



# Educrat IAS

India's Best Mentorship for Civil Services



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## DISASTER MANAGEMENT

*Mains Value Addition Material*



## TABLE OF CONTENT

<b>1. Introduction to Disaster Management</b>	<b>2</b>
a. Disasters	2
b. Hazards	2
c. Vulnerability	3
d. Risks	3
e. Disaster Preparedness	5
<b>2. Disaster Management in India</b>	<b>7</b>
<b>Institutional framework at the National Level</b>	<b>7</b>
<b>Institutional Framework at State Level</b>	<b>8</b>
<b>Institutional Framework at the District Level</b>	<b>9</b>
<b>Vulnerability Profile in India</b>	<b>10</b>
1. Earthquake	10
2. Tsunamis	13
3. Tropical cyclones:	15
4. Cold Waves	17
5. Heat Waves	20
6. Floods	22
7. Droughts	24
8. Landslides	28
9. Glacial Lake Outburst Flood (GLOF):	30
10. Lightening	32
11. Urban Floods	34
12. Cloudbursts	36
13. Avalanche	38
14. Forest Fires	40
<b>4. Anthropogenic Disasters Biological Disasters</b>	<b>45</b>
a. What is Biological Disaster?	45
b. Industrial Chemical Disasters	47
c. Nuclear Disasters	49
d. Stampede/ Crowd Management	50
<b>5. Global Framework on Disaster Management</b>	<b>53</b>
<b>CDRI</b>	<b>57</b>
<b>6. Role of community in Disaster Management</b>	<b>60</b>
<b>PRI's and Disaster Management</b>	<b>61</b>
<b>7. Previous Year Questions</b>	<b>63</b>

## 1. Introduction to Disaster Management

*“there’s no harm in hoping for the best as long as you’re prepared for the worst.”*

-Stephen King

*“When it comes to disaster management, a proactive approach is always better than a reactive one.”*

-Narendra Modi

### What is Disaster Management?

Disaster Management can be defined as the **organization and management of resources** and responsibilities for dealing with all **humanitarian aspects of emergencies** in order to lessen the impact of disasters.

According to the **Disaster Management Act 2005**, *disaster management can be defined as an integrated process of planning, coordinating, organizing, and implementing measures that are necessary for*

- Rehabilitation and reconstruction
- Prompt response to any threatening disaster
- Mitigation of any disaster or its consequences
- Preparedness to deal with any disaster
- Evacuation, rescue, and relief of the survivors
- Capacity building
- Assessing the severity of the after-effects of any disaster

So let us understand some key terms (to be written in your mains answer) before we dive into the chapter

#### a. Disasters

A disaster is a **serious disruption to the functioning of a community**, which causes **human, material, economic and environmental losses beyond a community's ability to cope**. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.

#### b. Hazards

A Hazard may be defined as **“a dangerous condition or event, that threat or have the potential for causing injury to life or damage to property or the environment.”** A hazard is any source of potential damage, harm or adverse health effects on something or someone.

**Now let us understand the basic difference between Disaster and Hazard**

DISASTER	HAZARD
Disaster is an event that occurs <b>suddenly/unexpectedly</b> in most cases and <b>disrupts the normal course of life</b> in affected area. It results in <b>loss or damage to life, property or environment</b> . This Loss is beyond the coping capacity of local affected population/society. And therefore requires external help.	Hazard is an event that has <b>potential for causing injury/loss of life</b> or damage to property/environment.

### c. Vulnerability

Vulnerability may be defined as “conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.”

**Vulnerability may be of different forms, such as:**

- 1. Economic Vulnerability** - Economic vulnerability of a community is the potential impacts of hazards on economic assets and processes
- 2. Physical Vulnerability** - It is the **potential for physical impact on the physical environment**. The physical vulnerability of an area depends on its **geographic proximity** to the source and origin of the disasters.
- 3. Social Vulnerability** - It represents the **potential impact of events** on certain groups such as the **poor, pregnant or lactating women, disabled, children, and elderly**.
- 4. Environmental Vulnerability** - It represents the **potential impact of events on account of the environmental conditions** (flora, fauna, ecosystems, biodiversity). **Wetlands, for example, are sensitive to increasing salinity from sea water**.
- 5. Attitudinal Vulnerability** - It refers to the **attitude of a community in response to an event or disaster**. Communities which have negative attitude towards change and lack initiative in life resultantly become more and more dependent on external support.

### d. Risks

Risk is a **measure of the expected losses due to a hazard event occurring in a given area over a specific time period**. Disaster risk arises when hazards interact with **physical, social, economic and environmental vulnerabilities**.

It considers the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environmentally damaged) resulting from interactions between natural or human induced hazards and vulnerable conditions.

**Risk = Probability of Hazard x Degree of**

**Vulnerability**

Group of people who are **immediately affected by a disaster**, and are the **first to respond** and help to copewith it, **before Government or relief agencies** can rush to the area.

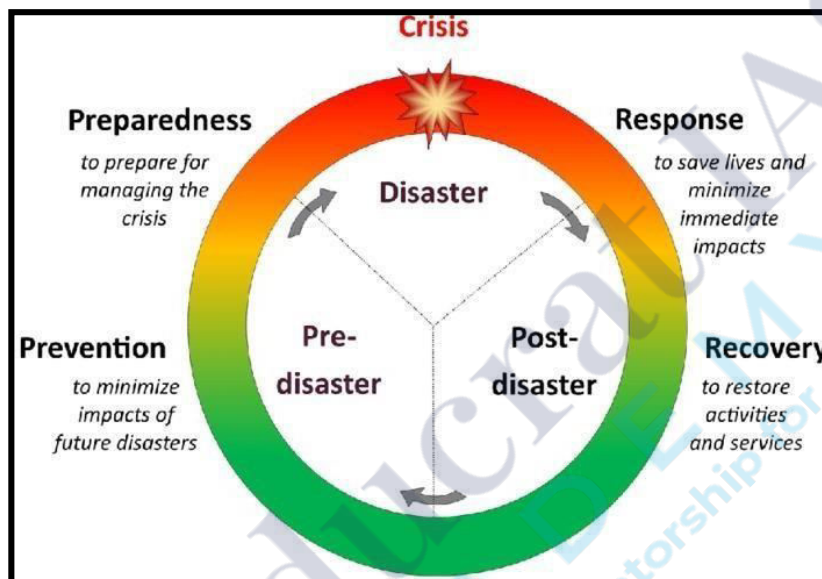


## Classification of Disasters

Disasters are classified based on severity i.e. having a major or minor impact on the affected region. It can also be classified if it is a natural or a man-made disaster. Examples of natural disasters include earthquakes, volcanic eruptions, hurricanes, and more. There are several man-made disasters as well including oil spills, transportation accidents, fires, mining accidents, and more. There are several man-made disasters as well including oil spills, transportation accidents, fires, mining accidents, and more

Disaster Management includes sum total of all activities, programs and measures which can be taken up before, during and after a disaster.

### DISASTER MANAGEMENT CYCLE



The three key stages of activities that are taken up within disaster risk management are:

#### 1. Before a disaster (pre-disaster)

- This is the **period when the potential hazard risk and vulnerabilities** can be assessed and steps taken for **preventing and mitigating the crisis**.
- These include **long-term prevention measures** such as **construction of embankments and earthquake resistant structures, afforestation, adoption of watershed management** etc.
- **Short term measures** such as carrying out awareness campaigns, ensuring enforcement of building codes etc. **can also assist in mitigation**. Risk reduction measures taken under this stage are termed as mitigation and preparedness activities.

#### 2. During a disaster (disaster occurrence)

- When a crisis actually occurs, those affected by it require a **speedy response to alleviate and minimize suffering and losses**. In this phase, certain 'primary activities' become indispensable. These are **evacuation, search and rescue, followed by provision of basic needs** such as food, clothing, shelter, medicines and **other relief material**.

#### 3. After a disaster (post-disaster)

- Recovery involves a **set of policies, tools and procedures** to enable the recovery or continuation of **vital technology infrastructure and systems** following a disaster.
- **Rehabilitation** consists of **actions taken in the aftermath of a disaster** to enable basic services to **resume functioning, assist victims' self-help efforts to repair dwellings** and community facilities,

and to facilitate the revival of economic activities.

- **Reconstruction:** Includes **construction of damaged infrastructure and habitats** and **enabling sustainable livelihoods**. It must be fully integrated into ongoing long-term development plans, taking account of future disaster risks.

## e. Disaster Preparedness

Disaster preparedness **refers to measures taken to prepare for and reduce the effects of disasters**. That is, to predict and, where possible, **prevent disasters, mitigate their impact on vulnerable populations**, and respond to and **effectively cope with their consequences**.

Preparedness efforts range from **individual-level activities** (such as first aid training), to **household actions** (e.g. stockpiling of equipment and supplies), **community efforts** (like training and field exercises), and **Governmental strategies** (including early warning systems, contingency plans, evacuation routes, and public information dissemination).

**The traditional 3 Rs (Rescue, Relief & Restoration) are now being replaced by 3 Ps (Prevention, Preparedness & Proofing).**

### Disaster Risk Reduction (DRR) and Planning

Disaster risk reduction is the **concept and practice of reducing disaster risks through systematic efforts to analyse and manage factors of disasters**, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events

### Relief and Rehabilitation

When an emergency or a disaster affects a city or a region, efforts are conducted initially **to care for the wounded, to restore lifelines and basic services**, and subsequently to **restore livelihoods and to reconstruct communities**.

- **The Relief phase:** In the immediate aftermath of the disaster, activities such as **search & rescue, rapid damage and needs assessments, and the provision of relief and first aid are conducted**. Temporary shelters are opened for those left homeless as well as humanitarian assistance is provided to those affected.
- **The Rehabilitation phase:** Rehabilitation **refers to the actions taken in the aftermath of a disaster to enable basic services to resume functioning, revive economic activities and provide support for the psychological and social well-being of the survivors**. In this phase basic services and lifelines are restored, even on a temporary basis, including the road network and other essential facilities including bridges, airports, ports and helicopter landing sites. It focuses on enabling the affected population to resume more-or-less normal (pre-disaster) patterns of life. It may be **considered as transitional phase between immediate relief and more major, long-term development**.

### Post-Disaster Recovery and Reconstruction

Reconstruction refers to the **full restoration of all services, and local infrastructure, replacement of damaged physical structures, the revitalization of economy and the restoration of social and cultural life**. Reconstruction must be **fully integrated into long-term development plans**, taking into account future disaster risks and possibilities to reduce such risks by incorporating appropriate measures. The **long-term recovery plans are related with Recovery and Reconstruction activities on the one side and institutionalizing disaster management in district administration on the other**. The Incident

Command System is now deactivated as the rehabilitation phase is over. Thereafter the normal administration shall take up the remaining reconstruction works in the disaster-affected areas.

**PM 10 point agenda on DRR – Mentioning about them in the answer will certainly fetch you marks**

Sl No.	Agenda Point
1	All development sectors must imbibe the principles of disaster risk management ▼
2	Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states ▼
3	Women's leadership and greater involvement should be central to disaster risk management ▼
4	Invest in risk mapping globally to improve global understanding of Nature and disaster risks ▼
5	Leverage technology to enhance the efficiency of disaster risk management efforts ▼
6	Develop a network of universities to work on disaster-related issues ▼
7	Utilise the opportunities provided by social media and mobile technologies for disaster risk reduction ▼
8	Build on local capacity and initiative to enhance disaster risk reduction ▼
9	Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster ▼
10	Bring about greater cohesion in international response to disasters ▼



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## 2. Disaster Management in India

*"India has demonstrated again to the world that if you set the bar high for reducing your exposure to risk then you will save many lives and reduce your economic loss."*

Former head of UNISDR

*"Strength does not come from physical capacity. It comes from an indomitable will."*

-Mohandas Karamchand Gandhi

*"Disaster mitigation... increases the self-reliance of people who are at risk - in other words, it is empowering."*

-Dr Ian Davis

### Legal and Institutional Framework in India

The Government of India enacted the **Disaster Management Act, 2005**, which envisaged the creation of a **Three-tier structure** comprising of the **National Disaster Management Authority (NDMA)**, **State Disaster Management Authorities (SDMAs)** and **District Disaster Management Authorities (DDMAs)**.

- **NDMA (National Disaster Management Authority):** It prepares policies and guidelines to combat the severe effects of disasters. As per this act, the **NDMA can have 9 members**, including a **chairperson with a tenure of 5 years**.
- **NEC (National Executive Committee):** It prepares the **national disaster management plan for the entire country** and ensures its annual review.
- **SDMA (State Disaster Management Authority):** It closely looks at all the states about the **pre-planning of the disaster management plans** as guided by national authorities.
- **NDRF (National Disaster Response Force):** This is a **special force** constituted to help and **assist survivors during disasters**.

