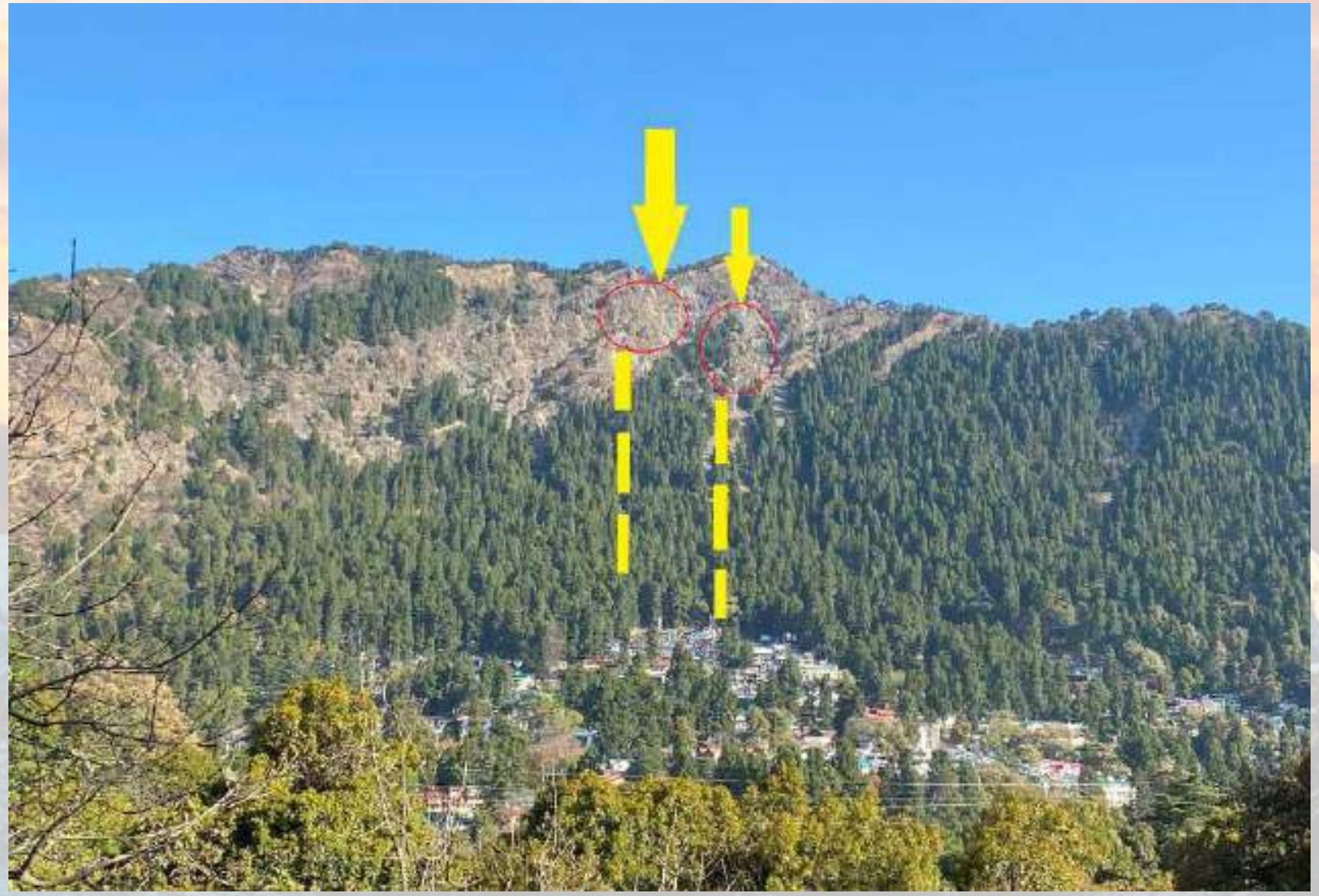


Project Activities Initiated

- Landslide Inventory Atlas of Alaknanda, Bhagirathi and Mandakini Valleys
- Landslide Hazard & Risk Assessment in Major Hill Townships of Uttarakhand
- Establishment of geo-technical & geophysical lab is under progress.
- Landslide Investigation and Mitigation measures at major landslide affected habitation and infrastructures. Examples: Baliyanala, Nanital, Mansa Devi hill, Haridwar; Bahugunagar, Karnprayag, Dharchula, Pithoragarh and Naina Peak, Nainital.

Slope Instability along Hill Bypass Road

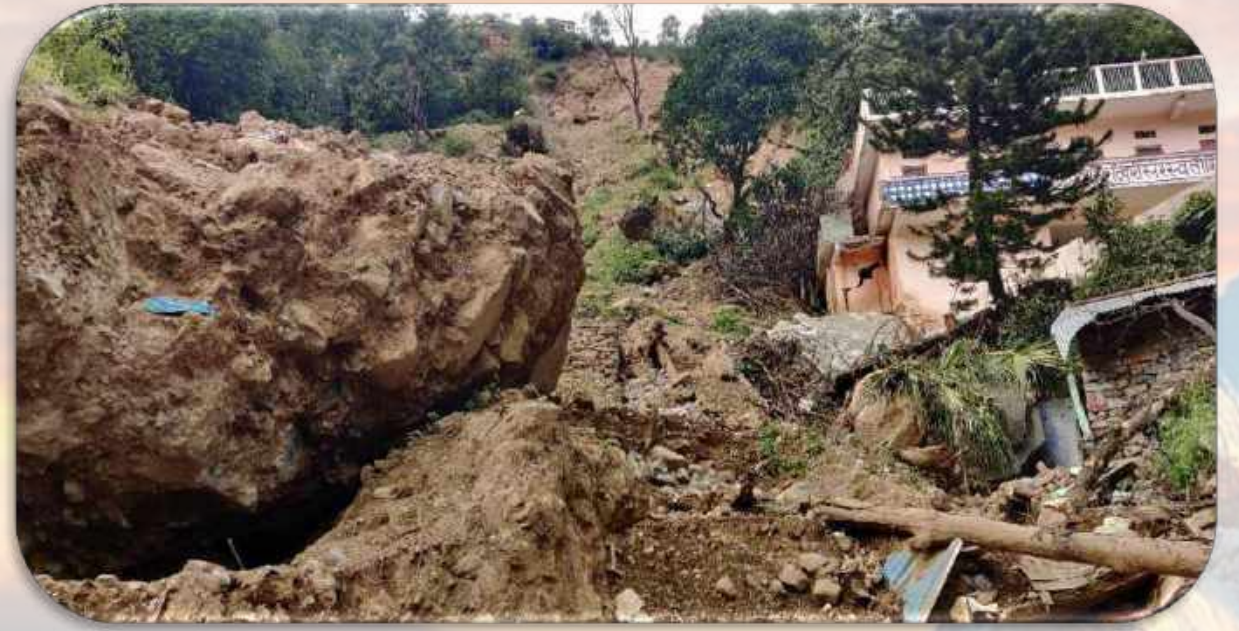
Naina Peak Landslide, Nainital



Slope Instability at Bahuguna Nagar, Karnprayag

Damaged Houses of Bahuguna Nagar, Karnprayag

Landslide & Slope Instability at Dharchula



Geotechnical Investigation

Mitigation Measures