Increased Flood and Flood Management

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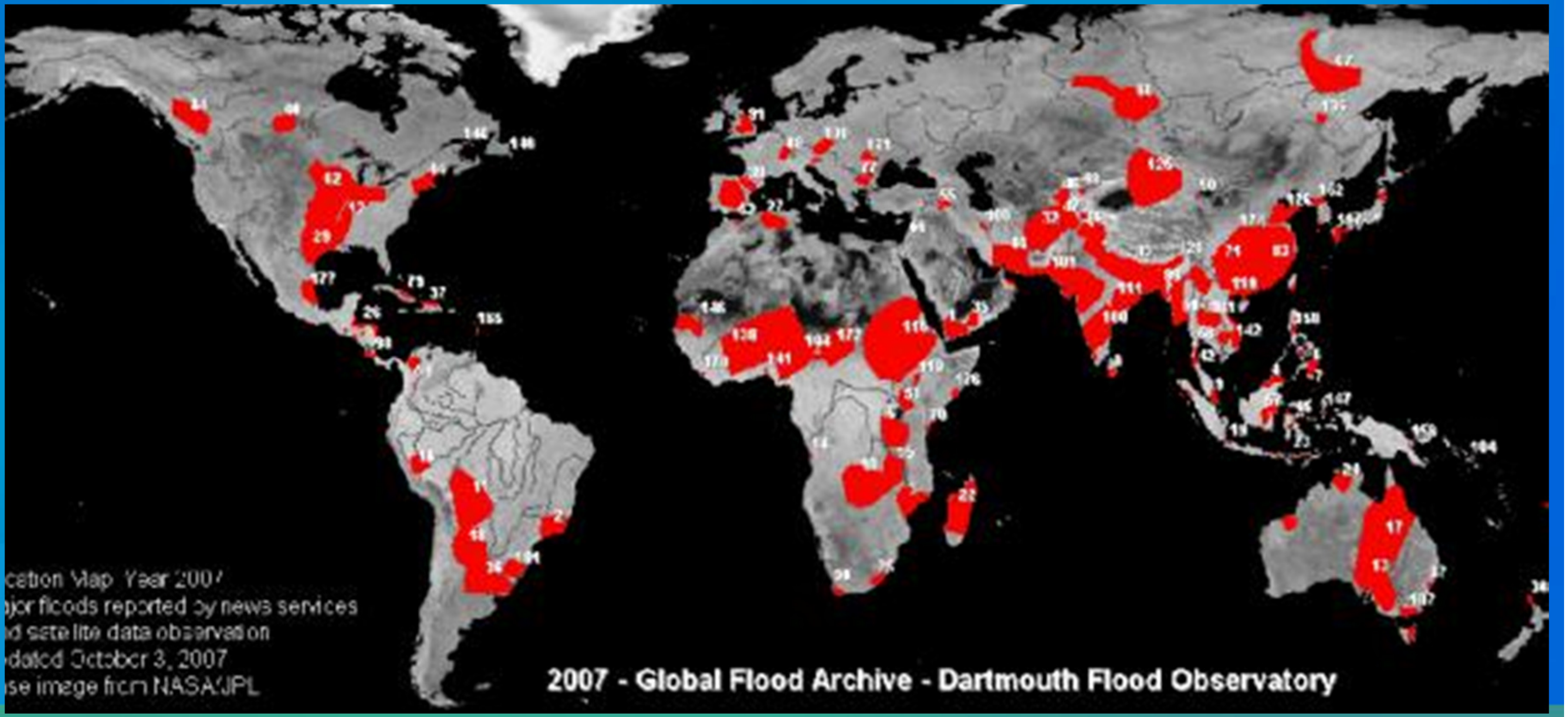
Flood Prone Areas in the World

- **Flood is one of the most damage causing natural disasters**
- **Every year floods exert a heavy toll on human life and property**
- **Flooding is not just confined to certain regions of the world**



Flood Prone Areas in India

India experiences one of the highest frequencies of flood

Flood prone area in India has been increasing significantly

India is the second-most flood-prone country in the world, after Bangladesh

Flood Hazards

Flood is the most frequent natural disaster claiming loss of life and property compared to any other natural disaster.

- About one-third of all losses due to nature's fury are attributed to floods.

On an average floods claim a loss of more than 50 billion US dollars per year and 40000 victims per year in the last decades of the twentieth century in the world (Berga, 2000).

Among all natural disasters, floods are the most frequent to be faced in India.

Flood Hazards

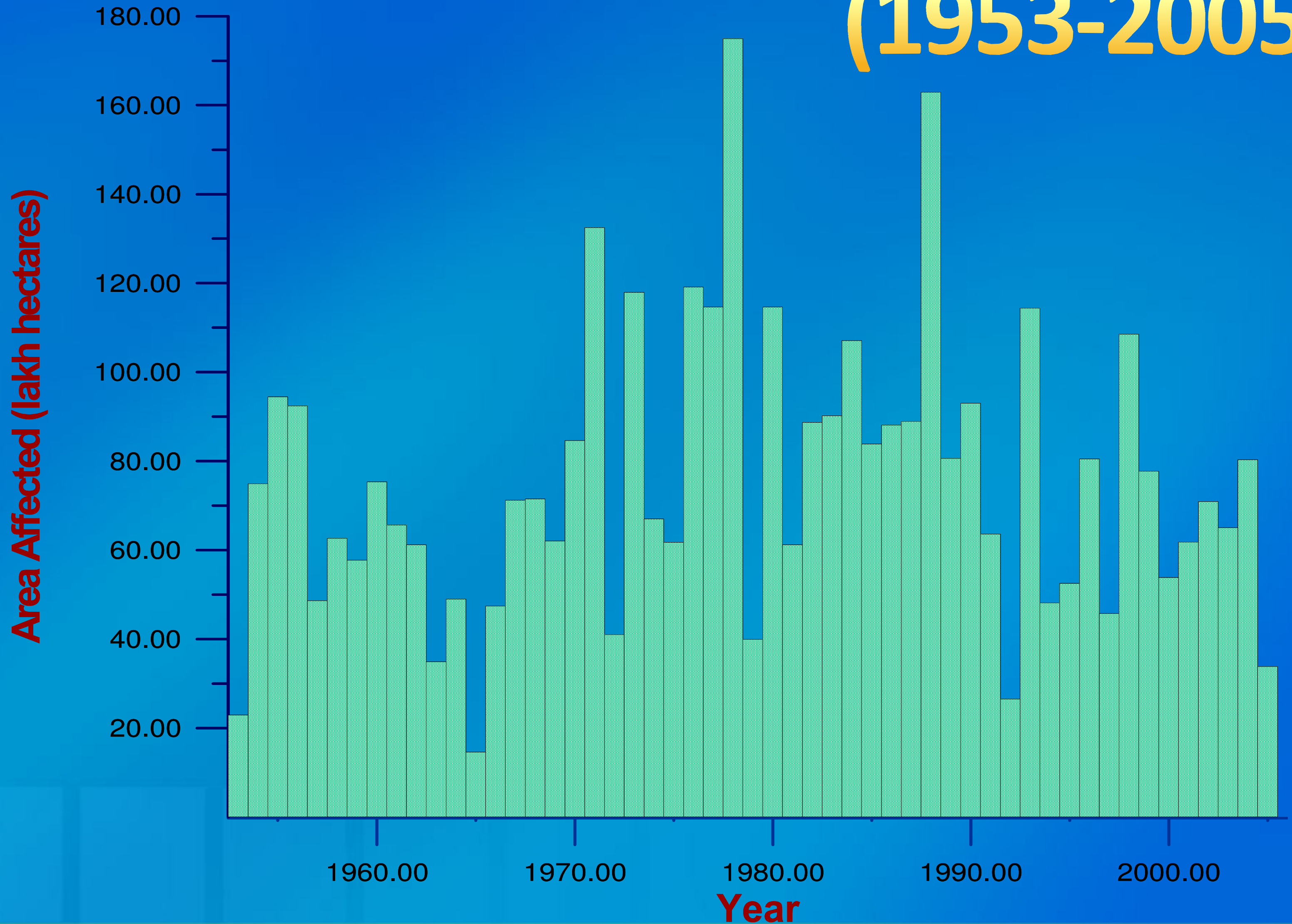
The total area liable to flooding is about 40 million hectares.

The annual average area affected by floods is 7.563 million ha.