Let's understand the functions of these bodies:

### Institutional framework at the National

#### Level

At the **national level**, overall coordination of disaster management vests with the **Ministry of Home Affairs (MHA)**. It coordinates with disaster affected states, line ministries, National Disaster Management Authority (NDMA), National Disaster Response Force (NDRF), National Institute of Disaster Management (NIDM), Home Guards and Civil Defence, and Armed Forces etc.

#### National Platform for Disaster Risk Reduction (NPDRR)

It is a **multi-stakeholder and multi- decision making body on disaster management**. It is chaired by the **Union Home Minister** with other ministers as its members. The **minister of state in-charge of disaster management in the home ministry and the Vice-Chairman of the National Disaster Management Authority are the NPDRR's vice chairpersons**.

Its functions include to review the progress made in the field of disaster management from time to time, appraise the extent and manner in which the disaster management policy has been implemented by the Central and State Governments, and other agencies concerned. It also advises on coordination between central and state governments.



## National Executive Committee

Constituted under the **DM Act, 2005** and chaired by the **Union Home Secretary** it acts as the coordinating and monitoring body for disaster management in India.

The NEC may give **directions to the relevant Ministries/Departments of the GoI, the State Governments, and the State Authorities** regarding measures to be taken by them in response to any specific threatening disaster situation or disaster as per needs of the State.

## Cabinet Committee on Security (CCS)

The Cabinet Committee on Security (CCS) is involved in decision making if the disaster has serious security implications. The **National Crisis Management Committee (NCMC)** deals with major crises that have serious or national ramifications such as **terrorism, hijacking** which require involvement of security forces.

## National Disaster Management Authority (NDMA)

It is the **apex body for disaster management**, constituted under the **DM Act, 2005 and headed by the Prime Minister of India**. It is responsible for laying down the policies, plans, and guidelines for disaster management. The guidelines of NDMA assist the Central Ministries, Departments, and States to formulate their respective Disaster Management (DM) plans.

- It approves the **National Disaster Management Plans** and plans of the Central Ministries /Departments.
- The general superintendence, direction, and control of the National Disaster Response Force (NDRF) are vested in and are exercised by the NDMA.
- The National Institute of Disaster Management (NIDM) works within the framework of broad policies and guidelines laid down by the NDMA.
- **NDMA** has the power to authorize the Departments or authorities, to make **emergency procurement of materials for rescue and relief** in a threatening disaster situation or disaster.
- It **oversees the provision and application of funds** for mitigation and preparedness measures.

## Institutional Framework at State Level

### State Disaster Management Authority

The DM Act, 2005 mandates the **creation of a State Disaster Management Authority with Chief Minister as the ex-officio Chairperson**. It is responsible for laying down the State Disaster Management Policy and approve the State DM Plans in accordance with the guidelines laid down by the Union. It is also responsible for coordinating the implementation of the plan and review the measures being taken for mitigation, capacity building and preparedness by the various state departments.

### State Executive Committee

It is **responsible for coordinating and monitoring of DM related activities in the state. The Chief Secretary of the state is its ex-officio chairperson**. It lays down the guidelines for preparation and implementation of national and state DM plans. It coordinates response in the event of a disaster and gives directions to departments. It is also **responsible for promotion of general awareness and community training**.

## Institutional Framework at the District Level

At the district level, **District Disaster Management Authority (DDMA)**, headed by the **District Collector/District Magistrate**, is responsible for overall coordination of the disaster management efforts and planning.

- As per provisions of the Act, each **State Government establishes a District Disaster Management Authority** for every district in the State.
- The DDMA is headed by the **District Collector** with the elected representative of the local authority as the Co- Chairperson.
- The **DDMA prepares the Disaster Management plan for the District and monitors its implementation**. It also ensures that the guidelines laid down by the NDMA and the SDMA are followed by all the district-level offices.
- Coordinate and monitor the implementation of the National Policy, State Policy, National Plan, State Plan and District Plan

### Financial Framework

- National Disaster Response Fund is a **fund managed by the Central Government for meeting the expenses for emergency response, relief and rehabilitation**. If the requirement of funds for relief operations is beyond the funds available in the State Disaster Response Fund account, additional Central assistance is provided from National Disaster Response Fund.
- **The National Calamity Contingency Fund (NCCF) introduced by 11th Finance Commission was merged with NDRF.**
- **The State Disaster Response Fund is used only for meeting the expenditure for providing immediate relief to the victims of disasters. The Standing Committee on Finance submitted its report on 'Central Assistance for Disaster Management and Relief' in 2019.**

### Key observations made by the committee are:

- **Scale of relief:** Rates and scale of assistance under SDRF and NDRF should be enhanced to cover majorheads of expenditure such as restoration of Government buildings, transmission power station etc.
- **Disaster Mitigation Fund:** The Committee recommended that a **separate Disaster Mitigation Fund should be operationalised** for undertaking permanent mitigation measures in disaster-prone states.
- The NDRF is funded through the **National Calamity Contingency Duty (NCCD) imposed on specified goods under central excise and customs**. With the introduction of GST, the scope of NCCD is **shrinking**. The revenue collected from NCCD has decreased significantly from Rs 5,690 crore in 2015-16 to Rs 2,500 crore in 2018-19.
- **Funding Mechanism:** It recommended that **an additional 10% of the allocation of the centrally sponsored schemes** may be specially **earmarked for permanent restoration of damaged structures**.
- **Increase in Funding:** Given the wide gap between the funds sought by affected states and those released by the central government, **the Committee recommended an annual increase of 15%** (from the current 5%) **in the total corpus of SDRF, for the period 2020-25.**

## Vulnerability Profile in India

“We cannot stop natural disasters but we can arm ourselves with knowledge: so many lives wouldn't have to be lost if there was enough disaster preparedness.”

**Petra Nemcova (Head of All Hands and Hearts - Smart Response)**

When disaster strikes, it tears the curtain away from the festering problems that we have beneath them.”

**Barrack Obama**

India is one of the ten worst disaster prone countries of the world. Disasters occur in India with grim regularity causing enormous loss of life and property. According to an **UN Office for Disaster Risk Reduction (UNISDR) report 2017**, India has been ranked as the world's most disaster-prone country for displacement of residents.

India is vulnerable to a large number of natural, as well as, human-made disasters on account of its unique geo-climatic and socio-economic conditions. Out of the 36 states and union territories in the country, 28 of them are disaster prone. Almost 85% of the country is vulnerable to single or multiple disasters and about 57% of its area lies in high seismic zones.

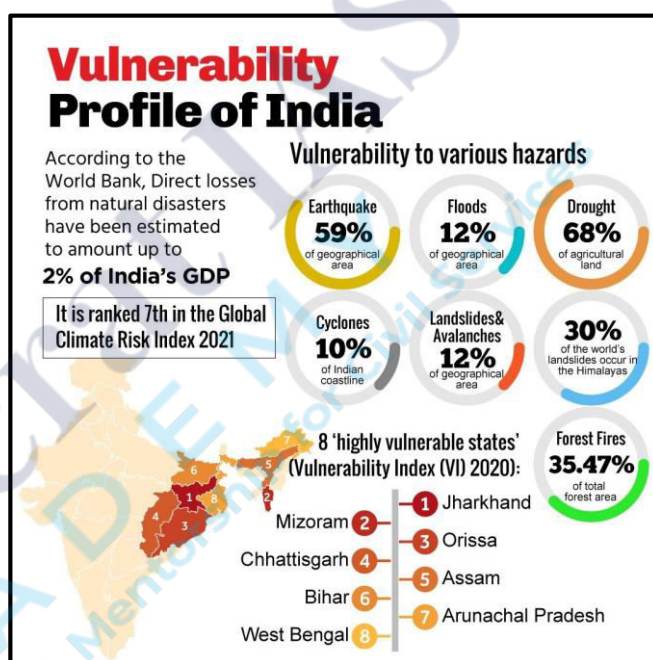
Approximately 40 million hectares of the country's land area is prone to flood, about 8% of the total land mass is vulnerable to cyclone and 68% of the area is susceptible to drought. The five distinctive regions of the country i.e. Himalayan region, the alluvial plains, the hilly part of the peninsula, and the coastal zone have their own specific problems. While on one hand the Himalayan region is prone to disasters like earthquakes and landslides, the plain is affected by floods almost every year. The desert part of the country is affected by droughts and famine while the coastal zone susceptible to cyclones and storms.

Besides the natural factors, various human-induced activities like increasing demographic pressure, deteriorating environmental conditions, deforestation, unscientific development, faulty agricultural practices and grazing, unplanned urbanization, construction of large dams on river channels etc. are also responsible for accelerated impact and increase in frequency of disasters in the country.

### Natural Hazards

#### 1. Earthquake

Earthquakes are by far the most unpredictable and highly destructive of all the natural disasters. Earthquakes that are of tectonic origin have proved to be the most devastating and their area of influence is also quite large.



These earthquakes result from a series of earth movements brought about by a sudden release of energy during the tectonic activities in the earth's crust.

**National Geophysical Laboratory, Geological Survey of India, Department of Meteorology along with recently formed National Institute of Disaster Management** have made an intensive analysis of **more than 1200 earthquakes** that have occurred in India in the past and based on these, they **divided India into following five earthquake zones**:

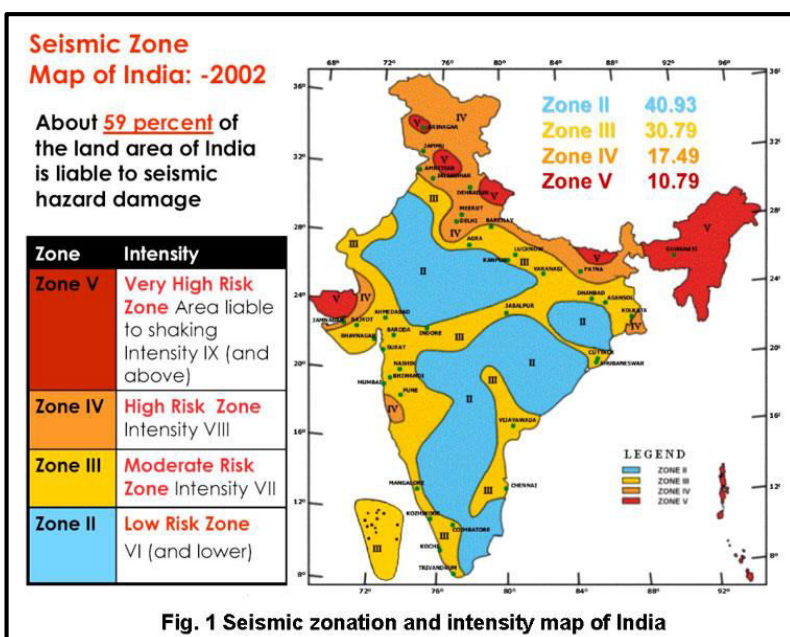
### Seismic Zones in India

- There are **four seismic zones (II, III, IV, and V)** in India based on scientific inputs relating to seismicity, earthquakes occurred in the past and tectonic setup of the region.
- **Previously, earthquake zones were divided into five zones** with respect to the severity of the earthquakes but the **Bureau of Indian Standards (BIS)** grouped the country into **four seismic zones** by unifying the first two zones.
- **BIS is the official agency for publishing the seismic hazard maps and codes.**

<b>Seismic Zone II:</b>	Area with <b>minor damage earthquakes</b> corresponding to intensities V to VI of MMscale (MM-Modified Mercalli Intensity scale).
<b>Seismic Zone III:</b>	<b>Moderate damage</b> corresponding to intensity VII of MM scale.
<b>Seismic Zone IV:</b>	Major damage corresponding to intensity VII and higher of MM scale.
<b>Seismic Zone V:</b>	<ul style="list-style-type: none"> <li>• Area determined by pro seismically of certain major fault systems and is seismically the most active region.</li> <li>• <b>Earthquake zone V is the most vulnerable to earthquakes</b>, where historically some of the country's most powerful shocks have occurred.</li> <li>• <b>Earthquakes with magnitudes in excess of 7.0 have occurred</b> in these areas, and have had intensities higher than IX.</li> </ul>

### Socio-environmental consequences of earthquakes:

- The idea of earthquakes is often associated with fear and horror **due the scale, magnitude and suddenness** at which it spreads on the surface of the earth without discrimination.
- It becomes a calamity when it strikes the areas of high density of population.
- It not only damages and destroys the settlement, infrastructure, transport and communication networks, industries and other developmental activities but also robs the population of their material and socio-cultural gains that they have preserved over generations. It renders





them homeless, which puts an extra pressure and stress, particularly on the weak economy of developing countries.

