NATURAL HAZARDS AND DISASTER RISK REDUCTION

Web Based Material Compiled By

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INTRODUCTION

Natural hazards are severe and extreme weather and climate events. Although they occur in all parts of the world, some regions are more vulnerable to certain hazards than others. Natural hazards become disasters when people's lives and livelihoods are destroyed.

The global expected average annual loss in the built environment associated with tropical cyclones (wind and storm surge), earthquakes, tsunamis and floods is now estimated at US$314 billion. This risk presents a real challenge to the global agenda of sustainable development. (…) In absolute terms, global average annual loss is concentrated in large, higher-income, hazard-exposed economies. However, in relation to annual capital investment or social expenditure, many low and middle-income countries, and in particular small island developing states (SIDS), have the highest concentrations of risk. - UNISDR: Global Assessment Report on Disaster Risk Reduction 2015

Human and material losses caused by such disasters are a major obstacle to sustainable development. By issuing accurate forecasts and warnings in a form that is readily understood and by educating people on how to prepare against such hazards, before they become disasters, lives and property can be protected. Emphasis is on disaster risk reduction: one dollar invested in disaster preparedness can prevent seven dollars' worth of disaster-related economic losses – a considerable return on investment.

As signatories to the Sendai Framework for Disaster Risk Reduction 2015–2030, WMO Members have undertaken to prevent new and reduce existing disaster risk through the implementation of a range of integrated and inclusive measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery and thus strengthen resilience. To support the assessment of global progress in achieving the outcomes and goals of the Sendai Framework, seven global targets have been agreed, most of which have direct implications for WMO and its Members.

WMO Disaster Risk Reduction activities are integrated and coordinated with other international, regional and national organizations. WMO coordinates the efforts of National Meteorological and Hydrological Services to mitigate human and property losses through improved forecast services and early warnings, as well as risk assessments, and to raise public awareness.

Natural hazards occur across different time and area scales and each is in some way unique. Tornadoes and flash floods are short-lived, violent events, affecting a relatively small area. Others, such as droughts, develop slowly, but can affect most of a continent and entire countries for months or even years. An extreme weather event can involve multiple hazards at the same time or in quick succession. In addition to high winds and heavy rain, a tropical storm can result in flooding and mudslides. In temperate latitudes, severe thunderstorms can be accompanied by a combination of large, damaging hail stones, tornadoes, strong winds or heavy rain resulting in flash floods. Winter storms with high winds and heavy snow or freezing rain can also contribute to avalanches on some mountain slopes and to high runoff or flooding later on in the melt season.

Some National Meteorological and Hydrological Services and specialized centres have responsibility for investigating geophysical hazards including volcanic explosions (airborne ash) and tsunamis, and hazardous airborne matter (radionuclides, biological and chemical substances) and acute urban pollution.

DROUGHT

Drought is a prolonged dry period in the natural climate cylce that can occur anywhere in the world. It is a slow on-set phenomenon caused by a lack of rainfall. Compounding factors, such as poverty and inappropriate land use, increase vulnerability to drought. When drought causes water and food shortages, there can be many impacts on the health of the population, which may increase morbidity and result in death. In recent years, most drought-related mortality has occurred in countries also experiencing political and civil unrest. In the period from 1970 to 2012, drought caused almost 680 000 deaths, due to the severe African droughts of 1975, 1983 and 1984 (Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes, WMO, 2014).

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Integrated Drought Management Programme

The Integrated Drought Management Programme (IDMP), a joint initiative between WMO and the Global Water Partnership, works with a wide range of partners in order to support stakeholders by providing them with policy and management guidance and by sharing best practices and knowledge for integrated drought management.

Drought in India has resulted in millions of deaths over the years. Indian agriculture is heavily dependent on the country's climate: a favorable monsoon is critical to securing water for irrigating India's crops. In parts of India, failure of the monsoons causes water shortages, resulting in poor yields. This is particularly true of major drought-prone regions southeastern Maharashtra, northern Karnataka, Andhra Pradesh, Odisha, Gujarat, Telangana, and Rajasthan.

Ramchandra Sabale, senior meteorologist in agriculture field, said, “The data shows severe famine was reported during 1965, 1972, 2002 and 2009 in India. Hence, whenever there was an active El Nino, we had faced severe drought as a result of low rainfall during monsoon.

India experiences droughts when the southwest monsoon is weak. Droughts occur as a result of a weak monsoon's inadequate rainfall. Droughts can also be brought on by the monsoons' late arrival or early departure. Droughts are another consequence of prolonged monsoon breaks during the rainy season.

As high as 68 percent of the cropped area in India is vulnerable to droughts of which 33 percent is classified as 'chronically drought-prone' comprising desert and semiarid regions that receive less than 750 mm mean annual rainfall. Out of the 328 million ha geographical area of India, 107 million ha (nearly one-third), spread over administrative districts in several states, is affected by drought. It includes about 39 per cent of cultivable land and about 29 per cent of our population.

Drought-affected area in Karnataka, India, 2012

Only about 35% of total agricultural land in India is irrigated and two-thirds of cultivated land is entirely dependent on rainfall. As such, the agricultural production system in the country is more vulnerable to damage from extreme climatic events, which causes increased water stress leading to inadequate water supplies for irrigation.

Already, rises in average temperatures, changes in rainfall patterns, increasing frequency of extreme weather events, such as severe droughts and floods, and the shifting of agricultural seasons have been observed in different agro-ecological zones of India. Long drought spells during Kharif and increased temperatures and unseasonal heavy rains during the rabi season have caused serious distress to the farming communities in different states in recent years. Four major farming systems are prevailing in India: the irrigated system, rainfed system, silvo-pastoral system, and desert farming.