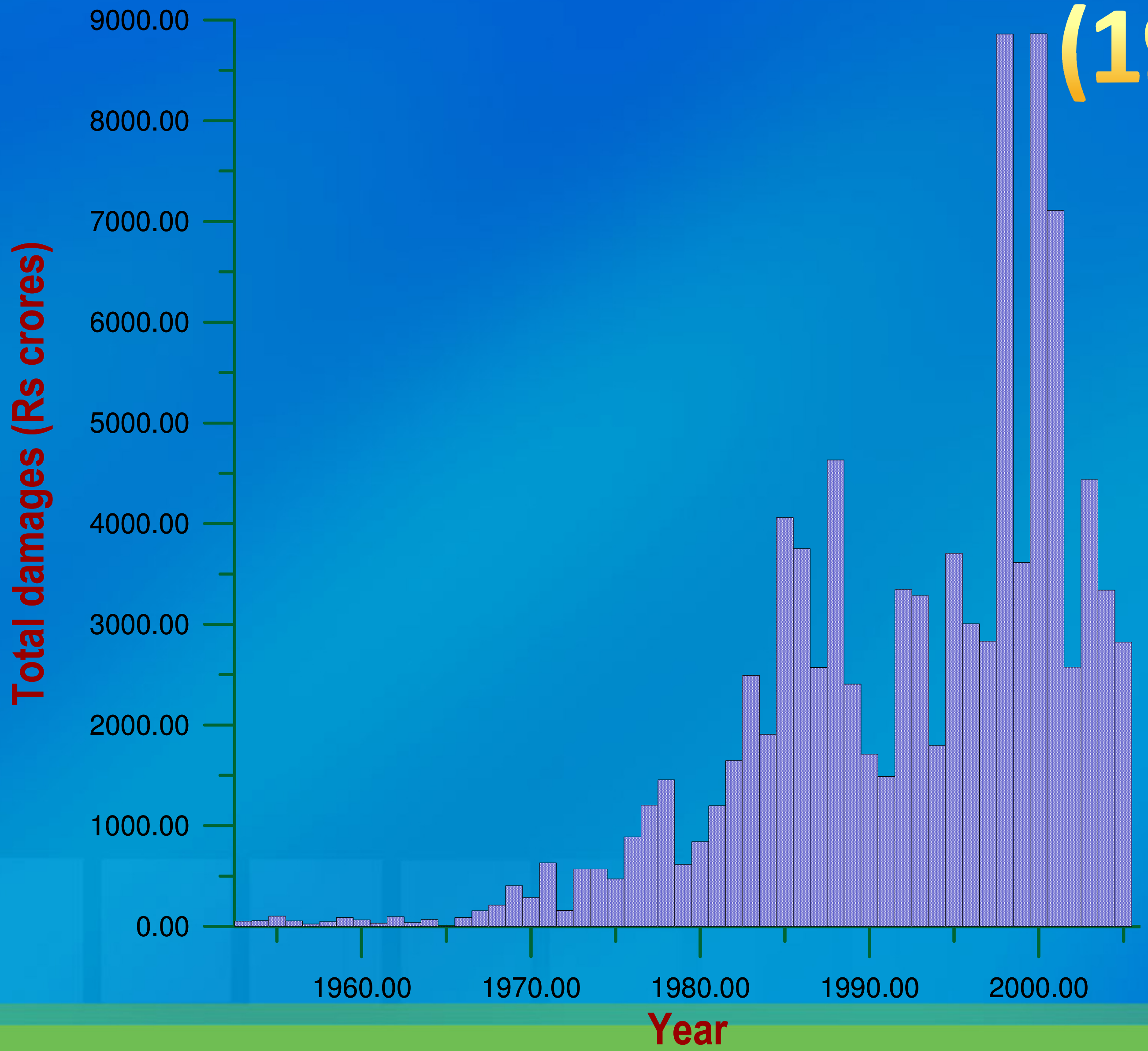
The annual average cropped area affected is approximately 3.7 million hectares.

The average annual total damage to crop, houses and public utilities during the period 1953-95 was about Rs 972.00 crores, while the maximum damage was Rs 4630.00 crores in 1988. in India.

Year wise Area affected by Floods (1953-2005)



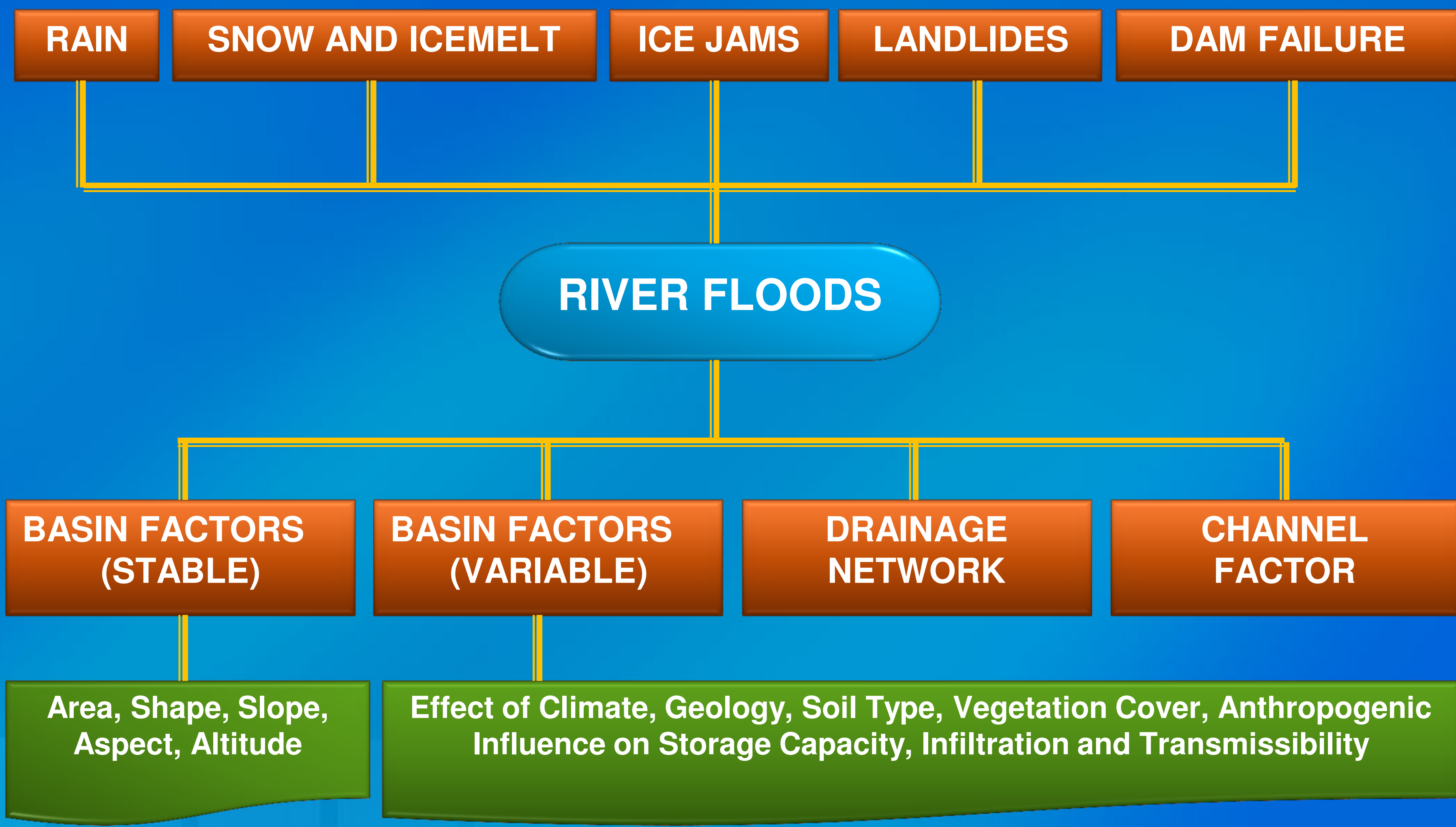
Year wise total damage by Floods (1953-2005)



Causes of Floods

- Intense precipitation
- Inadequate capacity within riverbanks to
- contain high flows, and silting of riverbeds
- Land slides leading to obstruction of flow
- and change in the river course
- Retardation of flow due to tidal and
- backwater effects
- Poor natural drainage
- Drainage congestion
- Cyclone
- Heavy rainstorms/cloud bursts
- Snowmelt and glacial outbursts
- Dam break flow

Causes of Floods



Flood Problems in India

Inundation, drainage congestion due to urbanization and bank erosion.

Depend on the river system, topography and flow Characteristics

Being a vast country, the flood problems in India may be visualized on regional basis.

India may be broadly divided into four zones of flooding

- Brahmaputra River Basin
- Ganga River Basin
- North-West Rivers Basin
- Central India and Deccan Rivers Basin

Brahmaputra River Basin

Basins of the rivers Brahmaputra and Barak with their tributaries

Covers the States of Assam, Arunachal Pradesh, Meghalaya, Mizoram, northern parts of West Bengal, Manipur, Sikkim, Tripura and Nagaland

Problems in this region : flood inundation, drainage congestion, erosion, river shifting, sedimentation

Ganga River Basin

The Ganga and its many tributaries (the Yamuna, the Sone, the Ghaghra, the Gandak, the Kosi and the Mahananda).

Covers Uttarakhand, Uttar Pradesh, Bihar, south and central parts of West Bengal, parts of Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh and Delhi.

Problems of flooding, erosion and drainage congestion, river shifting and meandering.

North – West River Basins

Comprises of basins of North-West rivers such as Sutlej, Ravi, Beas, Jhelum and Ghaggar.

Covers the states of Haryna, Punjab, Himanchal Pradesh, Jammu & Kashmir.

In comparison to the two zones, the flood problem in this zone is relatively less.

The major problem is that of inadequate surface drainage which causes inundation and water logging.

Central India And Deccan Rivers Basin

- Narmada, Tapi, Mahanadi, Godavari, Krishna and Cauvery.
- Mostly well defined stable courses.
- Floods in Lower reaches and in the delta area
- Covers all the southern States namely Andhra Pradesh, Chhattisgarh, Karnataka, Tamil Nadu, Kerala, Orissa, Maharashtra, Gujarat and parts of Madhya Pradesh.
- The Delta areas of the Mahanadi, Godavari and the Krishna rivers on the east coast periodically face flood and drainage problems, in the wake of cyclonic storms.

Special Flood Problems

- Problem of Tal Areas
- River bank/bed erosion
- Sediment transport by rivers
- Dam Break Floods
- Urban Flooding
- Flash Floods
- Flood due to Snow melt
- Flood in Coastal Areas

Structural Measures of Flood Mitigation & Management

- Dams and reservoirs
- Detention basins
- Embankments
- Channel improvement
- Drainage improvement
- Watershed management
- Flood proofing

Non-structural Measures of Flood Mitigation & Management

- Flood forecasting
- Disaster mitigation system and preparedness
- Flood plain zoning
- Flood insurance

Flood Hazard Modelling

Flood Hazard Modelling may be carried out using the hydrologic-hydraulic approach, remote sensing, GIS, flood frequency analysis and rating curve analysis

Based on the aforementioned methodology various types of maps such as:

- Flood inundation maps
- Flood hazard maps
- Flood risk zone maps
- Flood plain zoning maps may be prepared

Such maps provide detailed information on the areal extent, depth and duration of flooding as well as the associated risk