## EFFECTS OF EARTHQUAKES ON:

### Ground:

<b>Fissures</b>	· Earthquakes can create fissures in the crust of the earth which may result into possible chain effects.
<b>Settlements</b>	· Population settlement can be hampered due to earthquakes which may also result into loss of lives, migration of people to safer areas.
<b>Landslides</b>	· <b>High sloping areas are most vulnerable zones for landslides.</b> Human activities like intensive grazing, deforestation and natural phenomena like high rainfall can cause landslides. · <b>Example:</b> Himalayan region have high sloping areas which also constitutes 'very high damage risk zone' in India.

### On Manmade Structures:

<b>Cracking</b>	Earthquakes can cause <b>cracking of buildings, roads and other infrastructure.</b> In the long run these cracks can make the structures more vulnerable for further damage.
<b>Sliding</b>	<b>Earthquake can develop sliding of structures to the lower strata.</b> A tectonic plate can slide over another which can create unevenness on the ground. This causes sliding of buildings, roads and other infrastructures.
<b>Collapse</b>	<b>Manmade structures are high risk prone to earthquakes</b> if these are not constructed according to <b>the geological and geomorphological conditions of the area.</b> Thus, buildings collapse is common phenomenon during earthquakes.

### On Water:

<b>Waves</b>	Earthquakes can create waves on water bodies usually higher than normal. Such high waves can intrude human settlements, agriculture, forests etc.
<b>Hydro dynamic pressure</b>	Water bodies are highly sensitive to pressure changes as creates ripples of pressure. <b>Dams are particularly more vulnerable to such pressure systems.</b> Dam burst can occur if sufficient pressure is generated by earthquakes.
<b>Tsunami</b>	· Earthquakes can cause shift in tectonic plates and it may <b>create waves higher wavelengths.</b> Such waves are more destructive. · <b>Example:</b> 2004 Tsunami, 2018 Tsunami waves in Indonesia.

## Earthquake hazard mitigation:

It is not possible to prevent the earthquakes hence the best option is to emphasize on disaster preparedness and mitigation rather than curative measures such as:

- **Establishing earthquake monitoring centres** for regular monitoring and dissemination of information among the people in vulnerable areas. **Use of GPS can be of great help in monitoring the movement of tectonic plates.** EG: **bhookamp app.**
- **Preparing a vulnerability map of the country and dissemination of vulnerability risk information among the people** and educating them about the ways and means minimizing the adverse impacts of disasters.
- **Modifying the house types and building designs in the vulnerable areas** and discouraging construction of high-rise buildings, large industrial establishments and big urban centres in such areas. EG: **Uroosi architecture, Sandbox technique.**
- Making it **mandatory to adopt earthquake resistant designs** and use light materials in major construction activities in the vulnerable areas.

### Uroosi Architecture

Uroosi are wooden shutters used as partition walls within homes, instead of concrete walls.

Uroosi is believed to be a Persian term meaning 'hidden bride'.

It includes octagonal and decagonal ornamental pillars too.

Uroosi is one such, where wooden shutters could be rolled up to make one room or rolled down from hanging grooves in ceiling chambers, to partition the space into separate areas.

**Jalali House is a landmark in Srinagar** that has this architectural element.

**Salient features:** It has the ability to absorb seismic shocks and withstand them

## Current developments:

**India Quake App-** Ministry of Earth Sciences launched 'India Quake' app to enable users receive information about natural hazards on land and water. It has been **developed by National centre for Seismology** for automatic dissemination of earthquake parameter such as location, time and magnitude after the occurrence of Earthquake and avoid delay of information in the event of earthquake.

## 2. Tsunamis

- Tsunamis (Japanese for "harbour wave"), also **known as a seismic sea wave**, are a series of very **large waves with extremely long wavelength**, in the deep ocean, the length from crest to crest may be 100 km and more.
- It is **usually generated by sudden displacements in the sea floor** caused by **earthquake, landslides, or volcanic activity.**
- Most **tsunamis, including the most destructive ones are generated by large and shallow earthquakes** which usually occur near geological plate boundaries, or fault-lines, where geological plates collide.

- When the seafloor abruptly deforms the sudden vertical displacements over large areas disturb the ocean's surface, displace water, and generate tsunami waves. **Since the wave height in deep ocean will be only a few decimetres or less (i.e., a few inches), tsunamis are not usually felt aboard ships.**
- Nor are they visible from the air in the open ocean.
- The waves could travel away from the triggering source with **speeds exceeding 800 km/h over very long distances.**
- They could be **extremely dangerous and damaging when they reach the coast**, because when the **tsunami enters shallow water in coastal areas, the wave velocity will decrease accompanied by increase in wave height.**
- In shallow waters, a large tsunami crest height may rise rapidly by several metres even in excess of 30 m causing enormous destruction in a very short time.

As seen on **Indian Ocean shores in December 2004**, tsunami can cause massive death and destruction. They are particularly dangerous close to their sources, where the first waves in the tsunami train can arrive within a few to tens of minutes of the triggering event.

The earthquake and resulting tsunami in Indian Ocean on 26 Dec 2004 had devastating effects on India. Many people died and millions were displaced. **The hardest hit areas were on Southern coast and the Andaman and Nicobar Island.** Tsunamis have the potential of causing significant casualties, widespread property damage, massive infrastructure loss and long-term negative economic impacts. People caught in the path of a tsunami often have little chance of survival. People die from drowning or debris crushing them.

It is beyond the capacity of individual state or government to mitigate the damage. Hence, combined efforts at the international levels are the possible ways dealing of dealing with these disasters. **India has volunteered to join the International Tsunami Warning System (ITWS) after the December 2004 tsunami disaster.**

#### **Tsunami Capacity Building Research and Development:**

- Encourage development of **standardised methods for tsunami risk assessment** and scenario development, support studies to collect the data and compile knowledge.
- Develop suitable **large-scale digital maps** indicating the tsunami hazard basis on past tsunami events.
- States should develop **detailed computerised maps and databases of vulnerable areas along the coast** for planning and coordination of DM activities.

#### **Zoning or mapping:**

- **Database of Tsunami Risk and Vulnerability in the coastal areas** with information on trends of storm surge, high tides, local bathymetry, etc.
- States should ensure support to the Central Government agencies in zoning/ mapping and carry out at their level.

#### **Observation Networks, Information Systems, Monitoring, Research, Forecasting & Early Warning:**

- Assess the status of **existing important installations in coastal areas** to withstand tsunami
- Securing critical instrumentation to ensure fail-safe functioning of these critical instruments and their protection.
- States should support, cooperation for data collection and updates.

### Dissemination of warnings, data, and information:

- **Monitoring seismic activity**, provide warnings based on **seismic models and issue periodic bulletin.**
- **Dissemination of warnings to all, down to the last mile** – remote, rural or urban; Regular updates to people in areas at risk.

### Centre and states can coordinate on following matters:

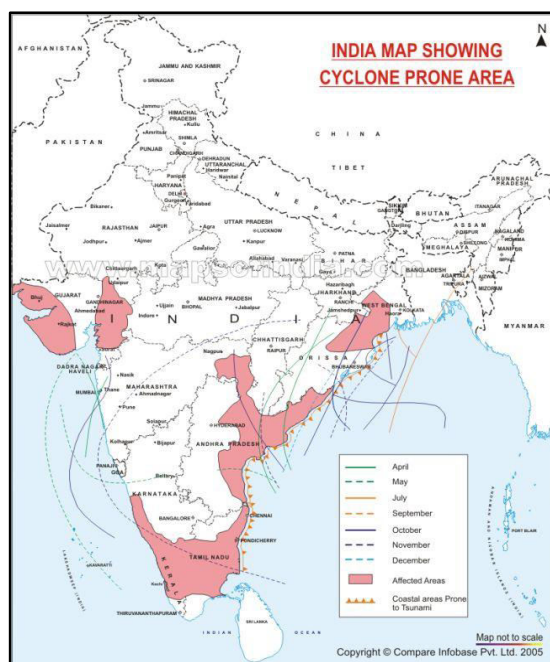
- Strengthening of **lifeline structures and high priority buildings**
- Shelters from storm surges and tsunamis
- Construction of **large-scale submerged sand barriers**
- Periodical dredging of the inlets and associated water bodies so as to absorb the influx during tsunami
- **Construction of submerged dykes** (one or two rows along the stretch of the coast) so as to decrease the impact due to the incoming tsunami and inland dykes to safeguard vital installations
- Hazard resistant construction, strengthening, and retrofitting of all lifeline structures and critical infrastructure.

### Current developments: Sagar Vani App:

- Sagar Vani app has been **developed by ESSO Indian National Centre for Ocean Information Services (INCOIS)** under Ministry of Earth Sciences.
- It is a software platform which **uses state of art technology for dissemination of ocean related information and advisory services** such as Potential Fishing Zone (PFZ) advisories, Ocean State Forecast (OSF), High Wave Alerts and Tsunami early warnings.

## 3. Tropical cyclones:

- India's long coastline of nearly **7,500 km** consists of **5,400 km** along the mainland, **132 km** in Lakshadweep and **1,900 km** in the Andaman and Nicobar Islands. About 10 per cent of the World's tropical cyclones affect the Indian coast.
- Of these, the **majority has their initial genesis over the Bay of Bengal** and strike the east coast of India.
- On an average, **five to six tropical cyclones form every year**, of which **two or three could be severe.**
- Cyclones occur frequently on both the **west coast in the Arabian Sea and the east coast in the Bay of Bengal.**
- More cyclones occur in the Bay of Bengal than in the Arabian Sea.
- An analysis of the frequencies of cyclones on the East and West coasts of India during 1891- 2000 shows that nearly **308 cyclones (out of which 103 were severe) affected the East Coast.**
- In India, **tropical cyclones occur in the months of May-June and October-November.**
- The cyclones of severe intensity and frequency in the northern part of the Indian Ocean are bimodal in character, with their primary peak in November and secondary peak in May.
- The **disaster potential is particularly high at the time of landfall in the northern part of Indian Ocean (Bay of Bengal and the Arabian Sea)** due to the accompanying destructive wind, storm surges and torrential rainfall. Of these, storm surges are the greatest killers of a cyclone, by which sea water inundates low lying areas of coastal regions and





causes heavy floods, erodes beaches and embankments, destroys vegetation and reduces soil fertility.

- The coastal states and union territories (UTs) in the country, encompassing 84 coastal districts which are affected by tropical cyclones.
- Four states (Tamil Nadu, Andhra Pradesh, Odisha and West Bengal) and one UT (Puducherry) on the east-coast and one state (Gujarat) on the west coast are highly vulnerable to cyclone disasters.
- The coastal states and union territories (UTs) in the country, encompassing 84 coastal districts which are affected by tropical cyclones.
- **Four states (Tamil Nadu, Andhra Pradesh, Odisha and West Bengal) and one UT (Puducherry)** on the east coast and **one state (Gujarat)** on the west coast are highly vulnerable to cyclone disasters.

#### **Initial conditions for emergence of tropical cyclones:**

- Large and continuous supply of warm and moist air that can release enormous latent heat.
- **Strong Coriolis force that can prevent filling of low pressure at the centre** (absence of Coriolis force near the equator prohibits the formation of tropical cyclones between 0-5-degree latitudes).
- **Unstable conditions through the troposphere** that creates local disturbances around which a cyclone develops.
- Absence of strong vertical wind wedge which disturbs the vertical transport of latent heat

#### **Tropical cyclones: NDMA Guideline**

- Observation Networks, Information Systems, Monitoring, Research, Forecasting & Early Warning:
- **Promote research and studies** – both in-house and extra-mural by providing research grants to researchers and institutions
- Studies on ecosystem and shoreline changes
- Promote availability in public domain cyclone database and forecasts
- Enhancement of **Observational Network Stations (ONS)**
- Establishment of planned **Automatic Weather Stations (AWS) and Rain-Gauge Network (RGN)**
- Enhancement of a **Doppler Weather Radar Network** over coastal regions
- **Integration of all ONS with AWS & RGN** in one single platform
- Modernisation of observation network, equipment, systems, technology.

#### **Zoning or mapping:**

Support the **preparation of detailed maps to delineate coastal wetlands, mangroves and shelter belts** and tracts for coastal bio-shields using best tools, field studies, and satellite data.

#### **Dissemination of warnings, data, and information:**

- Quick, clear, effective dissemination among central and state agencies
- Deployment of communication equipment
- Warnings using all types of options, types of technologies, and media
- **Providing weather information online and offline** and interface with mobile network service
- Providing warnings on radio, TV, and cell phones.

#### **Inter-agency coordination:**

Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data.

#### **Structural measures:**

Hazard resistant construction, strengthening, and **retrofitting** of all **lifeline structures** and **critical infrastructure**.

#### **Awareness Generation:**

- Carry out mass media campaigns
- Promote attitude and behaviour change in the awareness campaigns/ IEC
- **Promote culture of disaster risk prevention, mitigation, and better risk management**
- Promote use of insurance/ risk transfer
- Promote **Community Radio**
- Strengthening network of **civil society organisations** for awareness generation about **DRR and DM**

#### **Mock drills or exercises:**

Promote planning and execution of emergency drills by all ministries and in all States/UT's

#### **Vocational Training/ Skill Development:**

Promoting skill development for multi-hazard resistant construction in cyclone-prone areas for different types of housing and infrastructure.