In the past, droughts have periodically led to major Indian famines, including the Bengal famine of 1770, in which up to one third of the population in affected areas died; the 1876–1877 famine, in which over five million people died; and the 1899 famine, in which over 4.5 million died.[3][4] In simple words, drought has destroyed India on a large scale. Eighteen meteorological and 16 hydrological droughts occurred in India between 1870 and 2018. The most severe meteorological droughts were in the years 1876, 1899, 1918, 1965, and 2000, while the five worst hydrological droughts occurred in the years 1876, 1899, 1918, 1965, and 2000. The drought of 1899 can be classified as meteorological as well as hydrological and was the most severe documented drought India has ever experienced to date.

Impact of El Niño

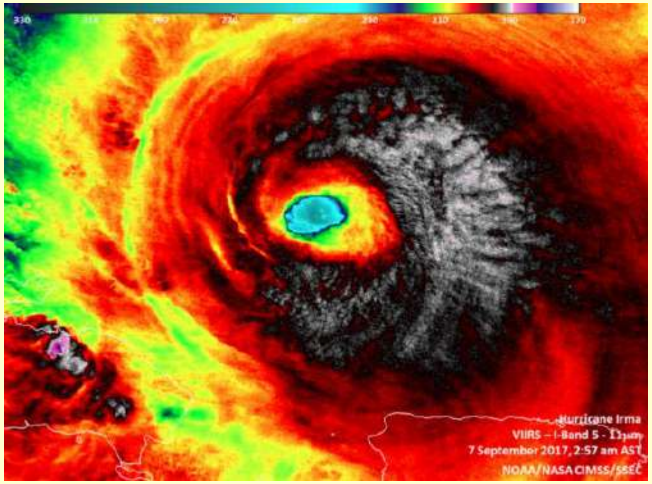
All such episodes of severe drought correlate with El Niño–Southern Oscillation (ENSO) events. El Niño-related droughts have also been implicated in periodic declines in Indian agricultural output. Nevertheless, ENSO events that have coincided with abnormally high sea surfaces temperatures in the Indian Ocean—in one instance during 1997 and 1998 by up to 3 °C (5 °F)—have resulted in increased oceanic evaporation, resulting in unusually wet weather across India. Such anomalies occurred during a sustained warm spell that began in the 1990s. A contrasting phenomenon is that, instead of the usual high-pressure air mass over the southern Indian Ocean, an ENSO-related oceanic low-pressure convergence center forms; it then continually pulls dry air from Central Asia, desiccating India during what should have been the humid summer monsoon season. This reversed airflow causes India's droughts. The extent that an ENSO event raises sea surface temperatures in the central Pacific Ocean influences the degree of drought.[Around 43 percent of El Niño events are followed by drought in India.

Some of the measures that can be taken to control or solve the problem of drought are listed below.

Desalination of water.
Rainwater harvesting.
Drip irrigation.
Harvesting water from air – technology has been developed by MIT.
Genetically modified crops.
Plant more trees.
Recycle organic waste.

Tropical Cyclones

Tropical cyclones are one of the biggest threats to life and property even in the formative stages of their development. They include a number of different hazards that can individually cause significant impacts on life and property, such as storm surge, flooding, extreme winds, tornadoes and lighting. Combined, these hazards interact with one another and substantially increase the potential for loss of life and material damage.



Over the past 50 years, 1 942 disasters have been attributed to tropical cyclones, which killed 779 324 people and caused US$ 1 407.6 billion in economic losses – an average of 43 deaths and US$ 78 million in damages every day.

Characteristics of tropical cyclones

A tropical cyclone is a rapid rotating storm originating over tropical oceans from where it draws the energy to develop. It has a low pressure centre and clouds spiraling towards the eyewall surrounding the "eye", the central part of the system where the weather is normally calm and free of clouds. Its diameter is typically around 200 to 500 km, but can reach 1000 km. A tropical cyclone brings very violent winds, torrential rain, high waves and, in some cases, very destructive storm surges and coastal flooding. The winds blow counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. Tropical cyclones above a certain strength are given names in the interests of public safety.

Classification of tropical cyclones

Depending on the maximum sustained wind speed, tropical cyclones will be designated as follows:

- Tropical depression is when the maximum sustained wind speed is less than 63 km/h.
- Tropical storm is when the maximum sustained wind speed is more than 63 km/h. It is then also given a name.
- Hurricane, typhoon, tropical cyclone, very severe cyclonic storm - depending on the basin - when the maximum sustained wind speed exceeds 116 km/h or 63 knots.

knot	km/h	Beaufort	**South West Indian Ocean***	**Arabian Sea and Bay of Bengal****	**North West Pacific****	**North Atlantic and North East Pacific*****	**South West Pacific and South East Indian Ocean***
Average wind speed			knot km/h	knot km/h		Knot km/h mi/h	knot km/h
			Zone of disturbed weather	Low pressure area			Tropical disturbance
17 **27**	**31** **50**	**6**	Tropical disturbance	Depression	Tropical depression	Tropical depression	Tropical low/depression
28 **33**	**51** **62**	**7**	Tropical depression	Deep depression			
34 **40** **47**	**63** 88	**8** **9**	Moderate tropical storm	Cyclonic storm	Tropical storm	34 39 Tropical storm	Tropical cyclone (gale) / Category 1
48 **52** **63**	**89** **117**	**10** **11**	Severe tropical storm	Severe cyclonic storm	Severe tropical storm	73	Tropical cyclone (storm) / Category 2
64	**118**	**12**	64 Tropical cyclone	64 Very Severe Cyclonic Storm	Typhoon	64 Hurricane CAT 1 82 153 95	64 Severe tropical cyclone (hurricane) / Category 3
						83 154 96 Hurricane CAT 2 95 177 110	
			89 165	89 166		96 178 111 Hurricane CAT 3 112 208 129	85 159
			90 166 Intense tropical cyclone 115 212	90 167 Extremely Severe Cyclonic Storm 119 221		113 209 130 Hurricane CAT 4 136 251 156	86 160 Tropical cyclone / Category 4 107 199
			116 213 Very intense tropical cyclone	120 222 Super cyclonic storm		137 252 157 Hurricane CAT 5	>107 >200 Tropical Cyclone / Category 5