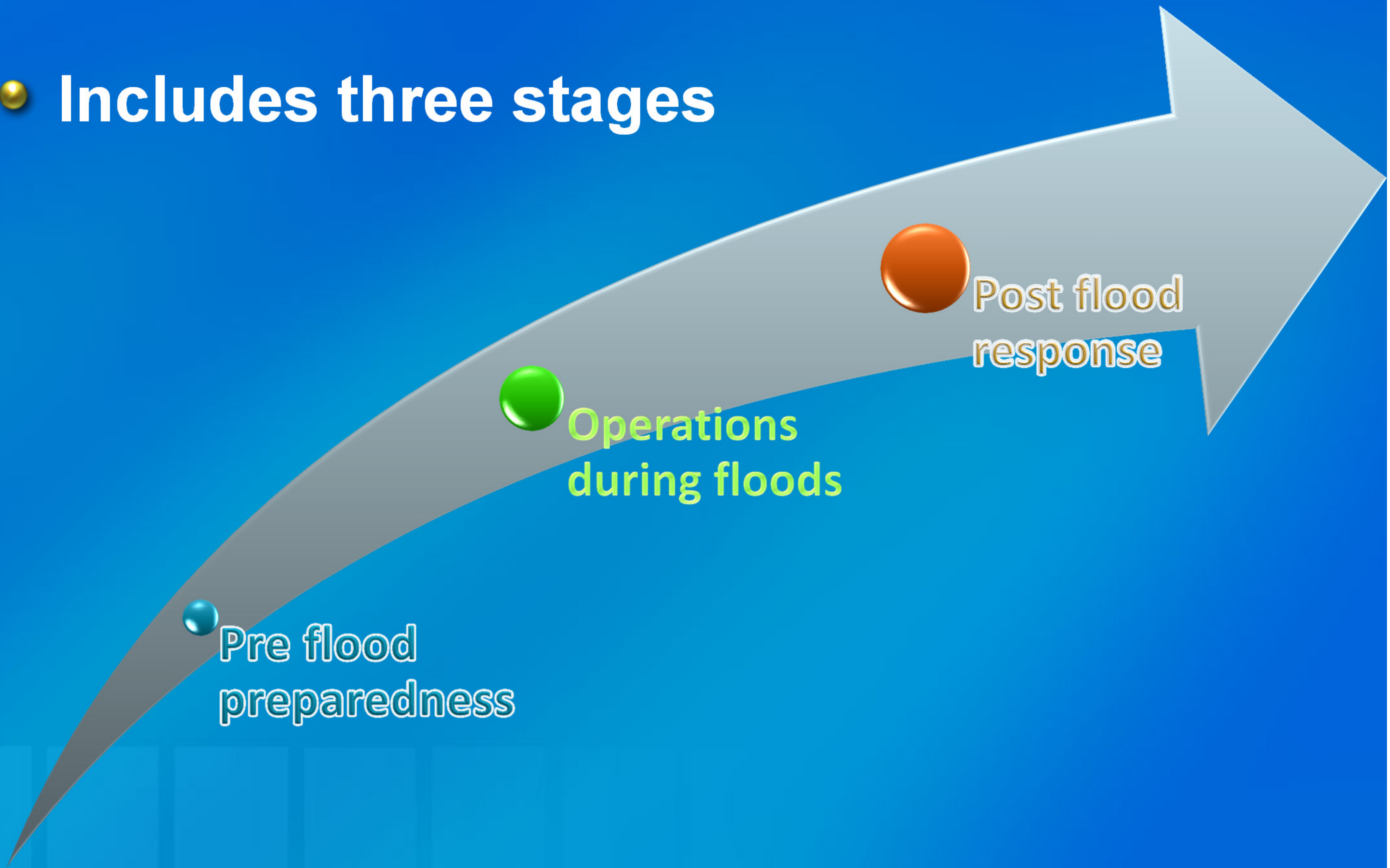
These maps may also be put to the broad spectrum of uses including implementation of land use regulations and flood plain zoning bylaws

A Working Group of National Natural Resources Management System (NNRMS, 2002) standing committee on water resources for flood risk zoning of major flood prone rivers considering remote sensing input was constituted by the Ministry of Water Resources in 1999.

The working group recommended flood risk zoning using satellite based remote sensing with a view to give thrust towards implementation of flood plain zoning measures.

Holistic Flood Mitigation

- **Includes three stages**



Pre Flood Preparedness

- Construction of Physical Flood Defense Infrastructure
- Legislation
- Investment in Research and Development
- Control of Development within Flood Plains
- Source Control and Infiltration & Storage/ Retardation Measures
- Land Use Planning and Management
- Building Codes, Including Flood Proofing
- Implementation of Flood Forecasting & Warning Systems

Pre Flood Preparedness

- Public Awareness and Education on Flood Risk & Emergency Actions
- Flood Insurance
- Flood risk management for all causes of flooding
- Disaster contingency planning to establish evacuation routes, critical decision thresholds, public service and infrastructure requirements for emergency operations etc.
- Construction of flood defense infrastructure, both physical defenses and implementation of forecasting and warning systems.

Operations During Floods

- Forecasting of future river flow conditions from the hydro-meteorological observations
- Deciding on the Operation of Reservoir and Retention Areas
- Forecasting River Flows and Probable Areas to be Inundated
- Issuing Warnings to the Appropriate authorities and the Public
- Evacuation of People and Animals
- Emergency Protection of Embankments from Breaching & Overtopping
- Response to the emergency by the public and the authorities.

Holistic Flood Management

- Relief Measures for those Immediately Affected
- Reconstruction of Flood Defenses & Damaged Buildings
- Recovery and regeneration of the environment and the economic activities in the flooded area, and
- Review of the flood management activities to improve the process and planning for future events in the area affected and more generally, elsewhere

Factors And Features for Flood Risk Mitigation & Management

	Risk factors and uncertainties	Vulnerability	Mitigation measures
Pre-flood preparedness	Design flood level Data series Applicability of methods Meteorological conditions Biased scientific Statements Dike crest under design flood level Dike structure Interconnected systems Lack of DEM	Settlements under design flood level Unauthorized constructions Not proper building material Not adequate foundation Not proper furniture	Further research Dike construction Floodway clearance Flood reservoirs Confinement plans Surveys, GIS
Operational flood management	Rainfall forecast Rainfall, water stage, discharge measurement Lack of data Time delays Catchment and river bed parameters Lack of flood Warnings and forecasts	Villages located high in the mountains Bad forecast communication Little time left because of rapid progress Reduced retention Lack of awareness	Better communication systems On-line remote sensing, radar, satellite images Flood forecasting systems Confinement plans Emergency management
Socio-economic factors	Community response Responsible authorities Political credit (in rehabilitation) Condition of confinement structures Social comprehension Divided river basins National interests Legal-institutional structures	Low income families Little investment No other place to live Lack of insurance Passing on flood problems to downstream areas	Integrated actions Enhanced flood awareness, Complex systems Joint international Monitoring and Forecasting Develop international legal and institutional structures

Training of Personals

- Flood disaster management team
- Administrators
- Arms forces
- Police personals
- Fire and Emergency service personals
- Medical personals
- NGOs

Measures for Flood Mitigation

Better gauging of rivers, collection of meteorological information and mapping of channels is needed

Doppler shift radars should be deployed to better monitor rainfall

Enhance the hydrological-meteorological network in vulnerable areas susceptible to flash flooding

Hydro-meteorological stations should be linked with robust and efficient communications, including the use of satellite telemetry for critical or remote sites to provide real time transfer of data among local, regional and central stations

Measures for Flood Mitigation

Better mapping of actual stream channels and river banks, including land slide and erosion potential

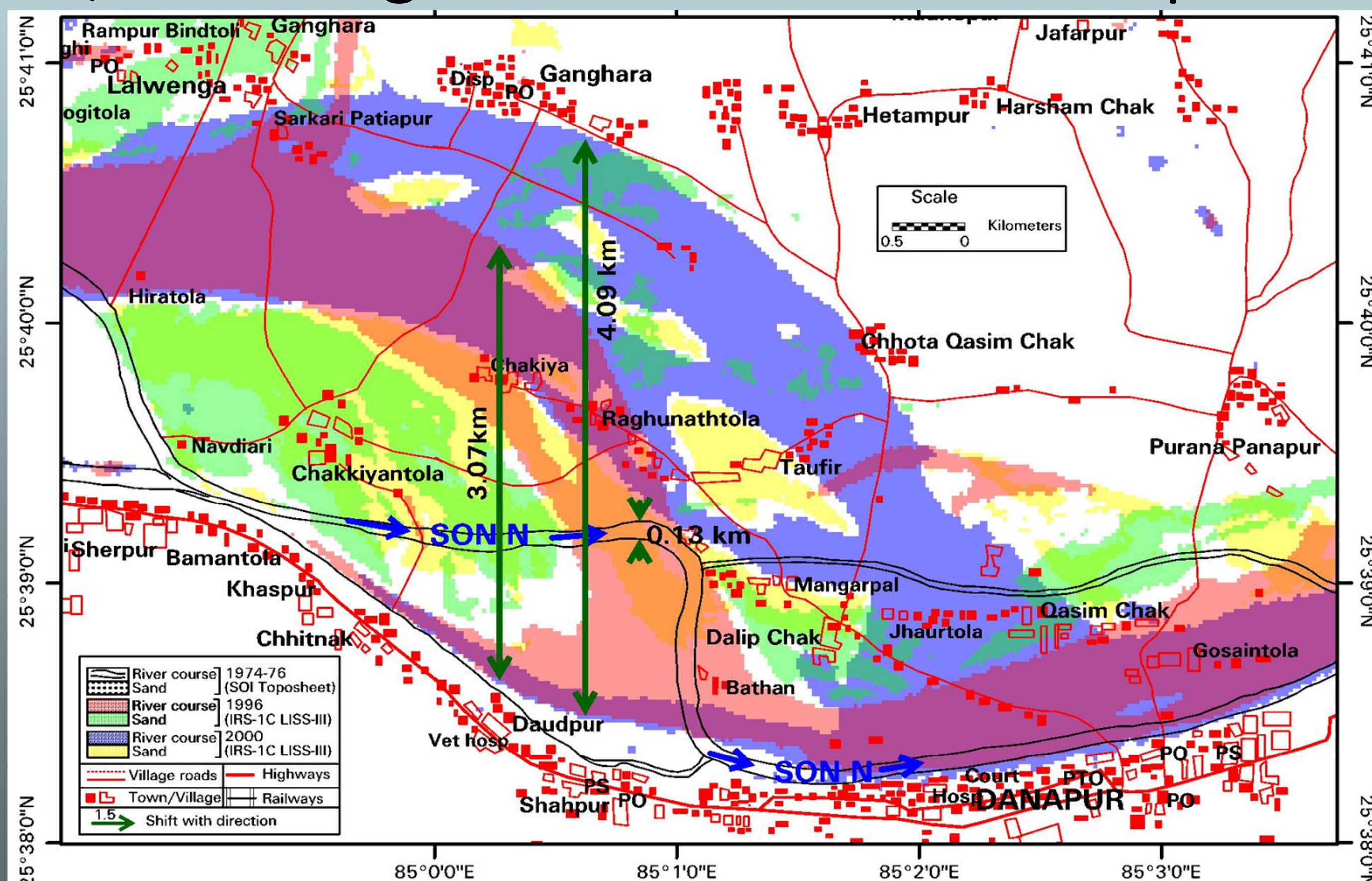


Fig. Details of widening of river Ganga at Daudpur near Danapur as obtained from SOI toposheet (1974-76) and IRS-1C LISS-III data (1996 and 2000)

Measures for Flood Mitigation

Better and current information about human populations and infrastructure, elevation and channels needs to be incorporated into flood and risk assessment models

Collect and maintain information about the locations of human populations, infrastructure and emergency response personnel

Use information collected to minimize risks and damages during flood events and to maximize relief efforts during and after flood events

Use hydrological and meteorological information for general water resources management beyond flood forecasting, plain zoning and flood hazard mitigation

Measures for Flood Mitigation

Better sharing of information between forecasters, state agencies, relief organization and general public

Make provisions to regulate water flow for flood moderation on the river. Storage resources on the rivers may be necessary to accomplish this goal

Monitor in real time the dangerous levees, dikes, banks, reservoirs etc.