#### **Empowering women, marginalized communities and persons with disabilities:**

Incorporating gender sensitive and equitable approaches in capacity development covering all aspects of disaster management.

#### **Community-Based Disaster Management**

- Training for **PRI, SHG, NCC, NSS, youth, local community organizations**.
- Strengthen ability of communities to manage and cope with disasters based on a multi-hazard approach.

#### **Current Developments:**

**1st 'National Conference on Coastal Disaster Risk Reduction and Resilience (CDRR&R) – 2020' Conference** was organized by the **National Institute of Disaster Management (NIDM)**, in New Delhi.

The conference focused on enhancing human capacity in terms of better understanding about coastal disaster risks and effective collaborative actions, by **implementing Prime Minister's 10-point agenda and Sendai Framework for Disaster Risk Reduction**.

NIDM, under **Ministry of Home Affairs** was constituted under the **Disaster Management Act 2005**.

It has been entrusted with the **nodal national responsibility for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management**.

## **4. Cold Waves**

- Cold wave and frost are **seasonal and localized hazards occurring only in the parts with severe winter**. Prolonged frost conditions and cold wave can damage certain frost-sensitive plants causing

crops loss. The susceptibility to frost varies widely across crops.

- The extent of damage caused by cold wave depends on **temperature, length of exposure, humidity levels, and the speed at which freezing temperature is reached**. It is difficult to predict a definite temperature level up to which crops can tolerate cold wave/frost because many other factors also affect it.
- Cold wave can cause death and injury to human beings, livestock and wildlife. **Higher caloric intake is needed for all animals, including humans to withstand exposure to cold and poor nutritional status can prove deadly in extreme cold conditions.**
- If a cold wave is accompanied by heavy and persistent snow, grazing animals may be unable to get the requisite food. They may **die of hypothermia from prolonged exposure or starvation.**

#### **IMD definitions for Cold Wave and Cold Day:**

- **Wind chill factor plays an important role** and brings down the actual minimum temperature depending upon the wind speed. The actual minimum temperature of a station should be reduced to **“Wind Chill Effective Minimum Temperature (WCTn)” based on wind chill factor using the relevant WMO criteria.**
- **For declaring “Cold Wave” and “Cold Day” WCTn should only be used.** If WCTn is 10°C or less, then only the conditions for cold wave should be considered.

#### **There is a Cold Wave:**

- When **normal minimum temperature is equal to 10°C or more; Cold Wave** if the departure from normal is - 5°C to -6°C and ‘Severe Cold Wave’ Departure from normal is -7°C or further.
- When **normal minimum temperature is less than 10°C; ‘Cold Wave’** – if the departure from normal is -4°C to -5°C and ‘Severe Cold Wave’ Departure from normal is -6°C or less.
- **When WCTn is 0°C or less, Cold Wave should be declared irrespective of normal minimum temperature of the station. However, this criterion is not applicable for those stations whose normal minimum temp**

#### **Cold Wave conditions for coastal stations:**

For coastal stations the threshold value of minimum temperature of 10°C is rarely reached. However, the local people feel discomfort due to wind chill factor which reduces the minimum temperature by a few degrees depending upon the wind speed. **For coastal stations, the “Cold Day” concept may be used following the criteria given below:**

- Actual minimum temperature of a station be reduced to WCTn
- This WCTn should be used to declare “Cold Wave” or “Cold Day”
- When minimum temperature departure is -5°C or less over a station, “Cold Day” may be described irrespective of threshold value of 10°C
- However, when a **threshold of 10°C is reached “Cold Wave” be declared.**
- **When a station satisfies both the Cold Wave and Cold Day criteria, then Cold Wave has higher priority and must be declared.**

## NDMA Guidelines:

<p><b>Cold waves: Mitigation measures for people</b></p>	<p>The State Governments must maintain <b>close coordination with India Meteorological Department (MOES (IMD))</b> and closely monitor cold wave situation. Warnings should be disseminated to the public through appropriate forums (including local newspapers and radio stations) on a regular basis. <b>Some of the mitigation measures to be followed are shown below:</b></p> <ol style="list-style-type: none"><li><b>Stay indoors</b> as much as possible</li><li>Listen to local radio stations for <b>weather updates</b></li><li><b>Eat healthy food</b> to supply heat to the body and <b>drink non-alcoholic beverages to avoid dehydration</b></li><li>Wear <b>several layers of lightweight and warm clothes</b>; rather than one layer of heavy clothing. The outer garments should be tightly woven and water-repellent.</li><li>Keep dry. Change wet clothing frequently to <b>prevent loss of body heat</b>.</li><li>Maintain <b>proper ventilation</b> when using kerosene, heater or coal oven to avoid toxic fumes.</li><li>In case of non-availability of heating arrangement, go to <b>public places where heating arrangements are made</b> by administration.</li><li><b>Cover your head, as most body heat is lost through the top of the head</b> and cover your mouth to protect your lungs.</li><li><b>Avoid over work</b>. Over exertion can cause heart attack</li><li><b>Watch for signs of frostbite</b>: loss of feeling and white or pale appearance on fingers, toes, ear lobes and the tip of the nose.</li><li><b>Watch for signs of hypothermia</b> (subnormal body temperature): uncontrolled shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness and apparent exhaustion. Immediately rush to the nearest hospital for medical treatment.</li><li><b>Stock up on food, water, and other necessities</b> before a cold wave</li><li>Stock <b>suitable forage</b> before cold waves for livestock</li><li>Keep hospitals in a state of readiness for the admission of victims of frostbite and hypothermia</li></ol>
<p><b>Cold waves: Mitigation measures for crops and animals</b></p>	<ol style="list-style-type: none"><li>Farmers are to <b>provide light irrigation</b> as per need, immediately prune damaged tips of branches or shoot, burn leave/waste material in the orchard to create smoke and <b>manage rejuvenation of damaged crops through pruning of dead material, application of extra doses of fertilizer through foliar sprays</b>.</li><li><b>Vulnerable crops may be sprayed with water</b> that will paradoxically protect the plants by freezing and absorbing the cold from surrounding air</li><li>Agencies specializing in animal care should provide necessary advisory and support for the care and protection of animals</li></ol>



- d. In cold wave conditions, animal and livestock owners must feed adequately with appropriate feed to avoid animal deaths. They must stock suitable feed or forage before cold wave to feed the livestock.
- e. They must avoid exposure of animals to extreme cold

## 5. Heat Waves

- Heat wave is a **period of abnormally high temperatures** that leads to **physiological stress, which sometimes can claim human life.**
- The **World Meteorological Organization** defines a heat wave as **five or more consecutive days during which the daily maximum temperature exceeds the average maximum temperature by five degrees Celsius.**
- Heat Waves typically occur between **March and June**, and in some rare cases even extend until July. Heat waves are more frequent over the **Indo-Gangetic plains of India.**
- On an average, **5-6 heat wave events occur every year over the northern parts of the country.** In the northern plains of the country, dust in suspension occurs in many years for several days, bringing minimum temperature much higher than normal and keeping the maximum temperature around or slightly above normal.
- According to **IMD, in India, it will be considered as heat wave if the maximum temperature of a met-sub- station reaches at least 40°C or more in the plains, 37°C or more in coastal areas and at least 30°C or more for hilly regions.**
- Higher daily peak temperatures and longer, more intense heat waves are becoming increasingly frequent globally due to climate change. India too is feeling the impact of climate change in terms of increased instances of heat waves that are more intense in nature with each passing year and have a devastating impact on human health thereby increasing the number of heat wave casualties.
- The health impacts of Heat Waves typically involve **dehydration, heat cramps, heat exhaustion and/or heat stroke.**

Heat wave Scenario		40°C	30°C
Maximum Temperature		Plains	Hills
Heat wave conditions prevail when...		Severe heat wave conditions prevail when...	
Normal maximum temperature	Deviation from normal	Normal maximum temperature	Deviation from normal
Above 40°C	4-5°C or more	Above 40°C	6°C or more
At or below 40°C	5-6°C or more	At or below 40°C	7°C or more

### The signs and symptoms are as follows:

- **Heat Cramps:** Edema (swelling) and Syncope (Fainting) generally accompanied by fever below 39°C
- **Heat Exhaustion:** Fatigue, weakness, dizziness, headache, nausea, vomiting, muscle cramps and sweating
- **Heat Stroke:** Body temperatures of 40°C or more along with delirium, seizures or coma, which is a potentially fatal.

### Heat Waves: Capacity Building

#### Observation Networks, Information Systems, Monitoring, Research, Forecasting, Early Warning and Zoning/ Mapping:

- Vulnerability Assessment and Establishing Heat-Health Threshold Temperatures
- Strengthening and maintaining monitoring and data logging systems for temperature, humidity, etc. required for threshold for heat wave alerts.
- Establish and maintain **community-based network** for sharing alerts
- Modify or customise warnings according to thresholds suitable for the State/UT

### **Dissemination of warnings, data, and information:**

- Create awareness preventive measures
- Extensive **IEC campaigns to create awareness** through print, electronic and social media
- **Specific messages for highly vulnerable groups** such as elderly, young children, outdoor workers and slum residents.

### **Inter-Agency coordination:**

- Ensure the local administration (city/district) can understand and meaningfully use all the heat wave-related information from various agencies and health authorities – central and state
- **Team preparation and coordination** – officials and agencies are well prepared for the heat-wave season
- Coordinate with IMD regarding forecasts, early warning and alert system based on drought severity
- Appointing a **State Nodal Agency and Officer**
- Preparing/Adapting Heat Wave Action Plan
- Implementation as per specific conditions in the state
- Establishing First Aid/ Medical Aid facilities in key locations
- **Identify vulnerable places and provide drinking water points** at those places and worksites along with ORS
- Avoiding outdoor games/sports activities.
- **Livestock preparedness during hot weather** – ensuring that the livestock has sufficient shade and water on hot days.

### **Warnings, information, data:**

- Coordinating the **dissemination of warnings to all, down to the last mile** – remote, rural or urban; Regular updates to people in areas at risk
- **“Do’s-and-Don’ts” during a heat wave** should be available in **local languages** and disseminated through media

### **Heat waves shelters and other measures:**

- Strengthening/mainstreaming the network medical assistance facilities.
- **Temperature forecasts and heat alerts** will be sent as bulk messages on mobile phones, local electronic media
- **Electronic screens at busy traffic intersections** and market places
- Effective transportation
- Promote cool roofs and heat reducing integrated development.

### **Awareness Generation:**

- Promoting awareness, alertness and preparedness
- Training programs for public, PRIs/ ULBs
- Carry out mass media campaigns in heat-wave prone areas
- Create awareness of coping with heat waves

### **Empowering women, marginalized communities, SC/ST, and persons with disabilities:**

Incorporating gender sensitive and equitable approaches in capacity development for coping with heat wave-emergencies.

## 6. Floods

- Floods are **relatively slow in occurrences** and often **occur in well identified regions** and within expected time in a year.
- Floods occur commonly when water in the form of **surface run-off exceeds the carrying capacity of the river channels and streams and flows into the neighboring low-lying floodplains.**
- Sometimes this even goes beyond the capacity of lakes and other inland water bodies in which they flow.
- Floods can also be **caused due to a storm surge, high intensity rainfall for a considerably longer time period**, melting of ice and snow, reduction in the infiltration rate and presence of eroded materials in the water due to higher rate of soil erosion.
- **Unlike other natural disasters human beings play important role in the genesis as well as spread of floods.** Indiscriminate deforestation, unscientific agricultural practices, disturbances along the natural drainage channels and colonisation of flood plains and river beds are some of the human activities that play an important role in increasing the intensity, magnitude and gravity of the floods.
- Various states of India face heavy loss of lives and property due to recurrent floods.
- **National Flood Commission has identified 40 million hectares of land as flood prone in India.**
- **Assam, West Bengal and Bihar** are among the high flood prone states.
- Apart from these, **most of the rivers in the northern states like Uttar Pradesh and Punjab are also vulnerable to frequent floods.**
- States like **Rajasthan, Gujarat, Haryana and Punjab are also getting inundated in recent years due to flash floods.** This is partly because of the pattern of monsoon and partly because of blocking of most of the streams and rivers by human activities.
- Sometimes **Tamil Nadu experiences flooding during November-January due to retreating monsoon.**

### Flood – NDMA guidelines

- Observation Networks, Information Systems, Monitoring, Research, Forecasting & Early Warning:
- Preparation of **close contour and flood vulnerability maps**
- Modernisation of **flood forecasting and warning systems** on a river basin basis
- Assist states/UTs in the **identification of priority flood protection and drainage improvement works**
- Monitoring of **flood preparedness, river basin and reservoir management plans**
- Studies and monitoring of rivers flowing from neighbouring countries
- Studies involving international cooperation for forecasting and cross border issues
- Implementation of the schemes for **real-time collection of hydro-meteorological data on important rivers** including the relevant rivers flowing from **Nepal, Bhutan and China**
- Specialised efforts for different types of floods and causes of flooding, including **cloudburst**
- Developing/ improving/ updating forecasting methods and models for quantification of inflows and storage of dams.