* 10-min average wind speed, ** 10-min (recording) 3-min (non-recording), *** 1-min average wind speed

Tropical cyclones and their related hazards

Tropical cyclones are associated with a variety of hazards. Damaging or destructive winds may reach speeds in excess of 300 km/h in the most intense systems. The combination of wind-driven waves and the low-pressure of a tropical cyclone can produce a coastal storm surge – a huge volume of water driven ashore at high speed and with immense force that can wash away structures in its path and cause significant damage to the coastal environment. Torrential rainfall results in flash-flooding, flooding, and potential landslides and mudslides.

Their potential for wreaking havoc caused by those associated hazards is exacerbated by the length and width of the areas they affect, their intensity, frequency of occurrence and the vulnerability of the impacted areas.

Tropical Cyclone Forecasting

Meteorologists around the world use modern technology, such as satellites, weather radars and computers, to track tropical cyclones as they develop. Tropical cyclones may be difficult to forecast, as they can suddenly weaken or change their course. However, meteorologists use state-of-art technologies and develop modern techniques such as numerical weather prediction models to forecast how a tropical cyclone evolves, including its movement and change of intensity; when and where one will hit land and at what speed. Official warnings are then issued by the National Meteorological Services of the countries concerned.

About 85 tropical storms form annually over the warm tropical oceans of the globe. Among these, a little more than half (45) become tropical cyclone/hurricane/typhoon. The WMO Tropical Cyclone Programme provides information on these hazards and the WMO Severe Weather Information Centre provides real-time tropical cyclone advisories.

The WMO framework allows the timely and widespread dissemination of information about tropical cyclones. As a result of international cooperation and coordination, tropical cyclones are increasingly being monitored from their early stages of formation. The activities are coordinated at the global and regional levels by WMO through its Tropical Cyclone Programme. The Regional Specialized Meteorological Centres with the activity specialization in tropical cyclones, and Tropical Cyclone Warning Centres, all designated by WMO, are functioning within the Organization's Tropical Cyclone Programme. Their role is to detect, monitor, track and forecast all tropical cyclones in their respective regions. The Centres provide, in real-time, advisory information and guidance to the National Meteorological and Hydrological Services.

Record of Top Ten Tropical Cyclones from 1970 to 2019

The soon to be released *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes 1970-2019* states that in the past 50 years, three of the top 10 disasters worldwide in terms of deaths were attributed to tropical cyclones. The deaths recorded in these three events account for 43% of the combined deaths of the top ten disasters. In addition, the *Atlas* records that seven of the top ten disasters in terms of economic losses were attributed to tropical cyclones, which account for 82% of the total economic losses of the combined top ten disasters. Six of these disasters occurred in the USA.

Ranked as the third most costly tropical cyclone, **Maria** in 2017 impacted a number of countries, including Dominica, Dominican Republic, Guadeloupe (FRA), Haiti, Martinique (FRA), Puerto Rico, United States of America, Virgin Island (US), and Virgin Island (UK). The losses in Dominica alone totaled to US$ 1.5 billion - estimated at over 200% of its Gross Domestic Product (IMF, 2019).

Top ten Tropical Cyclones in terms of death and economic losses (1970–2019)

	Disaster Type	Year	Country	Number of deaths		Disaster Type	Year	Country	losses in US$ billion
1	Storm	1970	Bangladesh	300 000	1	Storm (Katrina)	2005	United States of America	163.61
2	Storm (Gorky)	1991	Bangladesh	138 866	2	Storm (Harvey)	2017	United States of America	96.94
3	Storm (Nargis)	2008	Myanmar	138 366	3	Storm (Maria)	2017	Puerto Rico	69.39
4	Storm	1985	Bangladesh	15 000	4	Storm (Irma)	2017	United States of America	58.16
5	Storm (Mitch)	1998	Honduras	14 600	5	Storm (Sandy)	2012	United States of America	54.47
6	Storm	1977	India	14 204	6	Storm (Andrew)	1992	United States of America	48.27
7	Storm (05B)	1999	India	9 843	7	Storm (Ike)	2008	United States of America	35.63
8	Storm	1971	India	9 658	8	Storm (Ivan)	2004	United States of America	24.36
9	Storm (Fifi)	1974	Honduras	8 000	9	Storm (Charley)	2004	United States of America	21.65
10	Storm (Haiyan)	2013	Philippines	7 354	10	Storm (Rita)	2005	United States of America	20.94

Floods And Flash Floods

Several global issues, including increasing population pressure, continuous degradation of ecosystem services and climate variability and change, can contribute to a further increase in flood risks worldwide

https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction

In many parts of the world, flooding is a major problem. In the period from 1970 to 2012, storms and floods caused over one million deaths (Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes, WMO, 2014). Flood plains are often attractive areas for human development and a vast share of the world's population depends, whether directly or indirectly, on a number of key natural resources that are generally provided by floodplains.