Identify weak links and regularly check lines of communication to maximize lead time for flood forecasting

Train people to be self reliant, proactive and ready before the onset of floods

Effects of land use changes and climate change should also be studied considering sustainability aspects.

Measures for Flood Mitigation

Need for spatial models integrating precipitation, stream monitoring, watershed characteristic to maximize accuracy and effectiveness of forecast

Develop improved geo-referenced watershed data and GIS-based hydrological models to enable estimation of water balances and flows with the participation of professional institutes.

Geo-environmental appraisal of the likelihood of riverbank erosion, slope instability, debris flow material glacier lake outbursts should be undertaken to forecast potential risks.

Development of an integrated solution in which rainfall estimation and hydrologic forecasting are combined for flood forecasting

Basic Safety Measures in Flood Disaster

Before flood disaster

Don’t build houses or other dwellings on the flood plains.

Store fresh water supplies in buckets, plastic bottles and other containers.

Keep supplies of extra food, especially food that does not require cooking.

Have sandbags, wood planks, plastic sheets etc. Sandbags can be used to keep rivers from overflowing and divert flood water. The wood planks and plastic sheets can be used to board up windows, doors and keep water away from flowing into homes.

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- Put away toxic substances including kerosene, diesel and petrol cans, spray paint and motor oil.

Basic Safety Measures in Flood Disaster

Before flood disaster

- Store loose items inside, place documents, photos, valuables and clothing in plastic bags.
- Keep a portable radio and torches, flashlights etc. with fresh batteries.
- Lay out an emergency evacuation plan, knowing the procedure and what items are to be taken with you.
- Try to designate more than one escape plan. Know the way to reach at the higher ground and whether it will be high enough in the event of a flood.
- Listen carefully for flood warnings and news updates on radio, television and other mediums of communication.

Basic Safety Measures in Flood Disaster

During Flood Disaster

- If you hear the words “flood forecast” pertaining to your locality, then there is a possibility of its submergence because of overflowing of river due to heavy rain.
- If you hear the words “flood warning” realize that flooding will happen now or very soon.
- If you hear “flash flood warning” that means certain areas are expecting or experiencing sudden floods.
- Turn off all utilities such as electrical appliances, cooking gas, stoves etc.
- Be prepared to evacuate immediately. If necessary, flee to higher ground.

Basic Safety Measures in Flood Disaster

During Flood Disaster

- If you are driving your vehicles and tract, stay away from storm drains and irrigation ditches.
- Never go past a police blockade. Roped-off areas are usually off-limits and dangerous to citizens.
- Keep the battery operated radio and transistor on for further instructions.
- If your vehicle or tractor doesn't start and water is rising, leave it and reach at the higher ground.
- Use sandbags, plastic sheets and wood planks around your house as instructed.
- If you see a flood approaching, don't hesitate to evacuate!

Basic Safety Measures in Flood Disaster

After Flood Disaster

- Check for injuries and help the wounded if necessary.
- If you need additional help, call local help lines
- Avoid flooded areas.
- Be cautious when handling animals.
- Listen to news updates on what to do.
- Take precautions and don't be panicky in case of spread of communicable diseases.
- Help the administration by actively participating in the vaccination and disease eradication programmes.

Flood Response

- Response system
- Institutionalization
- Evacuation plan
- Estimation of the severity of the flood
- Flood management plan
- Search and Rescue teams
- Emergency relief
- Emergency medical relief

Types and Causes of Flash Floods

Based on the underlying processes causing flash floods, flash floods can be categorised as:

- Intense rainfall floods,
- Landslide dam outburst floods,
- Glacial lake outburst floods

Also caused by bursting of artificial structures such as dams.

Flash Floods and Riverine Floods

	Flash floods	Riverine floods
Features	Rapid water level rise above natural channels Reaches peak flow within minutes up to a few hours Rapid recession (within minutes to few hours) Often dissipate quickly Not necessarily related to base flow levels Short lag times	Slow water level rise beyond natural channels Reaches peak flow within days to weeks Slow recession (within days to weeks) Mostly coinciding with high base flow levels Medium to long lag times
Causes	Very high intensity rainstorms/ cloudbursts Rapid snow/glacial melt due to rapid increase in temperature Dam (both artificial and natural) breaks	Prolonged seasonal precipitation of low to high intensity Seasonal snow and glacial melt
Associated problems	Often carry high sediment and debris loads Very high hydraulic force and erosive power	Inundation
Frequency	Occasionally, any time during the year	Annually during rainy season
Affected areas	River plains and valleys Alluvial fans Mostly local extent Generally small to medium areas are affected	River plains and valleys Local to regional extent Large areas can be affected
Predictability	Very difficult to forecast	With appropriate technology and measures in place, forecasting is easily possible
Potential mitigation measures	Early warning systems Community preparedness and awareness Appropriate emergency measures	Real-time flood forecasting Community preparedness and awareness Appropriate emergency measures

Cloud Burst

An extreme amount of precipitation, sometimes with hail and thunder

Normally lasts no longer than a few minutes

Capable of creating severe flood conditions.

Describe any sudden heavy, brief, and usually un forecast rainfall with sufficient lead time.

What is a Cloudburst ?

A cloudburst is sudden copious rainfall. It is a sudden aggressive rainstorm falling for a short period of time limited to a small geographical area.

Meteorologists say the rain from a cloudburst is usually of the shower type with a fall rate equal to or greater than 100 mm (3.94 inches) per hour.

Generally cloudbursts are associated with thunderstorms. The air currents rushing upwards in a rainstorm hold up a large amount of water.

What is a Cloudburst ?

If these currents suddenly cease, the entire amount of water descends on to a small area with catastrophic force all of a sudden and causes mass destruction. This is due to a rapid condensation of the clouds.

They occur most often in desert and mountainous regions, and in interior regions of continental landmasses.

During a cloudburst, more than 2 cm of rain may fall in a few minutes. They are called 'bursts' probably because it was believed earlier that clouds were solid masses full of water. So, these violent storms were attributed to their bursting.

When there are instances of cloudbursts the result can be disastrous. Cloud burst is also responsible for flash flood creation.

In the Indian Subcontinent, a cloudburst usually occurs when a prominent monsoon cloud drifts northwards, from Bay of Bengal or Arabian Sea across the plains, then onto the Himalaya and bursts, bringing rainfall as high as 100 mm per hour.

BIGGEST CLOUDBURSTS

Uttarkashi and Rudraprayag: **June 16-17, 2013** **479 mm** in three hours

Leh: **August 2, 2010** **250 mm** in one hour

Mumbai: **July 26, 2005** **1,448 mm** in 10 hours

Over 100 mm of rain in an hour is a cloudburst

Why Cloudburst in Himalayas ?

Usually, the western Himalayan region experiences the cloud burst events during the monsoon season in association with the strong monsoon circulation or the interaction of monsoon circulation with the mid-latitude westerly system.

The orography of the region plays a dominant role by increasing the convection and hence the intensity of cloud burst.

It also occurs over other orographically dominant regions like the northeastern states and Western Ghats region.

It can occur also over the plain areas, but the frequency of such occurrence is very rare.

Cloudburst in Himalayas

Date	Cause of flood/Place
July, 1970	Alaknanda river in Uttarakhand.
August 15, 1997	cloud burst in Chirgaon in Shimla district, Himachal Pradesh
August 17, 1998	A massive landslide following heavy rain and a cloudburst at Malpa village
July 16, 2003,	flash floods caused by a cloudburst at Shilagarh in Gursa area of Kullu, Himachal Pradesh
July 6, 2004	heavy landslides triggered by a cloudburst in Alaknanda river
August 16, 2007	cloud burst occurred in Bhavi village in Ghanvi, Himachal Pradesh

Cloudburst in Himalayas

Date	Cause of flood/Place
August 7, 2009	landslide resulting from a cloudburst in Nachni area near Munsiyari in Pithoragarh district of Uttarakhand
August 6, 2010	Leh town of Ladakh region in Jammu and Kashmir
September 15, 2010	Cloud burst in Almora in Uttrakhand
June 9, 2011	Cloudbursts near Jammu
20 July 2011	Cloudburst in upper Manali
September 14, 2012	cloudburst in Rudraprayag district

Prediction of Cloudbursts

Prediction of cloudbursts is challenging, and requires high-resolution numerical models and mesoscale observations, high-performance computers and Doppler weather radars.

The radar can measure the size of raindrops in the clouds on the basis of which, conditions such as a cloud burst and unexpected rainfall can be predicted.