### Zoning, mapping, and classification flood prone areas:

Preparation of **large-scale hazard maps of flood prone areas** identifying areas of high vulnerability.

### Research and Development:

- Studies on support systems for people living in **flood prone areas**
- Evolving **designs of shelters** in flood prone areas
- Socio-economic impacts of flood
- River basin studies
- **Studies on flood related problems** such as soil losses caused by flooding of rivers, sediment

transport, rivercourse changes, and appropriate use of embankments

- **Promote research and studies – both in-house and extra-mural** by providing research grants to researchers and institutions
- **Hydrological and morphological studies** before undertaking major flood control or prevention measures

#### **Dissemination of warnings, data, and information:**

- Quick, clear, effective dissemination among central and state agencies
- Facilitate the **distribution of necessary communication equipment**, last-mile connectivity and access to disaster risk information
- International cooperation to share **warnings about rivers flowing from neighbouring countries**
- Promoting reliable networking systems for data and information sharing among central and state agencies
- Monitoring of landslides and blockages in rivers
- Warning systems
- Providing information in all possible ways and using all types of media
- **Interface with mobile network service providers** for warnings.

#### **Inter-agency coordination:**

Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data.

#### **Structural Measures:**

- Flood control measures such as **construction of embankments and levees**.
- Proper **alignment and design of Waterways and drainage systems** for roads, highways, and expressways.
- Enhancing the **safety of dams and reservoirs**.
- **Desilting/ dredging of rivers** to improve flow; **drainage improvement; floodwater diversion** through existing or new channels.
- Hazard resistant construction, strengthening, and retrofitting of all lifeline structures and critical infrastructure.

#### **Awareness Generation:**

- Carry out **mass media campaigns**
- Promote culture of **disaster risk prevention, mitigation, and better risk management**
- Promote attitude and behaviour change in the awareness campaigns/ IEC
- Strengthening network of **civil society organization** for awareness generation about DRR and DM
- Promote use of insurance/ risk transfer
- Promote **Community Radio**

#### **Mock drills or exercises:**

Promote **planning and execution of emergency drills** by all ministries and in all States/UT's

#### **Vocational Training/ Skill Development:**

Promoting **skill development for multi-hazard resistant construction in flood-prone areas** for different types of housing and infrastructure.



## Empowering women, marginalised communities and persons with disabilities:

Incorporating **gender sensitive and equitable approaches** in capacity development covering all aspects of disaster management.

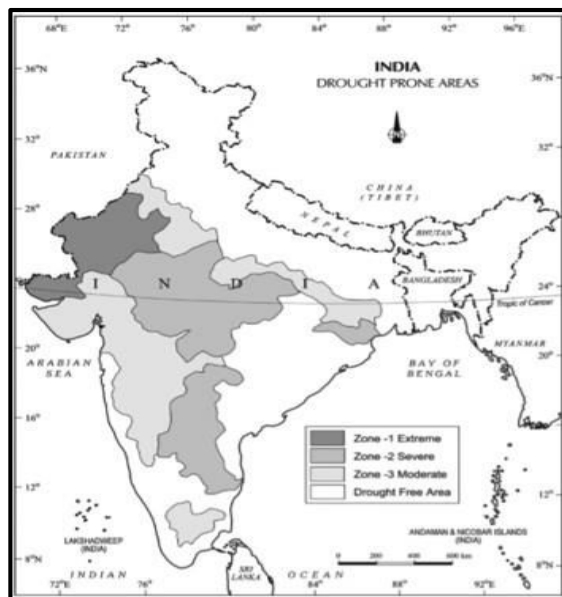
### Community-Based Disaster Management

- Training for **PRI, SHG, NCC, NSS, youth, local community organizations.**
- Strengthen ability of communities to manage and cope with disasters based on a multi-hazard approach.

## 7. Droughts

There is **no globally adopted operational definition for drought applicable to all contexts.** This is the primary reason why policy makers, resource planners, and other decision-makers as well as administrators have considerable difficulty recognising and planning for drought than they do for other disasters.

- **Global Assessment Report (GAR) 2015** notes that **agricultural drought is probably the most “socially constructed” of all disaster risks (UNISDR 2015)** and warns that due to global climate change, its frequency is expected to vary much.
- To determine the beginning of drought, **operational definitions specify the degree of departure from the long-term (usually at least 30 years) average of precipitation or some other climatic variable.**
- Broadly, **drought is perceived as sharply felt water deficit caused by variations in the natural hydro- metrological factors, agro-ecological conditions, moisture requirements of crops under prevailing cropping choices (systems, patterns).**
- The **WMO considers drought as a slow creeping natural hazard** that occurs in part due to the natural climatic variability.
- In recent years, concern has grown world-wide that droughts may be increasing in frequency due to climate change.
- **Responses to droughts in most parts of the world are generally reactive in terms of crisis management** and are known to be untimely, poorly coordinated and disintegrated. Conceptually, **drought is characterised by a protracted period of deficient precipitation resulting in water deficits, extensive crop damage, resulting in loss of yield.**
- Droughts affect vast areas of the country, transcending State boundaries. **A third of the country is drought prone.** Recurrent drought results in widespread adverse impact on people’s livelihoods and young children’s nutrition status.
- It **affects parts of Rajasthan (chronically), Gujarat, Maharashtra, Madhya Pradesh (MP), Uttar Pradesh (UP), Chhattisgarh, Jharkhand, and Andhra Pradesh.**
- Droughts cause severe distress in the affected areas.
- **Drought is a phenomenon that is widely considered as a ‘creeping disaster’** whose onset, end, and severity are difficult to determine.
- Unlike the suddenly occurring disasters, **a drought may develop very slowly over several months affecting very large geographical area** without causing little or no structural damage.



- The impacts depend on natural conditions, socio-economic situations, and the kind of land and water resources as well as the use patterns in the affected region.
- **Effective mitigation measures must prevent a drought turning into a famine due to water and food shortages.** Drought results from long period of dry weather and insufficient precipitation, which causes acute dry conditions.

### The National Commission on Agriculture in India defines three types of droughts:

<b>Meteorologic drought</b>	Defined as a situation when there is more than 25% decrease from the long-term average precipitation over an area.
<b>Agricultural drought</b>	Signifying the situation on when soil moisture and rainfall are inadequate to support healthy crop growth.
<b>Hydrological drought</b>	Resulting from prolonged meteorological drought manifested in depletion of surface and sub-surface water resources, which could occur even when the rainfall is normal, if there has been a substantial reduction in surface water holding capacity.

### The IMD recognizes five drought situations:

- **'Drought Week'** when the weekly rainfall is less than half of the normal
- **'Agricultural Drought'** when four drought weeks occur consecutively during mid-June to September
- **'Seasonal Drought'** when seasonal rainfall is deficient by more than the standard deviation from the normal.
- **'Drought Year'** when **annual rainfall is deficient by 20 per cent** of normal or more, and
- **'Severe Drought Year'** when **annual rainfall is deficient by 25 to 40 per cent** of normal or more.

In the absence of an unambiguous criterion, **the NDMA Guideline on 'Management of Drought' notes that there is a need to develop a multi-criteria index to classify droughts based on several factors such as the following:**

- **Meteorological** (rainfall, temperature, etc.)
- **Soil conditions** (depth, type, available water content, etc.)
- **Surface water** use (proportion of irrigated area, surface water supplies, etc.)
- **Ground water** (availability, utilisation, etc.)
- **Crop** (cropping pattern changes, land use, crop conditions, anomalies in crop condition, etc.)
- **Socio-economic** (proportion of weaker sections, poverty, size class of farm holdings, etc.)

### Droughts: NDMA guidelines Vulnerability mapping:

- **Block-wise rainfall deficit maps in the relevant regions** – at crucial stages of monsoon (e.g. early, middle, and end), separately for SW and NE monsoon
- Comprehensive assessment of **water deficit in dry-land farming, rain-fed, and drought-prone areas** every year, at the **end of the SW and NE monsoons** (stream flow, surface and groundwater)
- Agro-climatic region wise water deficit assessment reports for relevant regions separately at the end of SW and NE monsoon
- Provide technical assistance to the State Govt./SDMC to prepare vulnerability maps.

### Assessment, Monitoring, Forecasting, Early Warning:

- Improve the **drought forecast, and assessment of water deficit** (likely mismatch between estimates of requirements and availability) in the arid/semi-arid, drought-prone, and dry-land farming areas

- Prepare **detailed advisories on water conservation and crop management measures** based on drought and water deficit in consultation with experts for each State/UT which is likely to face acute water deficit
- **Monitoring key drought indices at National and State levels** as per latest national manual for drought management
- Developing **composite index of various drought indicators** relevant to each agro-climatic zone
- Develop a **multi-criteria method based on various indices** (vegetation, soil, water availability, etc.) as standardised framework for drought forecasting considering agro-climatic zones.

### Drought declaration:

- Apply the **latest (most updated) criteria and methods for assessment of drought conditions** and key indicators for declaring drought, as per latest recommendations of the appropriate agency
- Collaborate with State Government and its agencies for monitoring/ declaration of drought
- Separately, after end of SW and NE monsoon, if applicable, initiate **consultations to provide drought advisory to states by end of October for regions covered by SW monsoon and by end of March for regions relevant to NE monsoon.**

### Research:

- Agricultural research focussed on **drought-prone areas, arid/semi-arid tracts, and dry-land farming areas.**
- Research related to water conservation and management.

### Inter-agency coordination:

Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information and data.

### Structural Measures:

Ensure **rainwater harvesting and storage in drought-prone areas**, water conservation structures, **integrated water resources management** and drinking water storage and distribution facilities.

### Non-structural measures:

- Promote **water efficient irrigation systems** (sprinklers, drip, etc.)
- Promote protective irrigation through **micro irrigation systems**
- Provide advice to farmers to cope with **drought, crop management under drought conditions, and efficient water management**
- Training in water and soil moisture conservation
- Promote village-level information systems for natural resource management.

### Agricultural credit, agricultural inputs, finance, marketing, and crop insurance:

- Provide credit and financing products relevant to the drought-prone areas
- Promote agricultural insurance programmes and ensure that farmers are informed about the availability of insurance products
- Ensure risk cover for dry-land / rain-fed farmers who face very high rainfall uncertainty and dependent agricultural workers.

### Drought management plan:



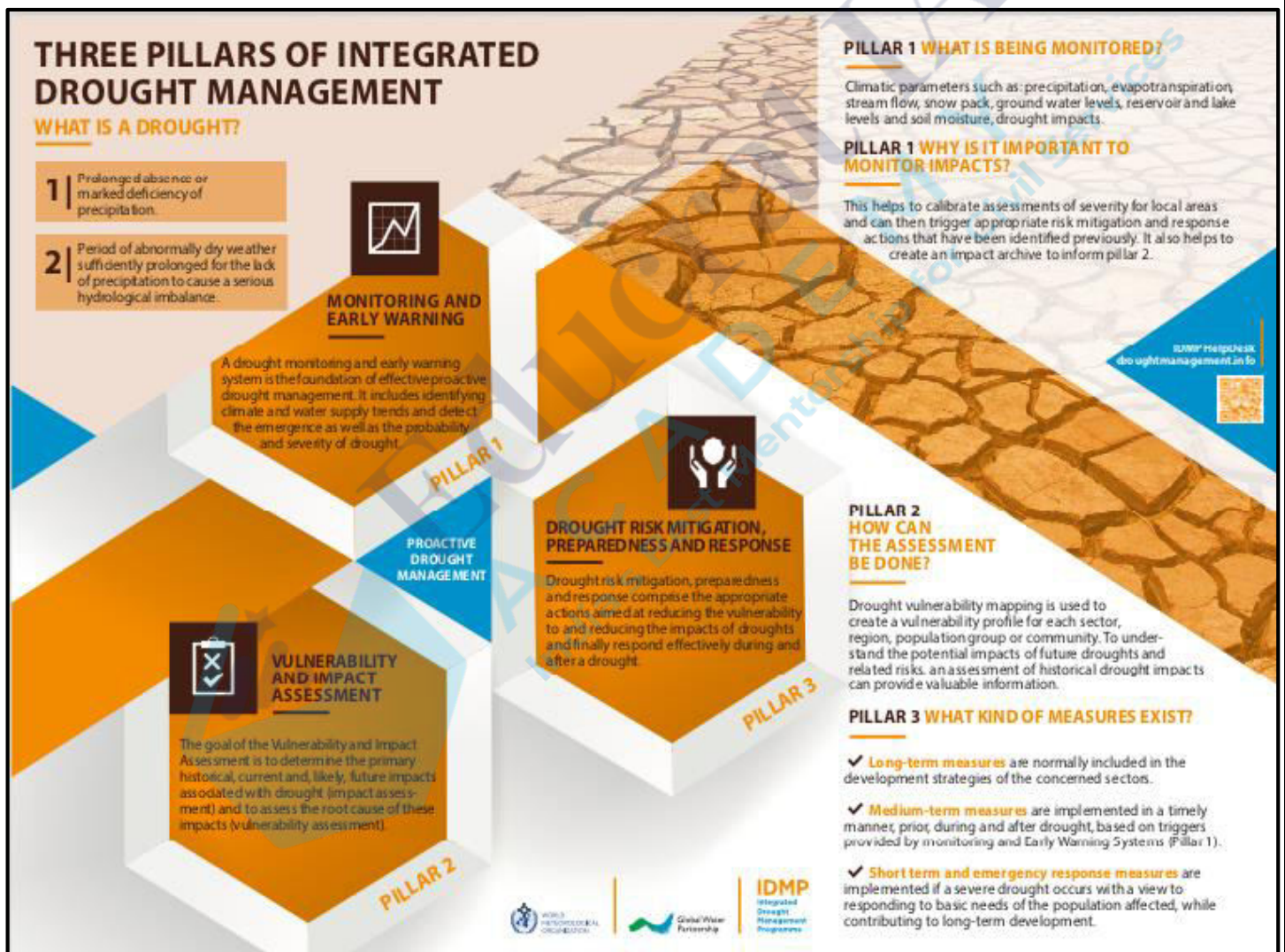
- Support the preparation of drought management plans based on detailed projections of water deficit in the drought-prone areas taking into account agro-climatic zones
- Provide advisory to the states having large areas that may face drought/ acute water deficit.