Several global issues, including increasing population pressure, continuous degradation of ecosystem services and climate variability and change, can contribute to a further increase in flood risks worldwide. In many parts of the world, this increase is further exacerbated by inadequate flood planning and management practices.

However, floods are an integral part of the natural regime of a river; thus flood management plays an important role in protecting people and infrastructure from floods and flooding. Integrating flood risks into the management of water resources provides a rationale to shift away from a single focused approach – such as flood control – towards an integrated flood management approach.

India is a country that faces the **twin challenges of floods and droughts every year.** The **monsoon** season, which brings about **75% of the annual rainfall,** is also a time of great variability and uncertainty. Year after year, as the monsoon season progresses, floods wreak havoc, leaving behind a trail of destruction and despair. As the 2023 monsoon progresses, floods are beginning to repeat the pattern of damage and destruction. The magnitude of this issue becomes apparent when we consider the staggering statistics: an average of **at least one major flood event each year,** resulting in significant loss of life and extensive damage to land, crops, houses, and public utilities.

What are the Causes of Floods in India?

Heavy Rainfall:

This is the **most common cause of floods** in India. The monsoon season, which lasts from **June to September, brings intense and erratic rainfall to different parts of the country.**

Sometimes, the rainfall exceeds the capacity of the soil to absorb or the drainage system to carry away the excess water, resulting in floods.

For example, in July 2023, Delhi received **'excess' and 'large excess' rain on five out of eight days,** from July 3-10. On July 9, it **recorded 221.4 mm of rain**, more than the 209.7 mm that is the average for all of July.

This contributed to the flooding of large parts of the city.

Snowmelt:

The snow and glaciers in the mountains melt due to rising temperatures and flow down into the rivers and streams.

This can **increase the water level and cause floods downstream.**

For example, in February 2021, a **massive flash flood occurred** in Uttarakhand due to a glacial burst that triggered an avalanche of snow, ice, and debris.

Cyclones and Storms:

These are weather events that **can bring strong winds and heavy rains** along the coastal areas of India.

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These are weather events that **can bring strong winds and heavy rains** along the coastal areas of India.

They can cause storm surges, which are sudden rises in sea level **due to low atmospheric pressure and high winds.**

Storm surges can inundate low-lying areas and cause coastal flooding.

For example, in May 2020, Cyclone Amphan hit **West Bengal and Odisha** with wind speeds of up to 185 km/h and storm surges of up to 5 meters.

River Overflow:

This is a cause of floods that occurs when the water level in a **river exceeds its carrying capacity** due to excessive inflow from upstream or reduced outflow downstream.

River overflow **can be caused by factors such as heavy rainfall, snowmelt, cyclones, dams, barrages, or siltation.**

For example, in 2023, the **Yamuna River overflowed its banks** due to heavy rainfall in upstream states such as Himachal Pradesh and Haryana. The barrages in Delhi were unable to effectively regulate and redirect the river's flow, leading to flooding of several areas along the river.

What are the Impacts of Floods in India?

Loss of Life:

Floods can cause fatalities due to drowning, injuries, infections, or electrocution. According to **the National Disaster Management Authority(NDMA),** floods are one of the most frequent and deadly natural disasters in India.

Every year on average 1,600 lives is lost due to floods.

Only half past 2023, **at least 60 deaths have been confirmed** due to floods across North India, though the actual toll may be higher.

Damage to Property:

Floods can damage or destroy houses, buildings, roads, bridges, railways, power lines, communication networks, and other infrastructure.

Floods can also damage or wash away crops, livestock, vehicles, and other assets.

According to the NDMA, floods affect about **75 lakh hectares** of land and inflict damage worth **Rs 1,805 crore to crops,** houses and public utilities every year in India.

In 2023, floods have caused extensive damage to several landmarks in Delhi, such as the **Red Fort and the Supreme Court.**

Displacement of People:

Floods can force people to leave their homes and seek shelter in safer places. This can disrupt their normal lives and livelihoods.

Floods can **also create humanitarian crises** by affecting the availability of food, water, sanitation, health care, and education.

According to the **Internal Displacement Monitoring Centre,** floods displaced about **5.4 million people** in India in 2020.

In 2023, floods have d**isplaced thousands of people in North India,** especially in Himachal Pradesh and Punjab.

Environmental Degradation:

Floods can have negative impacts on the environment by eroding the soil, altering the natural habitats of **flora and fauna, polluting the water sources, and increasing the risk of landslides and epidemics.**

Floods can also affect the ecological balance of rivers and wetlands by changing their hydrology and biodiversity.

For example, floods **can threaten the survival of endangered** species such as the **Gangetic dolphin** and the **gharial** in the Yamuna River.

Economic Losses:

Floods can affect the economic growth and development of India by reducing the **agricultural output, disrupting the industrial production, affecting the trade** and commerce, and increasing the expenditure on relief and rehabilitation.

Floods **can also affect the tourism sector** by damaging the cultural heritage and natural attractions.

According to a study by the World Bank, floods cost India about **$14 billion** annually in direct losses.

What are the Solutions for Flood Management in India?

Structural Measures

Storage Reservoirs:

These are artificial structures that **store water during high-flow periods** and release it during low-flow periods.

They can moderate the flood peak by reducing the volume and velocity of water downstream.

They can also conserve water for irrigation, electricity generation, water supply, and other purposes.