Flash Flood Management

- Advance and real time forecasting of precipitation using radar and satellite technology
- Advanced system of data acquisition in real time
- Data transmission to forecasting site
- Formulation of forecast
- Flood warning
- Dissemination of warning to appropriate authorities

Glacial Lake Outburst Flood (GLOF)

The sudden failure of a moraine dam on a glacial lake can release a very large amount of water called a Glacial Lake Outburst Flood

Outburst flood peak flow is directly related to lake volume, dam height and width, dam material composition, failure mechanism, downstream topography

GLOF Risk Mapping

GLOF risk mapping is an important tool to help for predicting the area likely to be impacted by a GLOF.

Estimate the vulnerability of those areas, and help in the planning mitigation measures.

Uttarakhand Floods 2013

Kedarnath

Kedarnath is located in the Himalayas, about 3584m(11759 Ft.) above sea level near Chorabari Glacier, the head of river Mandakini, and is flanked by breathtaking snow-capped peaks

Kedarnath

Kedarnath (or Kedarnath Main) and Kedarnath Dome (or Kedar Dome) are two mountains in the Gangotri group of peaks in the western Garhwal Himalayas.

Kedarnath is located on the main ridge that lies south of the Gangotri Glacier, while Kedarnath Dome, a subpeak of the main peak, lies on a spur projecting towards the glacier, two kilometres northwest of Kedarnath.

Possible reasons for the disaster are:

- The collapse of a moraine-dammed lake
- A catastrophic landslide onto, and then down, the glacier
- A landslide below the glacier created a dam, which then ruptured, releasing the flood
- A landslide event in a higher valley that became a channelized debris flow
- A simple case of too much rain on a large catchment, and a misplaced town

Possible reasons for the disaster are:

The nightmarish deadly episode is believed to have been initiated with incessant heavy rains followed by a massive cloudburst that resulted in fragmentation and landslides of Kedar Dome Mountain due to enormous accumulation of water in the valley.

On the basis of high resolution image using the RISAT-1 (Indian satellite) it is reported that the debris flow from northeast was initiated by a landslide high on the hillside, which then ran down the slope entraining debris en route. At the slope toe it was channelized by the glacier into a narrow gully. It is clear that the flow eroded out a large amount of material in this area. The area down slope of the failure was already a zone of active erosion, so the likelihood of entrainment (carrying along of particles in a current) was very high.

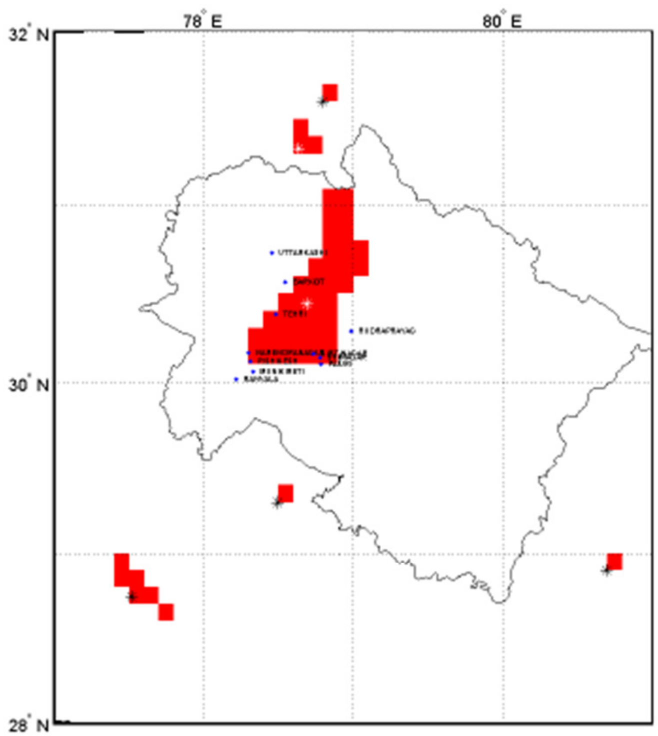
Prediction of Extreme Rainfall/Cloud Burst

This is an Experimental Run not an Operational Forecast

Prediction of Extreme Rainfall/ Cloud burst

Forecast time: 16 June 0730 GMT

(Red region shows predicted affected area due to severe rainfall while White * shows probable location of cloudburst)



Prediction given by the model

1. Possibility of high rainfall event at 28.75 N , 77.52 E with radius of influence of 28.89 kms.
2. Possibility of high rainfall event at 28.90 N , 80.70 E with radius of influence of 5.66 kms.
3. Possibility of high rainfall event at 29.30 N , 78.50 E with radius of influence of 5.66 kms.
4. Possibility of high rainfall event at 30.44 N , 78.69 with radius of influence of 58.71 kms.
   1. Possibility of cloud burst event

   Major Cities affected :

   1. BARKOT
   2. KIRTINAGAR
   3. MUNIKIRETI
   4. NARENDRANAGAR
   5. PAURI
   6. RAIWALA
   7. RISHIKESH
   8. RUDRAPRAYAG
   9. SRINAGAR
   10. TEHRI
   11. UTTARKASHI
5. Possibility of high rainfall event at 31.33 N , 78.63 with radius of influence of 10.80 kms.
   1. Possibility of cloud burst event
6. Possibility of high rainfall event at 31.60 N , 78.80 E with radius of influence of 5.66 kms.

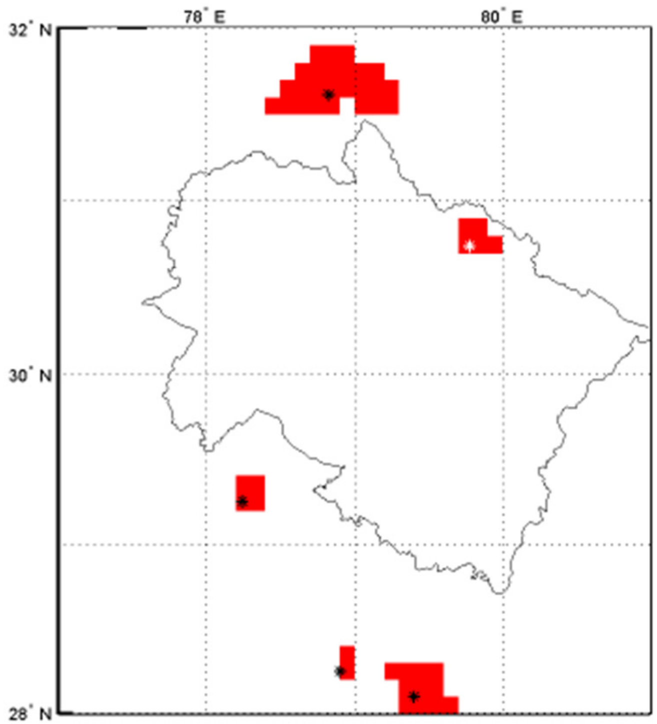
Prediction of Extreme Rainfall/Cloud Burst

This is an Experimental Run not an Operational Forecast

Prediction of Extreme Rainfall/ Cloud burst

Forecast time: 16 June 1400 GMT

(Red region shows predicted affected area due to severe rainfall while White * shows probable location of cloudburst)