**Awareness Generation:**

- Carry out **mass media campaigns**
- Promote **culture of disaster risk prevention, mitigation, and beer risk management**
- Promote attitude and behaviour change in the awareness campaigns/ IEC
- Strengthening network of **civil society organization** for awareness generation about **DRR and DM**.
- Promote use of insurance/ risk transfer
- Promote **Community Radio**

**Empowering women, marginalised communities and persons with disabilities:**

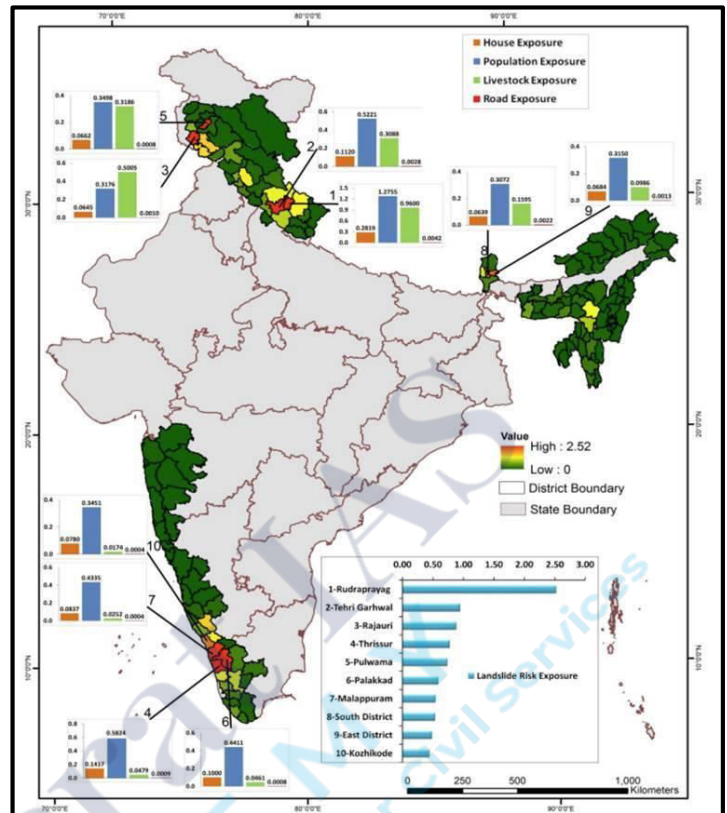
Incorporating gender sensitive and equitable approaches in capacity development covering all aspects



of disaster management.

## 8. Landslides

- Landslides occur in the hilly regions of India such as the Himalaya, North-East India, the Nilgiris, Eastern Ghats and Western Ghats.
- It is estimated that 30 per cent of the World's landslides occur in the Himalayan
- The Himalayan range, which constitutes the youngest and most dominating mountain system in the World, is not a single long landmass but comprises a series of seven curvilinear parallel folds running along a grand arc for a total of 3,400 kilometers.
- Landslides are also common in Western Ghats. In the Nilgiris, in 1978 alone, unprecedented rains in the region triggered about one hundred landslides which caused severe damage to communication lines, tea gardens and other cultivated crops.
- Scientific observations in north Sikkim and Garhwal regions in the Himalayas clearly reveal that there is an average of two landslides per sq. km.
- The mean rate of land loss is to the tune of 120 meter per km per year and annual soil loss is about 2500 tons per sq. km.
- It is estimated that economic loss due to landslides may reach between 1-2% of the gross national product in many developing countries.
- In India, about 0.42 million sq. km or 12.6% of land area, excluding snow covered area, is prone to landslide hazard.
- The landslide-prone Himalayan terrain falls in the maximum earthquake-prone zones (Zone- IV and V; BIS 2002) where earthquakes of Modified Mercalli intensity VIII to IX can occur, and thus, are also prone to earthquake-triggered landslides. The most recent example is the aftermath of 18 September 2011 Sikkim Earthquake in the Sikkim-Darjeeling Himalayas.



### Roles and Responsibilities

**Geological Survey of India-** the nodal agency for landslide studies. Geological Survey of India as a Nodal Agency is responsible for:

- Coordinating and undertaking geological studies for landslide hazard mitigation
  - Carrying out landslide hazard zonation
  - Monitoring landslides and avalanches
  - Studying the factors responsible for sliding and suggesting precautionary as well as preventive measure
- National Core Group has finalized the action plan for landslide studies with inputs of GSI and other organization.

### Salient Features of Action Plan

Finalization of uniform methodologies for Landslide Hazard Zonation (LHZ) on macro scales and meso scales. Carrying out Landslide Hazard Zonation of vulnerable areas on macro scales:



### **Carrying out Landslide Hazard Zonation of identified areas on meso scales:**

- To cover inhabited or sites proposed for infrastructural development
- **20- 25 sites** to be taken up initially, **10 sites to be taken up by GSI** and rest by other agencies
- A committee **comprising IIT- Roorkee, CBRI, NIRM, CRRI, CWC, IMD, THDC etc.** to distribute work to those willing to work in identified areas in time bound manner

### **Carrying out monitoring of landslides**

Slides that pose danger to communication routes or could cause blockade of drainages to be monitored continuously

### **To evolve an Early Warning System:**

**Need for evolving Early Warning System for landslide** has been long felt. Isolated work has been done by some agencies. This is an area where considerable amount of research is required. This is due to the fact that **several factors**, combined or individually, **directly or indirectly, trigger landslides.**

### **To prepare Inventory/ Database on LHZ:**

**Landslide Inventories are most important for any prediction model on Early Warning to be successful.** GSI has developed a format and circulated it to States & Agencies like BRO, CPWD etc. for reporting landslide incidences for input towards updating inventory. **GSI has developed and published an inventory of about 1000 landslide incidences from NW Himalayas, Eastern Himalayas**

**& North-eastern states.** The inventory has to be updated regularly and for this the cooperation from BRO, CPWD, Armed Forces, agencies engaged in infrastructure development and state departments like Forest, PWD, is required.

### **Awareness Generation:**

- **GSI to develop awareness strategy and to take up awareness programmes** in consultation with State Governments in hazard prone areas
- Another responsibility given to GSI is **to arrange a one day workshop with the aim to present GSI's point of view and interact with State Governments** and other agencies active in the field of landslides.
- **Aim is to raise awareness at various levels through Media Campaigns, Development & distribution of leaflets/ posters, Meetings & Workshops etc.**

### **Coordination:**

Any agency carrying out **Landslide Hazard Mitigation or States engaging agencies for carrying out LHZ may get approval from GSI with a view to:** (a) avoid duplication of work and (b) ensure that LHZ is carried out as per the prescribed parameters. After completion of work copy of report may be shared with GSI for record. GSI will report to the National Core Group in MHA through Joint Secretary & Central Relief Commissioner periodically on the progress made on different items.

### **National Landslide Risk Management Strategy (NLRMS)**

The National Disaster Management Authority (NDMA) has released National Landslide Risk Management Strategy (NLRMS).

## Highlights of the Strategy

- **Landslide Hazard Zonation:** It recommends **Landslide Hazard Zonation maps to be prepared at macro scale and meso level**. It focuses on making use of advanced state-of-the-art tools such as Unmanned Aerial Vehicle (UAV), Terrestrial Laser Scanner, and very high-resolution Earth Observation (EO) data.
- **Landslide Monitoring and Early Warning System:** Technical recommendation for developing and implementing **rainfall thresholds, Numerical Weather Prediction (NWP), Automatic Rain Gauges, etc.** have been included.
- **Awareness Programs:** A **participatory approach has been defined so that each section of the community is involved in the awareness drive**. Since the community is the first to confront the disaster before any aid reaches them, a mechanism of awareness is framed to involve and educate the community.
- **Capacity Building and Training of Stakeholders:** Creation of Centre for Landslide Research Studies and Management (CLRSM) to create a techno-scientific pool of expertise in the country

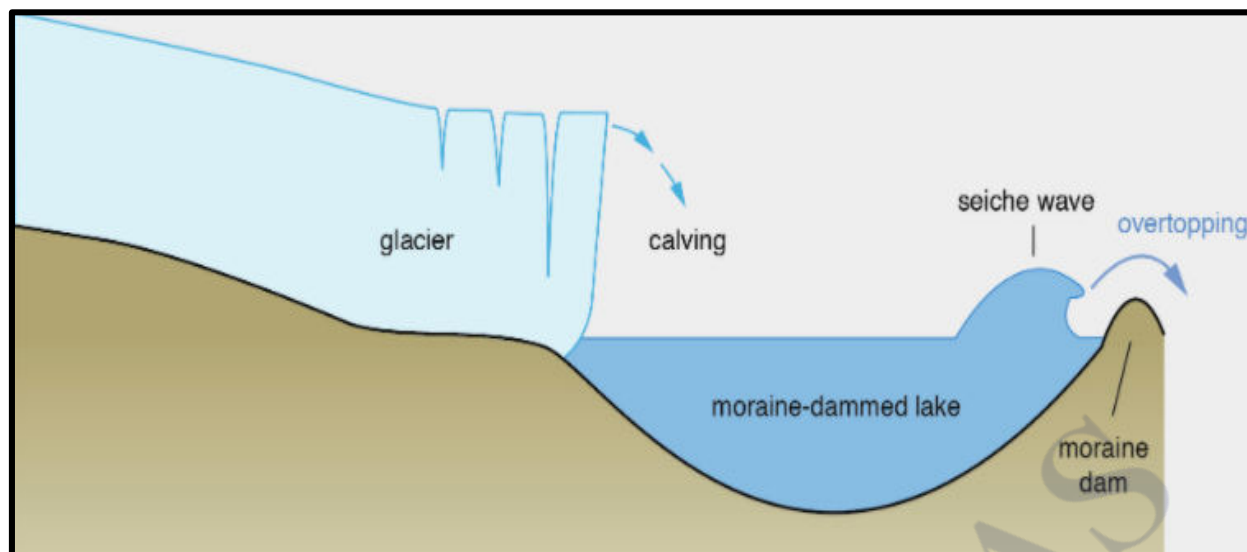
## 9. Glacial Lake Outburst Flood (GLOF):

- **Meaning:** A GLOF refers to the **flooding that occurs when the water dammed by a glacier or a moraine** (accumulations of dirt and rocks fallen onto the glacier surface) **is released suddenly**. When glaciers melt, the water in glacial lakes accumulates behind loose, natural “glacial/moraine dams” made of ice, sand, pebbles and ice residue.
- Unlike earthen dams, the weak structure of the moraine dam leads to the abrupt breach of the dam on top of the glacial lake which could cause flash floods in the downstream areas
- **Causes:** According to NDMA, **glacial retreat due to climate** change occurring in most parts of the **Hindu Kush Himalaya** has given rise to the **formation of numerous new glacial lakes**, which are the major cause of GLOFs.
- **Glacial Lakes:** Glacial lakes are typically **formed at the foot of a glacier**. As glaciers move and flow, they erode the soil and sediment around them, leaving depressions and grooves on the land. Meltwater from the glacier fills up the hole, making a lake.
- **Types:** Lakes form when meltwater ponds, and this can happen on the **ice surface** (supraglacial lakes), **in front of the ice** (proglacial lakes), or even **underneath the ice** (subglacial lakes).
- **Impact:** Glacier lakes can **affect ice flow by reducing friction at the ice-bed interface, encouraging basal sliding**. They can change the albedo of the ice surface, encouraging more surface melt.
- Proglacial lakes **cause calving, which affects mass balance and can decouple mountain glaciers** from climate.
- Glacier lakes can be hazardous; moraine and ice dams can fail, causing catastrophic glacier lake outburst floods or jokulhlaups.
- **Increase in Number of Glacial Lakes:** According to recent studies, there has been a rapid increase in the number of glacial lakes **due to a retreat in the glaciers caused by warming temperatures (due to global warming), and their potential to cause large scale flooding and destruction**.