For example, the Bhakra Nangal Dam **on the Sutlej River** has a storage capacity of about **9.34 BCM (billion cubic meters)** and helps in flood control as well as power generation and irrigation.

Embankments:

These are raised structures that confine the flow of water within a channel or along a bank.

They can **protect the adjacent areas from flooding by increasing the carrying capacity** of the river or diverting the excess water to other channels.

They can also provide access roads and recreational facilities along the river.

For example, **the Kosi embankment project in Bihar** aims to prevent flooding by constructing embankments along both sides of the Kosi River.

Diversions:

These are structures that divert a part or all of the flow of water from one channel to another.

They can **reduce flooding by transferring excess water to less vulnerable areas** or storage reservoirs.

They can also **provide irrigation or drinking water** to other regions.

For example, the Indira **Gandhi Canal project diverts** water from the Sutlej and Beas rivers to the Thar desert in Rajasthan for irrigation and drinking purposes.

Non-structural Measures

Flood Forecasting and Warning:

This is a system that provides a prior estimate of approaching floods based on meteorological and hydrological data.

It helps in **timely evacuation of people and movable assets** to safer places.

It also helps in reservoir operation and flood relief coordination.

For example, the Central Water Commission (CWC) operates a network of **flood forecasting stations across India** that issue daily bulletins and alerts on flood situations.

Flood Plain Zoning:

This is a regulatory measure that restricts or regulates the use of land in flood-prone areas based on their vulnerability and suitability.

It **aims to minimize the exposure and damage to human settlements and infrastructure** by discouraging or prohibiting development activities in high-risk zones.

It also **promotes conservation and restoration** of natural flood buffers such as wetlands and forests.

For example, NDMA has **issued guidelines for flood plain zoning** in India that classify the land into four zones: prohibited, restricted, regulated, and free.

Flood Insurance:

This is a financial measure that provides compensation for losses caused by floods to individuals or groups who pay a premium to an insurance company.

It aims to reduce the burden of **relief and rehabilitation on the government** and encourage risk reduction measures by the insured parties.

It also helps in creating a database of flood risk and damage assessment. For example, the Pradhan Mantri Fasal Bima Yojana (PMFBY) is a crop insurance scheme that **covers losses due to floods and other natural calamities.**

Flood Awareness and Education:

This is a social measure that involves creating awareness and imparting knowledge about floods among **various stakeholders such as communities, officials, media, NGOs, etc.**

It aims to **enhance the preparedness and response capacity** of people by providing information on flood hazards, risks, mitigation measures, early warning systems, evacuation routes, emergency contacts, etc.

It also helps in building a culture of safety and resilience among people.

For example, the NDMA conducts various awareness campaigns and training programs on flood management in India.

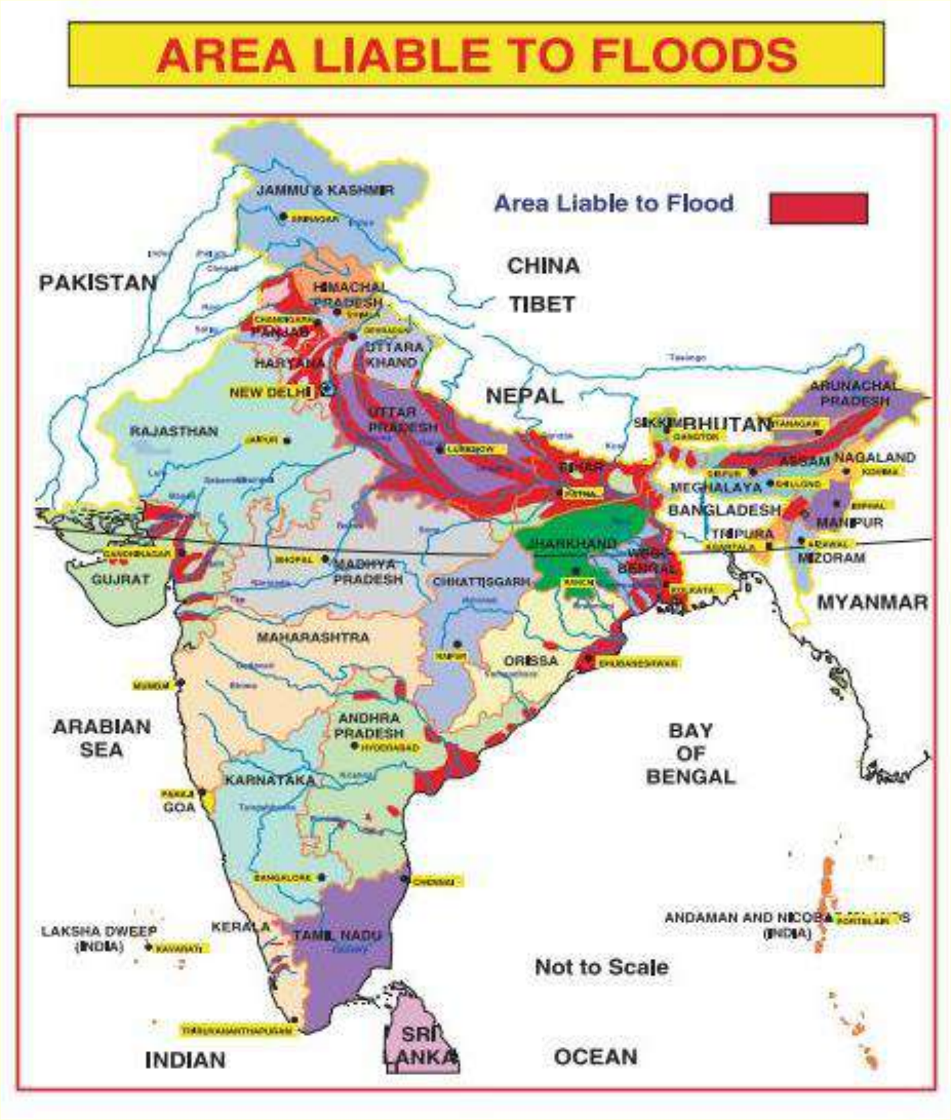
What Should be the Way Forward?