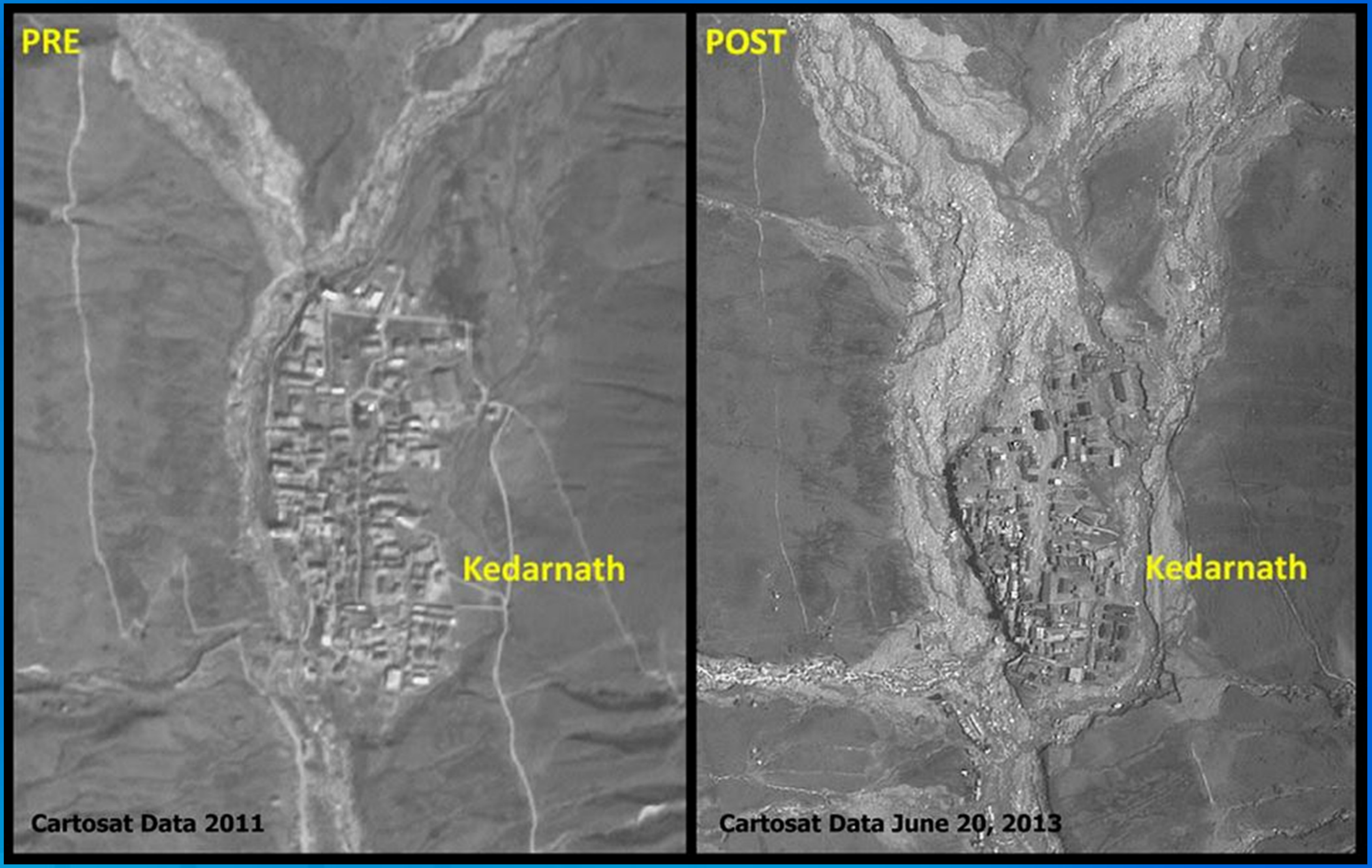


Prediction given by the model

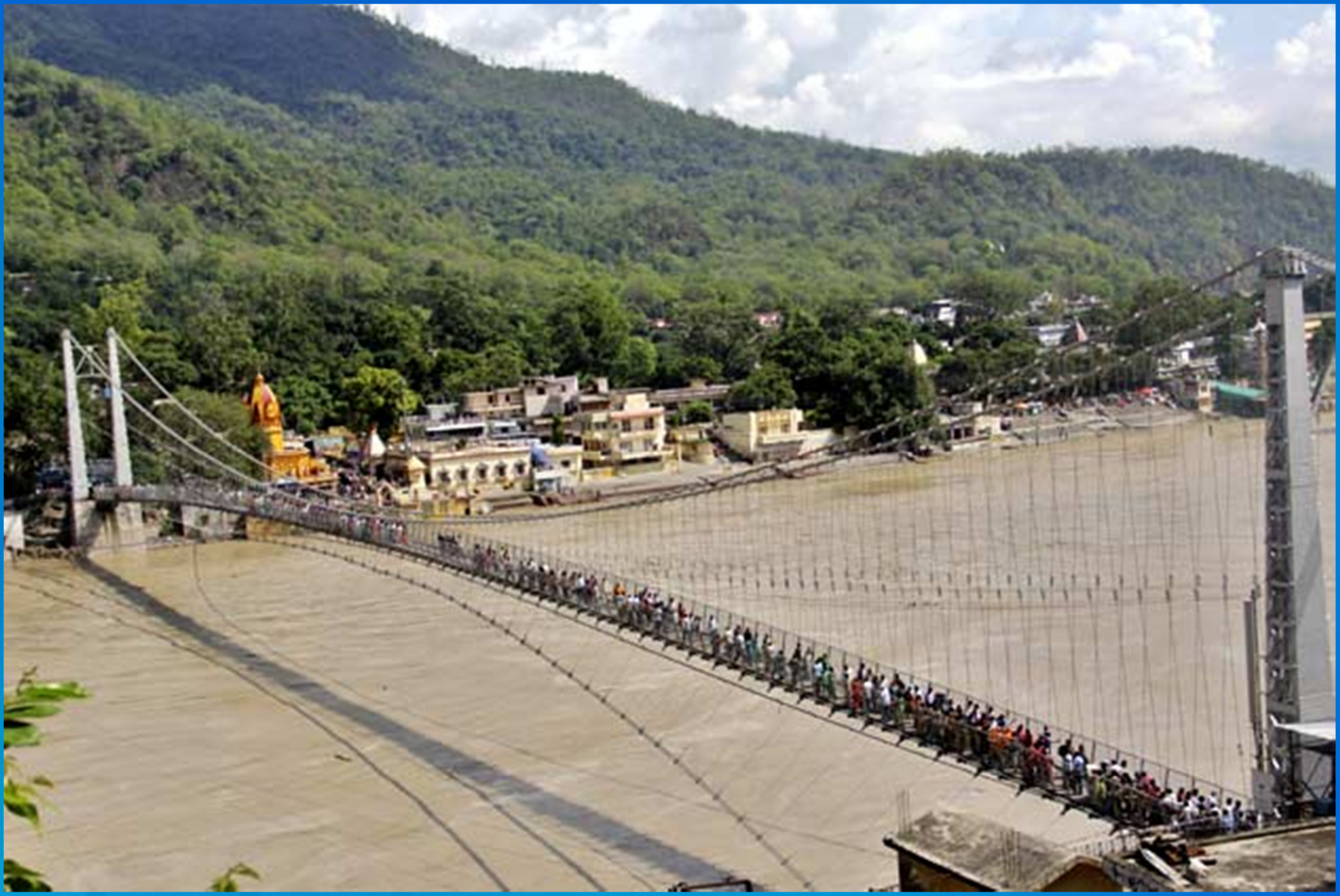
1. Possibility of high rainfall event at 28.10 N , 79.40 E with radius of influence of 21.21 kms.
2. Possibility of high rainfall event at 28.25 N , 78.90 E with radius of influence of 13.43 kms.
3. Possibility of high rainfall event at 29.25 N , 78.25 E with radius of influence of 13.50 kms.
4. Possibility of high rainfall event at 30.74 N , 79.78 E with radius of influence of 11.90 kms.
   1. Possibility of cloud burst event

3d view of Kedarnath area

Satellite data Kedarnath area



Cartosat data of Kedarnath area
2011 and June 20, 2013



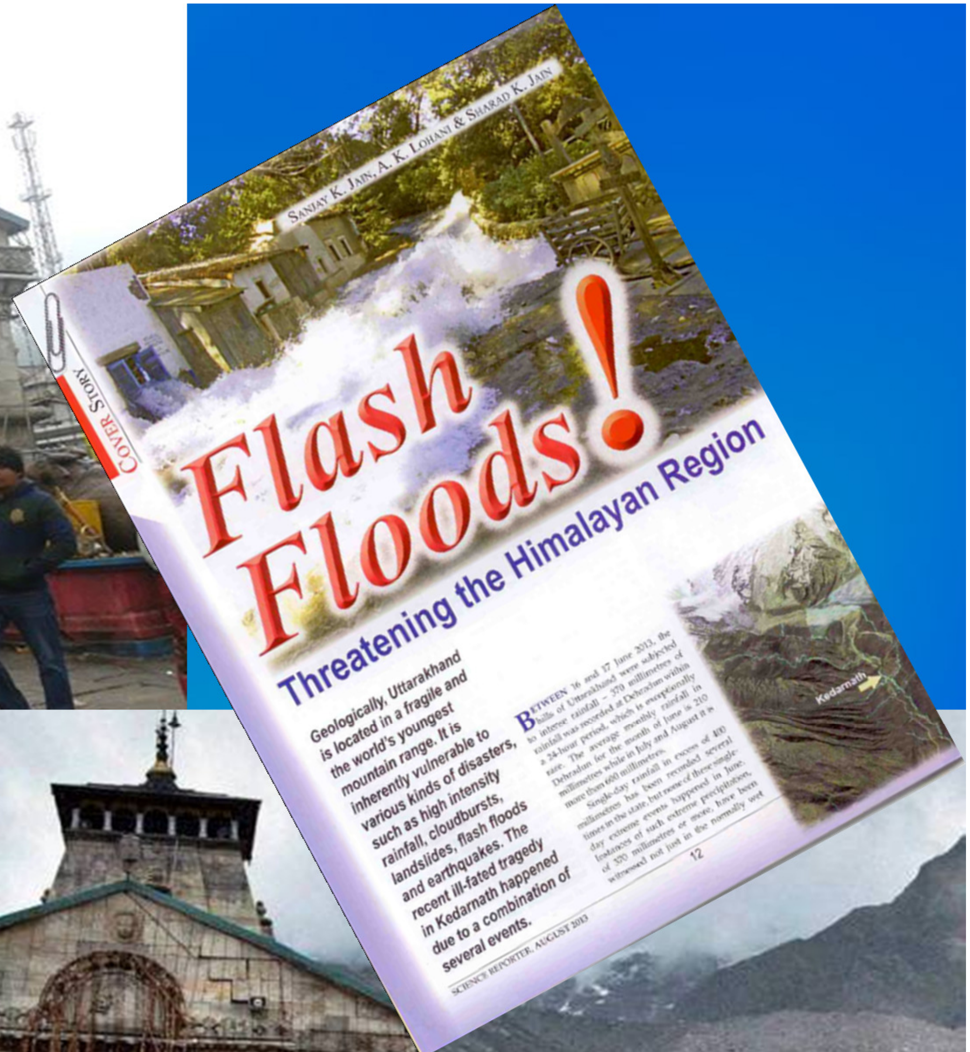
A View of Ram Jhula on 16th June 2013.

A View of Ram Jhula on 17th June 2013

The water levels in Tehri dam were low at the start of the monsoon. This proved a critical factor in the dam retaining waters of an engorged Bhagirathi and preventing rise in the Ganga at Rishikesh that could have been ruinous for the town and its ashrams.

A submerged idol of Hindu Lord Shiva stands in the flooded River Ganges in Rishikesh

Kedarnath temple stays intact, its surroundings have gone with flow



Sanjay K. Jain, A. K. Lohani & Sharad K. Jain

COVER STORY

Flash Floods!