The **Kedarnath tragedy in 2013**, for example, had involved a breach in a large glacial lake.

According to a study sponsored by the **Central Water Commission (CWC)**, conducted during 2011-15, there are **352, 283 and 1,393 glacial lakes and water bodies in the Indus, Ganga and Brahmaputra basins**

respectively.



### Guidelines on Risk Reduction

The NDMA guidelines suggest that risk reduction can be done by **identifying and mapping potentially dangerous lakes, taking structural measures** to prevent their sudden breach, and **establishing mechanisms** to save lives and property in times of a breach.

- **Identifying Potentially Dangerous Lakes:** Potentially dangerous lakes can be identified based on **field observations, records of past events, geomorphologic and geotechnical characteristics** of the lake/dam and surroundings, and other physical conditions.
- **Use of Technology:** Promoting use of **Synthetic-Aperture Radar imagery** (a form of radar that is used to create two-dimensional images) to **automatically detect changes in water bodies**, including new lake formations, during the monsoon months.
- Methods and protocols could also be developed to allow remote monitoring of lake bodies from space.
- **Channeling Potential Floods:** To manage lakes structurally, the NDMA **recommends reducing the volume of water with methods** such as controlled breaching, pumping or siphoning out water, and making a tunnel through the moraine barrier or under an ice dam.
- **Uniform Codes for Construction Activity:** Developing a broad framework for **infrastructure development, construction and excavation in vulnerable zones**. There is a need to accept procedures for land use planning in the GLOF prone areas.
- **Enhancing Early Warning Systems (EWS):** The number of implemented and operational GLOF EWS is very small, even at the global scale. In the **Himalayan region**, there are at **three reported instances** (two in Nepal and one in China) of **implementation of sensor- and monitoring-based technical systems for GLOF early warning**.
- **Training Local Manpower:** Apart from pressing specialised forces such as **National Disaster Response Force (NDRF), ITBP and the Army**, **NDMA has emphasised the need for trained local manpower**. It has been observed that over **80% of search and rescue is carried out by the local community** before the intervention of the state machinery and specialised search and rescue teams. The local teams could also assist in planning and setting up emergency shelters, distributing relief packages, identifying missing people, and addressing the needs for food, healthcare, water supply etc.
- **Comprehensive Alarm Systems:** Besides classical alarming infrastructure consisting of acoustic alarms by sirens, **modern communication technology using cell and smartphones** can complement or even replace traditional alarming infrastructure.

## 10. Lightning

### Global studies regarding Lightning

- A study published in 2015 found out that, **an increase of one degree Celsius** would increase the frequency of **lightning strikes by 12 percent**.
- A study published in **Geophysical Research Letters in March 2021**, too, has established links between **climate change** and **rising incidences of lightning** in the Arctic region.
- The number of lightning strikes recorded during the summer months between 2010 and 2020 shot up from around 18,000 at the start of the decade to more than 150,000 by 2020.
- Another research finds out that, **Urbanisation, increased population and a warmer climate** guarantee an intensification of human exposure to lightning hazards.
- An increase in lightning incidents may be directly related to the **climate crisis and the availability of more moisture over land due to warming**.
- Scientists also found out the **link between cloud burst events**, which cause sudden heavy rainfall often triggering flash floods, and forest fires.

### Lightning in India

- As many as **18.5 million lightning strikes** were recorded in India **between April 1, 2020, and March 31, 2021**, according to India's second annual report on lightning released by Lightning Resilient India Campaign (LRIC) recently. This is an **increase of 34 percent** compared to the previous year.
- At least **1,697 people died due to lightning** between **April 1, 2020, and March 31, 2021**. Of this, 401 died in Bihar, followed by Uttar Pradesh (238 deaths) and Madhya Pradesh (228 deaths).
- Lightning strikes increased in **Punjab** 331 per cent, followed by **Bihar** (168 per cent), **Haryana** (164 per cent), **Puducherry** (117 per cent), **Himachal Pradesh** (105 per cent) and **West Bengal** (100 per cent).

### What is lightning?

- Lightning is a very **rapid and massive discharge of electricity** in the atmosphere. It is the process of occurrence of a natural 'electrical discharge of very short duration and high voltage between a cloud and the ground or within a cloud.
- These discharges are generated in **giant moisture-bearing clouds that are 10-12 km tall**. These clouds have their bases about 1-2 km from the Earth's surface.
- There are two types of lightning. Such as,
  - a. Intercloud or intracloud (IC) lightning:** These are visible and harmless.
  - b. Cloud to ground (CG) lightning:** This is harmful as the 'high electric voltage discharge for very short time leads to electrocution.

### NDMA guidelines to prevent loss of life due to lightning

- **Mapping of major lightning affected zones.** It can be done on the basis of availability of data of numbers of lightning incidence, deaths occurred and injured persons data
- Sharing of data between different agencies for preparation of mitigation plans
- **Lightning strike warning system** that would inform people of the forthcoming disaster
- Structural protection measures like **Lightening Shields for buildings** and other structures
- Promote **installations of high grade lightning arresters** and **Doppler Radars** at subsidized rates by the government

- Improved wiring with trip-boxes and good earthing
- Educating and **creating mass awareness** on how to safely respond to lightning storms
- Use of social media to effectively deliver the warnings
- The focus on **Lightning protection and awareness is the need of the hour**. 100% Safety can be assured with installation of Lightning protection devices only
- Essence of 100% safety from Lightning is **possible only on installation of standard Lightning protection devices**. Ex: Lightning Safe Grid at Babadham Deoghar and Lightning safe Cyclone Shelters of Odisha. Results have been very evident as **Odisha had zero lightning casualties during Cyclone Fani**

**Damini App** was developed by the Indian Institute of Tropical Meteorology (IITM-Pune) and Earth System Science Organization (ESSO) under the ministry of earth sciences.

The app monitors the lightning occurrence all over India and alerts the user of lightning near them by a GPS notification under 20 km and 40 km.

Further, the Damini app also triggers warning about lightning strikes **three hours in advance** which can help reduce losses to life and property.

**Lightning Resilient India Campaign:** A collaborative effort between CROPC and IMD, aiming to provide early warning services and knowledge dissemination related to lightning risks, contributing to reduced fatalities and enhanced lightning risk management.

**Micro Zonation:** The process of dividing a geographical area into smaller zones based on specific characteristics or features, such as patterns of lightning strikes in this context.



## 11. Urban Floods

As India reaches the tipping point of transitioning from a mostly rural to an urban society, **Urbanisation is intrinsic to development and often serves as a major driver of economic growth**. By 2030, 40.76% of the country's population is expected to reside in urban areas. However, Urban planning machinery has not evolved at the pace of urbanisation and technological advancements.

**Unplanned development and climate change** are driving many tragic events, including urban flooding, requiring serious attention.

In the **2020 floods in Hyderabad**, thousands of houses were submerged. **The 2015 Chennai flood is a stark reminder of how rapid urbanisation is making cities prone to urban floods**. And most recently, **Bengaluru** has been the site of many such flooding incidents during this monsoon season.

### What is Urban Flooding?

Urban flooding is the **inundation of land or property in a built environment**, particularly in more densely populated areas (like cities), **caused by rainfall overwhelming the capacity of drainage systems**.

Unlike rural floods (Heavy rain over a flat or low-lying area), **urban flooding is not only caused by just higher precipitation but also unplanned urbanisation (catchments) that:**

- increases the flood peaks from 1.8 to 8 times
- increases the flood volumes by up to 6 times.

### Causes of Urban Flooding in India

- **Encroachments on Drainage Channels:** In Indian cities and towns, due to increased land prices and less availability of land in the city centre. **New developments are coming up in low-lying areas**, usually as encroachments over lakes, wetlands and riverbeds.
- **Climate Change:** Exacerbated by changing climate, resulting in extreme events. The climate change has caused an **increase in the frequency of short duration heavy rainfall leading to higher water run-off**. NASA studies indicate that the **urban heat island effect** also results in increased rainfall over urban areas that in turn leads to flooding.
- **Unplanned Tourism Activities:** Water bodies have been used as an attraction for tourism development for decades. **Water plants that reduce the runoff speed are being removed from rivers and lakes for maintaining tourism activity**. Example: Ashtamudi Lake in Kollam, Kerala polluted from oil spillage from boats.
- **Uninformed Release of Water from Dams:** Unplanned and sudden release of water from dams and lakes lead to floods in an urban area, without giving the public enough time to respond. **Example: Chennai Floods 2015** due to release of water from **Chembarambakkam Lake**.
- **Illegal Mining Activities:** Illegal mining of river sand and quartzite for use in building construction deplete the natural bed of the rivers and lakes. It **causes soil erosion and reduces the water retention capacity of the waterbody** increasing the speed and scale of water flow. **Example:** Jaisamand Lake- Jodhpur, Cauvery river- Tamil Nadu.

### Impacts of Urban Flooding

- **Loss of Life and Property:** Urban floods are often associated **with loss of life and physical injury** either directly due to the effect of floods or indirectly due to infections by water-borne diseases spreading during the inundated period.

- **Urban flooding has localised impacts** like structural damage to buildings, property, crops. Besides, it causes disruptions of water supply, sewerage, power and transmission lines, communication, traffic-road and railways and other infrastructure.
- **Ecological Impacts:** Trees and plants are washed away during extreme flood events and riverbank erosion is caused by high-speed flood water.
- **Impact on Animal and Human Health:** Stagnation of stormwater in the localities, and contamination of consumable water leads to various health problems resulting in plagues/epidemics.
- The sewage and solid waste washing into houses and neighbourhoods also causes a variety of diseases to spread.
- **Psychological Impacts:** Loss of shelter and relatives creates emotional turmoil in the mental health of the stranded. The recovery process in case of such incidents is a tiresome process and time consuming that often leads to long lasting psychological trauma.

### NDMA guidelines on management of urban flooding

The **National Disaster Management Authority (NDMA)** has issued guidelines on management of urban flooding in **2010**. The key guideline was to create a **National Hydro-meteorological Network**. The guidelines say that for **providing early warning, the Central Water Commission (CWC) should maximize the real-time hydro-meteorological network to cover all the urban centers in dealing with urban flooding**. The requirement should consider all cities/ towns which are particularly located on river banks, upstream and downstream of major and medium dams and island cities. Based on that assessment, CWC will initiate the process to prepare a plan and implementation strategy.

### Other recommendations:

- Use of **Doppler Weather Radars** to be expanded to cover all urban areas in the country.
- Coordination mechanism to be established among all agencies for deriving maximum benefit from the efforts of each individual organization.
- A dedicated **high bandwidth communication channel** is to be built, for ensuring smooth underlying sensor web flow of all available information and products.
- **State-of-the-art automatic water level recorders** must be installed throughout the drainage network of the watershed, which may sometimes extend beyond the administrative boundary of the ULB.
- **Technical Umbrella for urban Flood Forecasting and Warning** to be established at national and state level.
- An inventory of the existing storm water drainage system to be prepared. The inventory will be both watershed based and ward based.
- **Catchment** to be the basis for planning and designing the storm water drainage systems in all ULBs.
- **Contour mapping of urban areas** to be prepared at **0.2 to 0.5 m contour interval** for detailed delineation of the watershed/ catchment for planning drainage systems.
- **Pre-monsoon desilting of all major drains** to be completed **by March 31** each year.
- **Suitable interventions in the drainage system** like traps, communitors, trash racks can be provided to reduce the amount of solid waste going into the storm sewers.
- All future road and rail bridges in cities crossing drains to be designed such that they do not block the flows resulting in backwater effect.
- Inlets to be provided on the roads to drain water to the roadside drains and these has to be designed based on current national and international practices.
- Every building in an urban area must have **rainwater harvesting as an integral component** of the building utility.