The entire suite of measures **structural and non-structural, appropriate mix of grey, blue and green infrastructure** needs to be considered for flood management.

Mindsets need changing flood flows should be seen as a resource to be conserved for subsequent use and water security.

A river basin approach should be adopted for flood management while taking care of the environment.

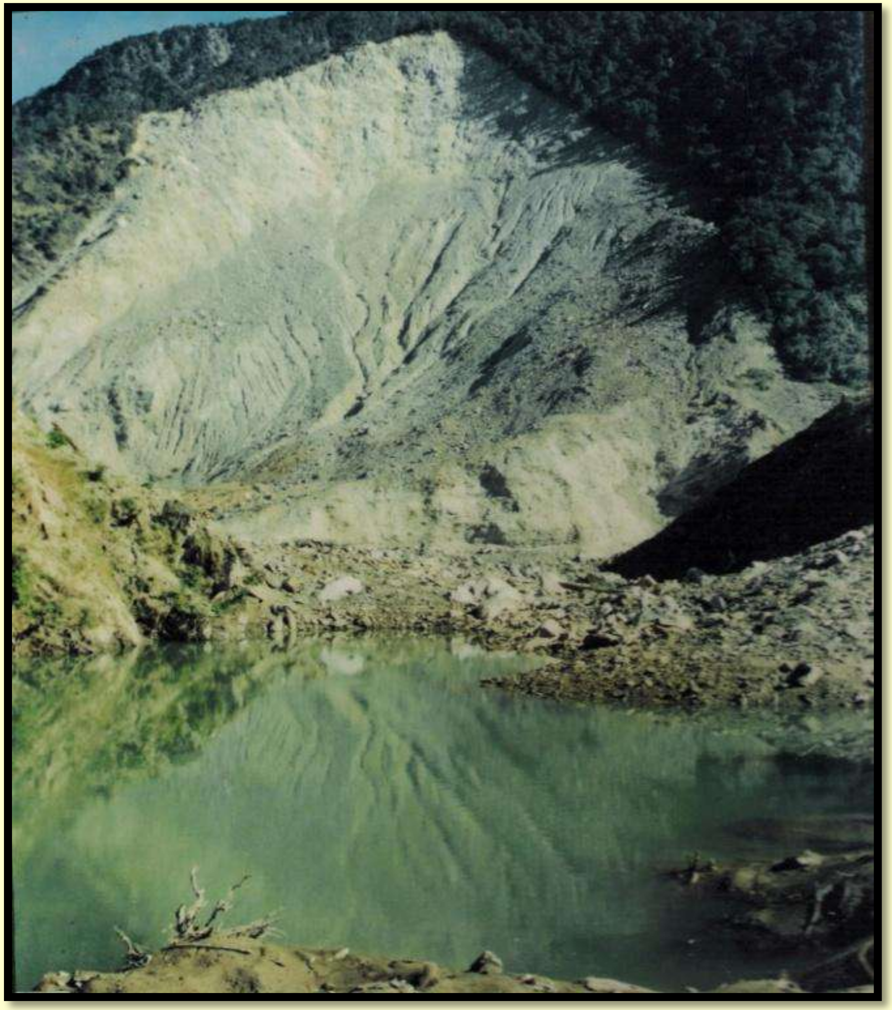
It is prudent we **upgrade the hydro-infrastructure in the country** now so that the tools to manage increased variabilities are available in time.



https://www.drishtiias.com/daily-updates/daily-news-editorials/floods-havoc-in-india

Landslide or mudslide (mudflow)

Mudslides and landslides are local events and usually unexpected. They occur when heavy rain or rapid snow or ice melt or an overflowing crater lake loosens vulnerable parts of the landscape on steep slopes, resulting in large amounts of earth, rock, sand or mud flowing swiftly down slope. Hillsides or mountain sides that are bare or have had their vegetation cover degraded through clearance or by forest or brush fires may be especially at risk. They can reach speeds of over 50 km/h and can bury, crush or carry away people, objects and buildings. In Venezuela in 1999, after two weeks of continuous rain, landslides and mudflows slid down a mountain, destroying towns and causing an estimated 15 000 fatalities.