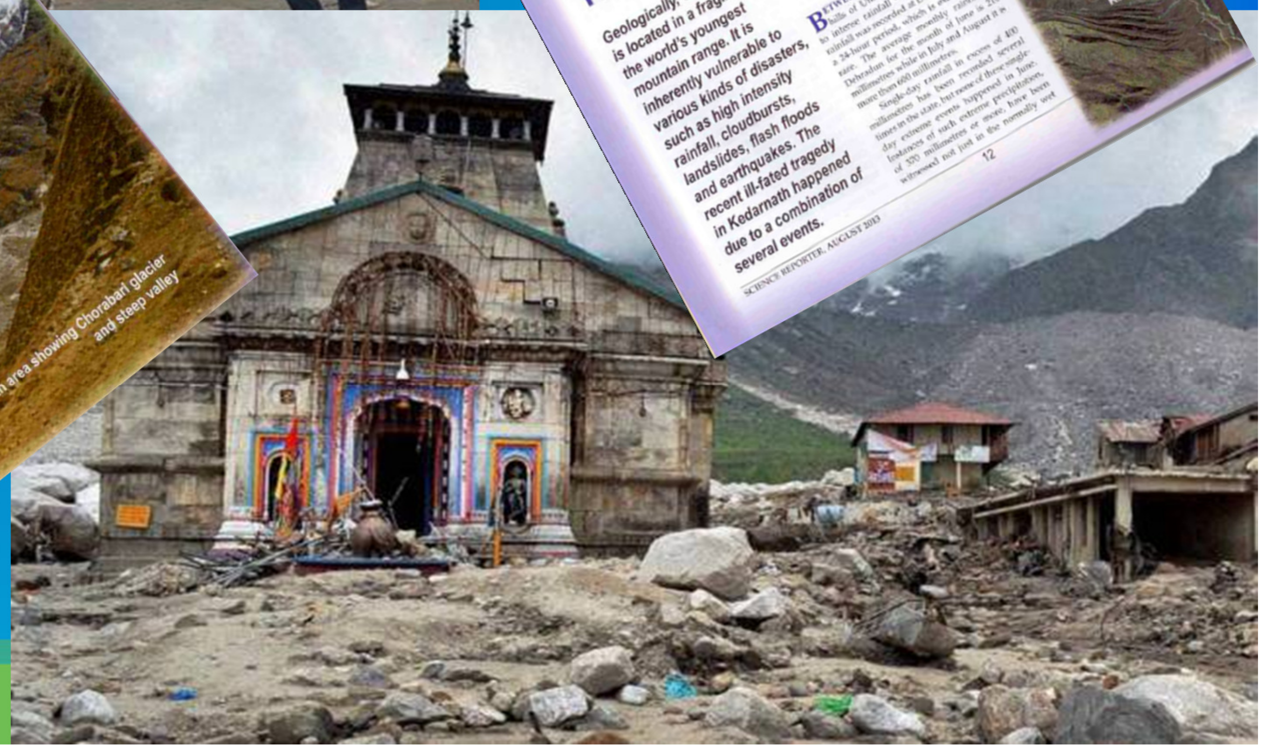
Threatening the Himalayan Region

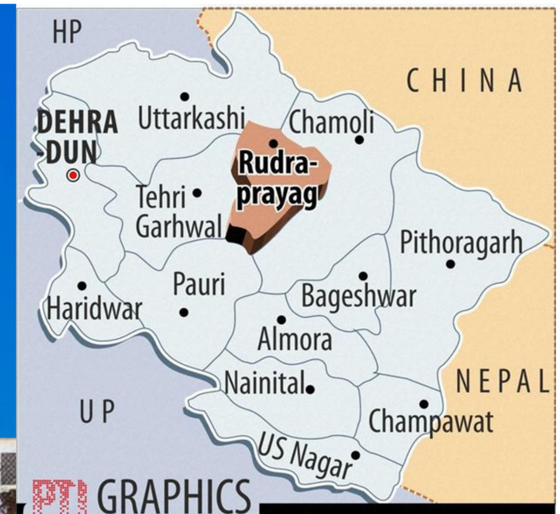
Geologically, Uttarakhand is located in a fragile and the world's youngest mountain range. It is inherently vulnerable to various kinds of disasters, such as high intensity rainfall, cloudbursts, landslides, flash floods and earthquakes. The recent ill-fated tragedy in Kedarnath happened due to a combination of several events.

BETWEEN 16 and 17 June 2013, the hills of Uttarakhand were subjected to intense rainfall – 370 millimetres of rainfall was recorded at Dehradun within a 24-hour period, which is exceptionally rare. The average monthly rainfall in Dehradun for the month of June is 210 millimetres while in July and August it is more than 600 millimetres.

Single-day rainfall in excess of 400 millimetres has been recorded several times in the state, but none of these single-day extreme events happened in June. Instances of such extreme precipitation, of 370 millimetres or more, have been witnessed not just in the normally wet

Kedarnath area showing Chorabari glacier and steep valley





असी गंगा घाटी में हालात खौफनाक

अलग-थलग गांवों में पहुंचा इंटर एजेंसी ग्रुप

अमर उजाला ब्यूरो

बुरा है घाटी का हाल

होमगार्ड के जवान की मौत

जोखिम उठाकर संगमचट्टी क्षेत्र के दौरे पर गए स्वयंसेवी।

गजोली गांव में बीमार बच्चों का उपचार करते एसबीएमए के कार्यकर्ता।

बाढ़ के बाद इस हाल में असी गंगा प्रथम का तकरीबन तैयार हो चुका विद्युतगृह।

असी गंगा की बाढ़ में इस तरह तबाह हुआ है संगमचट्टी बाजार।

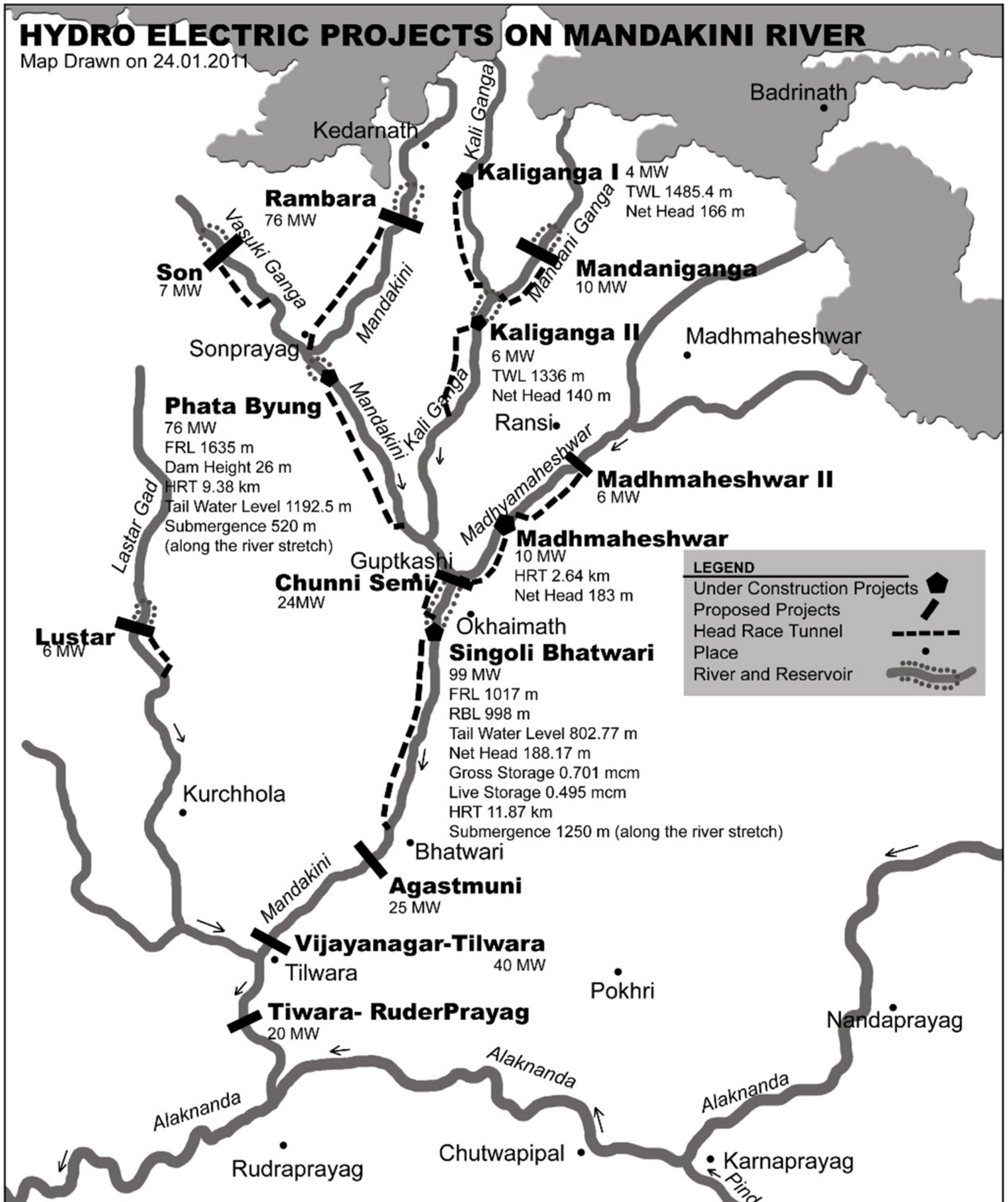
बाढ़ से पहले इस गेट से कल्डियाणी हाईस्कूल।

बढ़ता जा रहा आपदा में मरने वालों का आंकड़ा

अमर उजाला ब्यूरो

- पिलंग में भूधंसाव से हुई थी भादर सिंह की मौत
- कल्डियाणी में दो साधुओं की मौत की आशंका

Cloudburst in Uttarakhand kills 30, several people missing



Some people are of the opinion that the Kedarnath disaster was caused due to construction of hydropower projects in Upper Ganga basin. However, the project nearest to Kedarnath is about 10 km downstream and is under construction. Obviously hydropower projects have no direct role in the catastrophic event at Kedar Nath.

Hydro Electric Projects in Mandakani River

TEHRI DAM
ON JUNE 16-17

FLOOD THREAT IN DOWNSTREAM AREAS

HEAVY INFLOW INTO DAM

- Inflow into the dam is around 950 cumecs a day and around 1,100 cumecs being released
- A high alert has been issued in areas on the banks of Ganga in Haridwar, Pauri and Tehri districts
- 50 villages adove Tehri dam got completely cut off
- On Sunday, level in the Ganga near Haridwar reached 293.08m, just about a metre below the danger level of 294m.

Tehri reservoir recorded the rise of 25 meters within 48 hours of rainfall on 16-17 June.

Due to heavy rainfall in Uttarakhand the water inflow in Tehri dam from Bhagirathi and its tributaries reached about 7,000 cumecs, of which a mere 500 cumecs was released from Tehri Dam Reservoir and remaining 6,500 cumecs of water stored in the reservoir.

On June 16, Alaknanada and Bhagirathi had a combined flow of around 13,000 cumecs at Haridwar out of which only 500 cumecs of Bhagirathi water was released from Tehri Dam Reservoir.

In case the whole of the water inflow of Bhagirathi would have been released from the Tehri Reservoir it could have caused an additional rise in the water level.

Traditional Flood Management

- Addresses only negative aspects of flooding
- Focuses on reducing flooding and reducing the susceptibility to flood damage
- Provides adhoc reactions and are carried out in isolation
- Expresses the risk of flooding simply as the exceedence probability of a flood of a given magnitude on a particular stretch of river
- In limited studies flood inundation modeling for various return periods has been attempted.

Challenges

Population growth and economic growth - Increased population and enhanced economic activities in floodplains further increase the risk of flooding

Riverine aquatic ecosystems - Provide benefits like clean drinking water, food, materials, water purification, flood mitigation and recreational opportunities

The magnitude and variability of flow regime needed within a basin to maximize the benefits to society and to maintain a healthy riverine ecosystem must strike a balance between competing interests in a river basin

Intensity and duration of precipitation events are likely to increase due to climate change, resulting in an increase of the frequency of major floods in many regions

Integrated Flood Management

Concept

First introduced in a concept paper in 2003

IFM calls for a paradigm shift from the traditional, fragmented and localized approach, and encourages the use of the resources of a river basin as a whole, employing strategies to maintain or augument the productivity of floodplains, while at the same time providing protective measures against losses due to flooding.

(World Meteorological Organization)

Integrated Flood Management

Concept — Revised in 2009 (WMO)

Consideration of emerging issues, such as risk management, urbanization, climate variability and change, and adaptive management

Integrated Flood Management

Paradigm shift

Absolute protection from floods is a myth

We should aim at maximizing net benefits from the use of flood plains, rather than trying to fully control floods

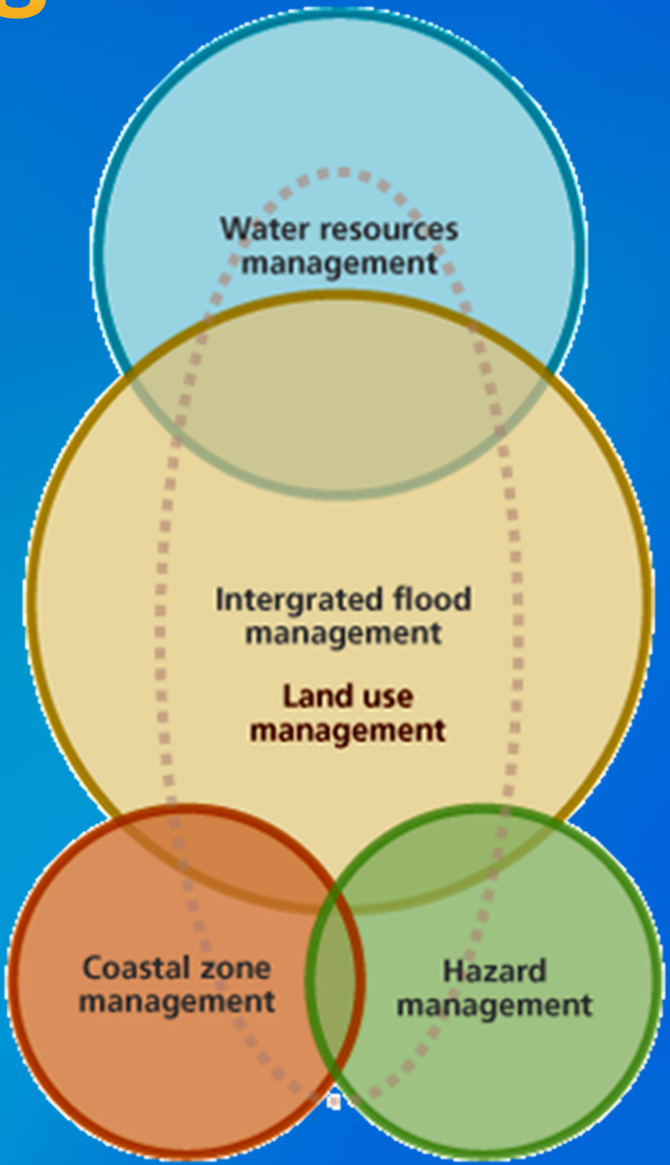
Integrated Flood Management

Improves the functioning of the river basin as a whole

- Recognizing that floods have beneficial impacts and can never be fully controlled

Integrates land and water resources development in a river basin

Maximizes the efficient use of floodplains and minimizes loss of life



Integrated Flood Management

A holistic approach to emergency planning and management is preferable to a hazard-specific approach, and IFM should be part of a wider risk management system

This approach fosters structured information exchange and formation of effective organizational relationships

In integrated flood management planning, achieving the common goal of sustainable development requires that the decision-making processes of any number of separate development authorities be coordinated

Integrated Flood Management

Elements of IFM

- Manage the Water Cycle as a Whole
- Integrate Land and Water Management
- Manage Risk and Uncertainty
- Adopt a Best-Mix of Strategies
- Ensure a Participatory Approach
- Adopt Integrated Hazard Management Approaches

Research Needs for Main Streaming of IFM

Reducing flooding:

Dams and reservoirs, dikes, levees and flood embankments, high flow diversions, dranage congesation, coastal and low land area flooding, catchment management, urban flooding management.

Reducing vulnerability to flood damage:

Flood indudation assessment using 2D flood inundation modeling, design and location of facilities, flood proofing , aggredation and de-aggredation of rivers, flood forecasting and warning, parcipatory approch, institutional arrangements, linkages

Preserving the natural resources of flood plains:

Flood risk assessment, flood hazard mapping for flood plain zoning, water quality & sediment load management, enviornmental and ecology aspects

Research Needs for Main Streaming of IFM

Mitigating the impacts of flooding:

Information and education, disaster Preparedness, integrated hazard management

Climate change:

Collobration/capacity building on rainfall forecasting, prediction and modelling of hydrological extremes and flood inundation modeling

Manual/strategy :

Integrated Water Resource Management, DSS (IFM)

Constraints & perceived Remedial Measures for implementing research findings in IFM

Generally conventional data such as daily stream flow data for major gauging sites and daily/ hourly rainfall data are available but river cross-sections, L-sections, topographic data at short contour intervals, reservoir inflow, outflow, land use data and soil data are not adequately available. Therefore, appropriate instrumentation and automation in data collection for meteorological, hydrological and other related data is required.

Setting up of suitable manual and automatic data observation network for hydro meteorological and hydrological and other related data in the Himalayan and other hilly regions and establishment of data collection network for small catchments for short interval stream flow data and other related data collection should be paid attention.

Data collection, processing, storage, retrieval and dissemination using the state-of-art knowledge in Information Technology sector should be encouraged.

Preparation of standards/guidelines based on the advanced techniques and tools for planning, design and operation of water resources projects and IFM should be encouraged.

Constraints & perceived Remedial Measures for implementing research findings in IFM

Preparation of user manuals, user friendly software based on the advance hydrological techniques/ methods e.g. regionalization of Clark IUH parameters for various hydro meteorological subzones of India and applications of L-moments approach of regional flood frequency analysis, 1-D, 2-D hydrodynamic modelling of river flows and inundation, development and use of optimal reservoir rating curves for integrated operation of reservoirs and IMF should be encouraged.

Solution of the complex water issues involves multidisciplinary approach. Presently, most of the systems/ organizations lack the adequate man-power/ competence/ skills for adopting the multidisciplinary approach and new emerging technologies for solving complex water issues based on the concept of IWRM and IFM for sustainable development.

Constraints & perceived Remedial Measures for implementing research findings in IFM

Education and Training of engineers/ professionals/ personnel involved in water resources planning, development and management and IFM including short duration courses, refresher courses and degree courses as well as Training of Trainers and training of on the job engineers/ personnel/ and capacity building programmes and outreach activities for water resources planning, design and management should be given more attention.

Training and capacity building for adopting the emerging techniques such as remote sensing and GIS applications, isotopic applications, hydrological modeling and soft computing techniques should be encouraged.

Constraints & perceived Remedial Measures for implementing research findings in IFM

Specialized courses in hydrology/ water resources planning, development, management and IFM at under-graduate (B.E./ B.Tech.) level as well as diploma lelvel should be designed and run at the educational institutes for providing in-depth and focused knowledge of the required subjects/ disciplines for hydrologic analyses and water resources planning, development and management.

Brain Storming Sessions/ Workshops for the field engineers/ practioners, planners, researchers and academicians and other related professionals should be organized to indentify the constraints, bottlenecks and difficulties being faced in adoptation of new emerging technologies for solving complex water issues.

Concluding Remarks- Technical

Data Collection and Data Base Management

- Network design
- Data Monitoring System
- Regular Monitoring
- Data Storage and retrieval systems
- GIS for Spatial data management
- Web based information system

Early Warning System and communication technology

Concluding Remarks- Technical

- High resolution numerical models and meso-scale observations, high performance computers and Doppler weather radars for prediction of cloud burst
- Suitable structural and non-structural measures for flash flood risk management
- GLOF risk mapping and its simulation
- Land slides vulnerability maps
- Integrated flood management

Concluding Remarks- Technical

Possible Risk Reduction Measures for scientific Management of Land Slides

Simulation of Mud flows and possible impacts on river regimes

Design flood estimation for the culverts, bridges, barrages and other hydraulic structures

Efficacy of structural measures and other human interventions on the river flow characteristics

Concluding Remarks-General

A holistic and pro-active approach for prevention, mitigation and preparedness for disaster management.

Each Ministry/Department of the Central/State Government should set apart an appropriate quantum of funds for specific schemes/projects addressing vulnerability reduction and preparedness.

Where there is a shelf of projects, projects addressing mitigation should be given priority. Mitigation measures must be built into the on-going schemes/programmes.

A culture of planning and preparedness is to be inculcated at all levels for capacity building measures

Concluding Remarks-General

Each project in a hazard prone area should have mitigation as an essential term of reference. The project report should include a statement as to how the project addresses vulnerability reduction.

Community involvement and awareness generation, particularly that of the vulnerable segments of population and women should be emphasized as necessary for sustainable disaster risk reduction.

This is a critical component of the policy since communities are the first responders to disasters and, therefore, unless they are empowered and made capable of managing disasters, any amount of external support cannot lead to optimal results.

Concluding Remarks-General

There should be close interaction with the corporate sector, nongovernmental organisations and the media in the national efforts for disaster prevention/vulnerability reduction.

Institutional structures/appropriate chain of command should be built up and appropriate training imparted to disaster managers at various levels to ensure coordinated and quick response at all levels; and development of inter-State arrangements for sharing of resources during emergencies.

Standard operating procedures and disaster management plans at state and district levels as well as by relevant central government departments for handling specific disasters should be laid down.


THANKS
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