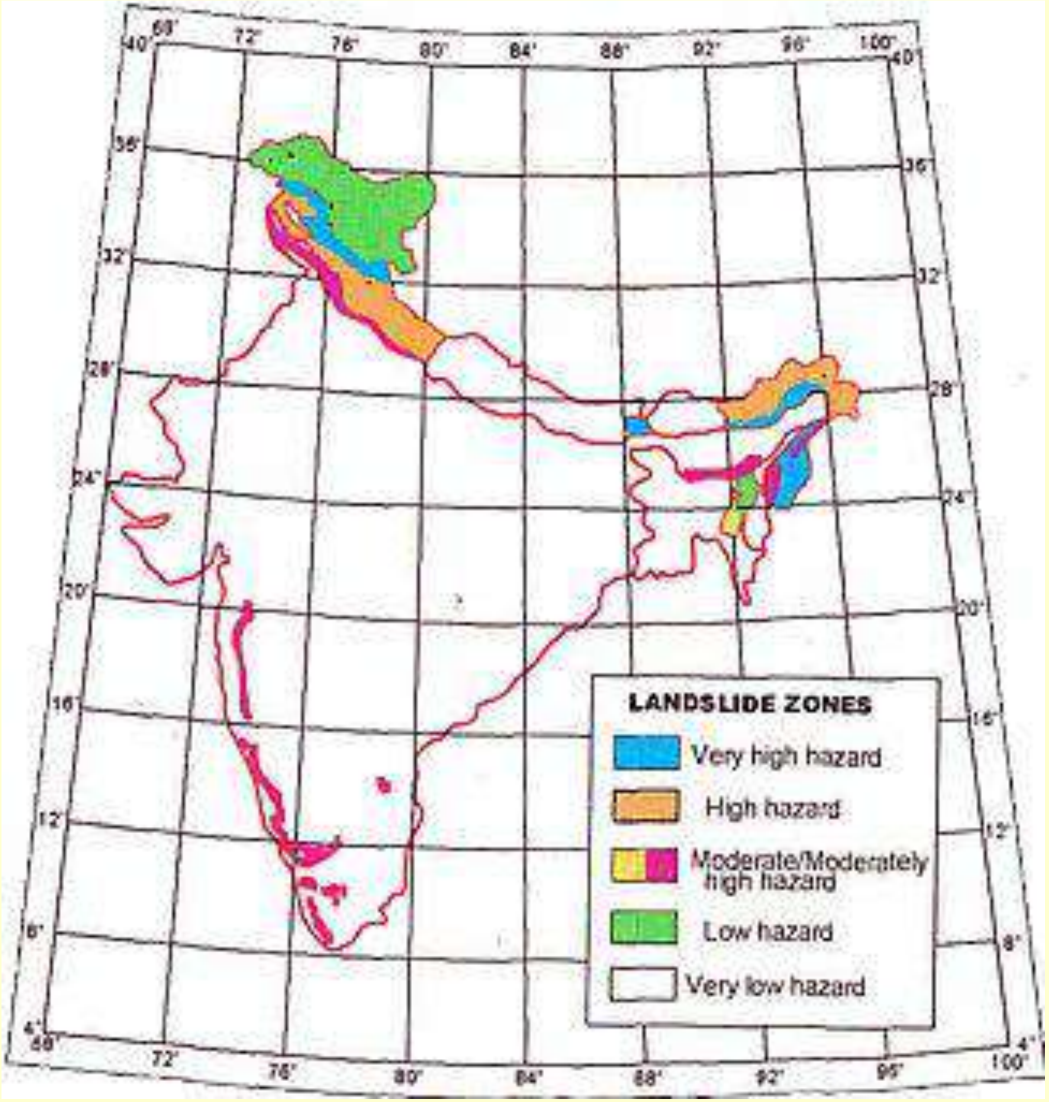


The Photograph of Okhimath landslide which formed a lake in Madhyamaheshwerganga, Rudraprayag district.

Landslide in India

India has the highest mountain chain on earth, the Himalayas, which are formed due to collision of Indian and Eurasian plate, the northward movement of the Indian plate towards China causes continuous stress on the rocks rendering them friable, weak and prone to landslides and earthquakes. The slow motion of the Indian crust, about 5 cm/year accumulates stress to which natural disasters are attributed. Some landslides make unique, and unparalleled catastrophes. Landslides and avalanches are among the major hydro-geological hazards that affect large parts of India besides the Himalayas, the Northeastern hill ranges, the Western Ghats, the Nilgiris, the Eastern Ghats and the Vindhyans, in that order, covering about 15 % of the landmass. The Himalayas alone count for landslides of every fame, name and description- big and small, quick and creeping, ancient and new. The Northeastern region is badly affected by landslide problems of a bewildering variety. Landslides in the Darjeeling district of West Bengal as also those in Sikkim, Mizoram, Tripura, Meghalaya, Assam, Nagaland and Arunachal Pradesh pose chronic problems, causing recurring economic losses worth billions of rupees. A different variety of landslides, characterized by a lateritic cap, pose constant threat to the Western Ghats in the South, along the steep slopes overlooking the Konkan coast besides Nilgiris, which is highly landslide prone.

Some spectacular events of tragedies are reported as Varnavat landslide, Uttarkashi District, Malpha landslide Pithoragarh district, Okhimath landslide in Chamoli district, UK and Paglajhora in Darjeeling district as well as Sikkim, Aizawl sports complex, Mizoram.These are some of the more recent examples of landslides. The problem therefore needs to be tackled for mitigation and management for which hazard zones have to be identified and specific slides to be stabilized and managed in addition to monitoring and early warning systems to be placed at selected sites.



NDMA guidelines are being followed for Landslide Hazard Zonation (LHZ) maps at 1: 50,000 scale and progressively larger scales for specific areas. National Remote Sensing Center (NRSC),Department of Science and Technology (DST), Council of Scientific and Industrial Research (CSIR), Indian Institute of India (IITs), Universities have done tremendous work in this regard. The NRSC Atlas on selected corridors of Uttarakhand and Himachal Pradesh has been a very useful Atlas (Please see NRSC work on Landslides). DST has funded more than 30 projects spread over India by various academic institutions the reports of which can be requested from DST (NRDMA).

An example of LHZ map at 1: 50,000 scale from a part of Himalayas in Chamoli district (Pachauri, 1992) shown here is based upon several geological, geotechnical parameters. Such maps are being refined and relooked for higher level of verification and acceptability for public use. Approximately 15 % of the Indian landmass has to be covered by such maps at 1: 50,000 scale or higher to classify slopes in various levels of hazards. Geographical Information System (GIS) and Remote Sensing applications are being used through NRSC under a special group of GIS for LHZ at NDMA through database collection from all concerned departments and being stored through good offices of GIS and other agencies, CSIR labs, DST etc as a parallel theme on landslide mitigation.

Avalanche:

An avalanche is a mass of snow and ice falling suddenly down a mountain slope, often taking earth, rocks and rubble with it. Avalanches can be highly destructive, moving at speeds in excess of 150 km/h. The moving snow also pushes air ahead of it as an avalanche wind strong enough to cause serious structural damage to buildings, woodlands and mountain resorts. Thousands of avalanches occur every year, killing an average of 500 people worldwide.

2022 Uttarakhand avalanche

Snowstorm and Wind Direction: Heavy snowstorms are more likely to cause Avalanches. ...
Heavy snowfall: Heavy snowfall is the first, since it deposits snow in unstable areas and puts pressure on the snow-pack. ...
Human Activity: ...
Vibration or Movement: ...
Layers of Snow: ...
Steep Slopes: ...
Warm Temperature:

The Himalayas are well known for the occurrence of snow avalanches particularly Western Himalayas I . e. the snowy regions of Jammu and Kashmir, Himachal Pradesh and Western Uttar Pradesh.

On 4 October 2022, an avalanche hit the Draupadi Ka Danda peak in Uttarakhand, India. 27 mountaineers in the Advanced Mountaineering Course of the Nehru Institute of Mountaineering were killed as a result.[1] The death toll makes this the worst mountaineering disaster recorded in India.[2]

Avalanches In India: A deadly avalanche on Tuesday killed seven tourists in Sikkim's Nathu La mountain pass. ...

GULMARG, JAMMU AND KASHMIR (FEBRUARY 2023) ...
UTTARKASHI, UTTARAKHAND (OCTOBER 2022) ...
KAMENG, ARUNACHAL PRADESH (FEBRUARY 2022) ...
CHAMOLI, UTTARAKHAND (APRIL 2021) ...
CHAMOLI, UTTARAKHAND (FEBRUARY 2021)

Duststorms/sandstorms:

Sand and dust storms usually occur when strong winds lift large amounts of sand and dust from bare, dry soils into the atmosphere. Over the last decade, scientists have come to realize the impacts on climate, human health, the environment and many socio-economic sectors. WMO Members are at the vanguard in evaluating these impacts and developing products to guide preparedness, adaptation and mitigation policies.

The natural environment suffers, for example, from lack of precipitation for extended periods and uncontrolled land use, leading to desertification. It is estimated that one-third of the Earth's surface and one-fifth of the world's population are threatened by desertification. WMO, therefore, directs its attention to the aspects of climate variability and change that impact the environment.

The observational data of weather, climate and the atmosphere that are collected through the WMO networks of observing, data-transmitting and forecasting systems keep policy-makers informed of the state of the environment so that they are in a better position to prevent its further degradation and are used by used by the Intergovernmental Panel on Climate Change (IPCC) in its assessments of climate climate change, its potential impacts and options for adaptation and mitigation.

WMO is the recognized, comprehensive source of unique global systematic observations on the state of a wide variety of geophysical phenomena, datasets and long-term archives, and scientific and technical expertise in support of policy advice on various critical environmental issues.

Biodiversity (the variety of life on Earth and the natural patterns it forms) helps keep the global environment working. Polluted air, depleted or contaminated water, degraded soil and urban growth are all threats to biodiversity. Rising ocean temperatures are responsible for the widespread bleaching of coral reefs that support vast populations of marine life and are also important tourist attractions. Ecosystems such as wetlands, forests and lakes are an important part of the natural regime of a river. They are a buffer between river and terrestrial ecosystems and play an important role in storing or attenuating floodwaters. Stratospheric ozone protects plants, marine life, animals and people from solar ultraviolet radiation, which is harmful for life on Earth. Chlorofluorocarbons and other anthropogenic chemicals are responsible for the destruction of ozone. It is necessary, therefore, to ensure that all these Earth systems remain healthy.

An essential activity of National Meteorological and Hydrological Services is to monitor long-term changes in atmospheric greenhouse gases, ultraviolet radiation, aerosols and ozone, and to assess their consequent effects on people, climate, air and water quality and marine and terrestrial ecosystems. Another important activity is monitoring the atmospheric and water transport of dangerous particles in the wake of a volcanic explosion or an industrial accident.

The Global Atmosphere Watch (GAW) programme provides reliable scientific data and information on aerosols, greenhouse gases, selected reactive gases, ozone, ultraviolet radiation and precipitation chemistry (or atmospheric deposition). The GAW Urban Research Meteorology and Environment (GURME) project works together with the Group of Experts on Scientific Aspects of Marine Environmental Protection (GESAMP) as well as provides Sand and Dust Storms Warning (SDS-WAS). GAW recently initiated the Integrated Global Greenhouse Gas Information System (IG3S) that will use observations of greenhouse gases and inverse modelling techniques to support climate mitigations efforts. This new approach (explained in the animations below) supports of the UN Framework Convention on Climate Change (UNFCCC) and its Paris Agreement by providing an additional way of identifying and estimating urban and national emissions. It seeks to empower policymakers to take more effective action on mitigation.

Reference : https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction

ANY QUESTIONS

PLS. FEEL FREE TO ASK

THANK YOU ALL

FOR YOUR PATIENCE