- **Concept of Rain Gardens** to be incorporated in planning for public parks and **on-site stormwater management for larger colonies** and sites those are to be developed.
- Low-lying areas in cities have to be **reserved for parks** and other low-impact human activities.
- Encroachments on the drain should attract penal action.
- **Flood hazard assessment** has to ascertain level of acceptable risk of flooding on the basis of projected future scenarios of rainfall intensities and duration and land use changes.
- Flood damage has to be according to the **physical characteristics of the area** such as land use, topography, drainage area, outfall system and the capacity of the existing stormwater drainage system.
- **Ward level Information System** has to be developed using **high resolution satellite images/aerial photos**, integrated with socio-economic data covering natural resources and infrastructure facilities on appropriate scale (1:1000) at community level.
- States/UTs have to build partnerships with public/ private insurance companies and civil society to sensitive communities about available schemes and also develop appropriate micro-insurance schemes targeted at low-income groups.
- The database of the **National Urban Information System (NUIS)** will be expanded to cover infrastructure facilities at community level integrated with socio-economic data.
- Urban Flooding has to be dealt as a separate disaster, de-linking it from riverine floods which affect the rural areas.
- Storm water drainage concerns will be made a part of all EIA norms.
- Buildings have to be **designated as Flood Shelters** and all necessary arrangements have to be ensured ahead of the flood season. Children, women, the aged and the differently-abled persons has to be given special attention.
- Post-floods, restoration of power, telecommunications, road and railway transport will get top priority

## 12. Cloudbursts

### About:

- Cloudbursts are **short-duration, intense rainfall events over a small area**.
- It is a weather phenomenon with unexpected **precipitation exceeding 100mm/h over a geographical region of approximately 20-30 square km**.
- In the Indian Subcontinent, it **generally occurs when a monsoon cloud drifts northwards**, from the Bay of Bengal or the Arabian Sea across the plains then on to the Himalaya that sometimes brings 75 millimetres of rain per hour.

### Occurrence:

- The **relative humidity and cloud cover is at the maximum level with low temperature and slow winds** because of which a high amount of clouds may get condensed at a very rapid rate and result in a cloudburst.
- **As temperatures increase, the atmosphere can hold more and more moisture and this moisture comes down as a short very intense rainfall for a short duration** probably half an hour or one hour resulting in flash floods in the mountainous areas and urban floods in the cities.

### Cloudburst are Different from Rainfall:

- Rain is condensed water falling from a cloud while cloudburst is a sudden heavy rainstorm.

- Rain **over 100mm per hour is categorised as a cloudburst.**
- The cloudburst is a natural phenomenon, but occurs quite unexpectedly, very abruptly, and rather drenching.

### Impact of Climate Change:

- Several studies have shown that climate change **will increase the frequency and intensity of cloudbursts** in many cities across the globe.
- In May 2021, the **World Meteorological Organization** noted that there is about a **40% chance of the annual average global temperature temporarily reaching 1.5°C above the pre-industrial level** in at least one of the next five years.
- It added that there is a **90% likelihood of at least one year between 2021 and 2025 becoming the warmest on record and dislodge 2016** from the top rank.
- It is seen that **more cloudbursts are happening in Himalayan region because the decadal temperature rise** in the Himalayan region is higher than the global rate of rising temperatures.

### Consequences of Cloudbursts:

- Flash floods
- Mudflows
- Calving

### Prediction:

- There is **no satisfactory technique** for anticipating the occurrence of cloud bursts because they develop over a small period of time.
- **A very fine network of radars is required** to be able to detect the likelihood of a cloud burst and this would be expensive.
- Only the areas likely to receive heavy rainfall can be identified on a short range scale. Much of the damage can be avoided by way of identifying the areas and the meteorological situations that favour the occurrence of cloud bursts.



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## 13. Avalanche

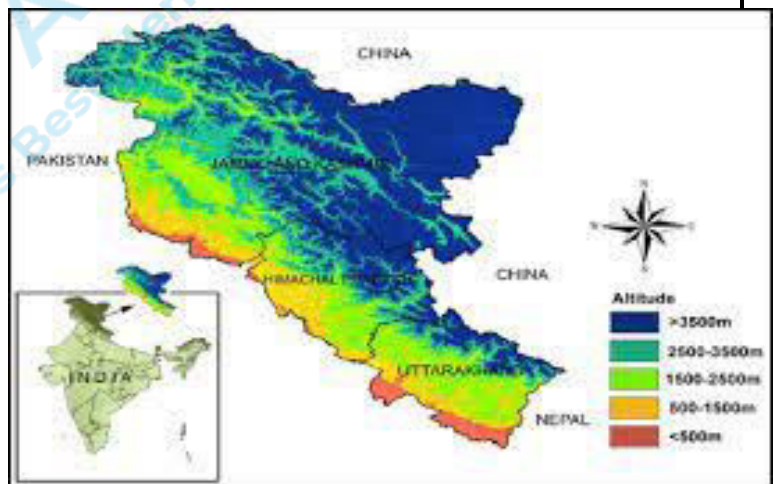
- **Avalanche**, a mass of material moving rapidly down a slope.
- An avalanche is typically triggered when material on a slope breaks loose from its surroundings; this material then quickly collects and carries additional material down the slope.
- There are various kinds of avalanches, including **rock avalanches** (which consist of large segments of shattered rock), **ice avalanches** (which typically occur in the vicinity of a glacier), and **debris avalanches** (which contain a variety of unconsolidated materials, such as loose stones and soil).
- The size of an avalanche can range from a small shifting of loose snow to the displacement of enormous slabs of snow.
- In a slab avalanche, the mass of descending snow may reach a speed of 130 km (80 miles) per hour and is capable of destroying forests and small villages in its path.

### What are the Factors that Destabilise the Snowpack?

- Snow avalanches are most likely to occur **after a fresh snowfall adds a new layer** to a snowpack.
- Avalanches can be triggered by **natural forces**, such as the pull of **gravity** on a steep slope, earthquakes, warming **temperatures** (weakening the bonds between the layers), wind, **terrain, vegetation and general snowpack conditions**.
- They can also be caused by **human activity**, such as the load of a skier, construction/development activities or by use of explosives (to set off hazardous slopes) as part of avalanche control.

### Avalanche Prone Zones in India:

- The Himalayas are well known for the occurrence of snow Avalanches particularly Western Himalayas - the snowy regions of Jammu and Kashmir, Himachal Pradesh and Western Uttar Pradesh.
- There are three types of snow avalanche zones –
- **Red Zone:** The most dangerous zone that have an impact pressure of more than 3 tonnes per square metre.
- **Blue Zone:** Where the avalanche force is less than 3 tonnes per square metre and where living and other activities may be permitted.
- **Yellow Zone:** Where snow avalanche occurs only occasionally.




### Prediction and protective measures:

- In order to reduce fatalities and to protect villages and roads, people attempt to predict and prevent avalanches.
- **Accurate avalanche prediction requires an experienced avalanche forecaster** who often works both in the field to gather snowpack information and in the office with sophisticated tools such as remotely accessed weather data, detailed historical weather and avalanche databases, weather models, and avalanche-forecasting models.
- **Avalanche detention wall.**
- Avalanche forecasters combine their historical knowledge of past conditions with their knowledge of the affected terrain, current weather, and current snowpack conditions to predict when and where avalanches are most likely to occur.
- **Avalanche mitigation wall.**




- In addition to predicting avalanches, **people employ a variety of techniques to reduce avalanche danger**. Explosives are used to trigger avalanches on potentially unstable slopes so that the avalanches will occur when people are not endangered.
- Such avalanche control is particularly effective for ski areas and highway corridors.
- In some areas prone to avalanches, particularly near villages and fixed structures, devices such as **avalanche rakes (large reinforced fencing)** are used on slopes to hold snow in place, and diversion structures such as dams or wedges are used at the base of the slope to stop, split, or deflect the snow in an avalanche.
- **Though expensive**, these defensive measures are common throughout the Alps, where numerous villages are found in areas known for dangerous avalanches.



## SURVIVING AN AVALANCHE

<h3>Before an Avalanche</h3> <ul style="list-style-type: none"> <li>• Listen to radio, watch TV, read newspapers for weather updates.</li> <li>• Stay indoors, suspend all outdoor plans once an official warning is issued.</li> <li>• Avoid steep slopes and critical areas.</li> <li>• Keep an evacuation plan ready; demarcate evacuation routes.</li> <li>• During low danger avalanche warning, move on slopes carefully and mark your tracking path using a piece of cloth, stick etc.</li> </ul>	<h3>When Caught in Avalanche</h3> <ul style="list-style-type: none"> <li>• Try to stay near the surface or get away to the sides.</li> <li>• Hold on to something sturdy.</li> <li>• Make breathing space by creating air pocket using one hand.</li> <li>• Breathe calmly, especially if you're unable to reach the surface.</li> <li>• Stay calm, knock the surface regularly to attract rescuers.</li> </ul>
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**Be Smart  
Be Prepared**

## 14. Forest Fires

The National Institute of Disaster Management (NIDM), India defines **forest fire as an unclosed and freely spreading fire that consumes the natural fuels**. When a **fire burns out of control it is known as Wild Fire**.

**There are two types of forest fire:**

- **Surface Fire-** A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter on the forest floor and is engulfed by the spreading flames.
- **Crown Fire-** The other type of forest fire is a crown fire in which the crown of trees and shrubs burn, often sustained by a surface fire.

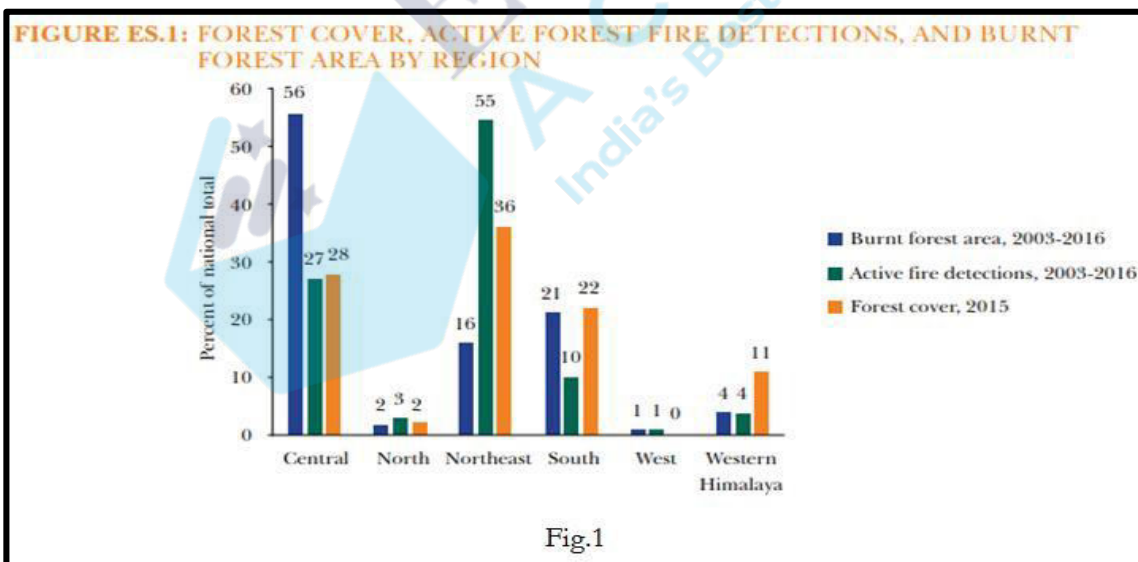
### Statistics: Forest Fire in India

**Vulnerability:** According to 2015 Indian Forest Survey report, **64.3% of forests in India are prone to forest fires**. Out of these, the fire prone areas that fall under **heavy fire incidence class are 2.4%, moderate class are 7.49% and mild are 54.4%**. Tropical thorn forests, tropical dry deciduous forests and sub-tropical broadleaved hill forests are more prone to forest fires

### Overall Trend and Pattern of Forest Fire:

According to the report titled **Strengthening Forest Fire Management in India**

- At least **60 per cent of districts in India** are affected by forest fires each year
- **Top 20 districts in terms of fire frequency** are located mainly in the **Northeast**
- The **top-20 districts in terms of burnt area** are mainly in **Central India**.
- Districts experiencing widespread and frequent forest fires include areas of dry and moist deciduous forest in the borderlands of **Chhattisgarh, Maharashtra, and Telangana** that are affected by fire on a nearly annual basis



According to Forest Survey of India, More than **95% of forest fires in India are man-made**. India has recorded a 46% increase in the number of forest fires from 2003-2017

## Factors of Forest Fire

- **Weather:** Fire intensity and behaviour are intricately related to weather and climate. Seasonal weather patterns influence the onset, duration, and severity of the fire season. **India's monsoons are largely responsible for the seasonal nature of forest fires in India.** For most parts in India, **forest fires peak** during the dry months of **March or April** before the arrival of the monsoon.
- **Topography:** Local topography influences the difficulty of fire prevention and suppression and can raise the potential for out-of-control fires. **Steep slopes and rugged terrain are more prone to fire** and prevention is also difficult in such areas. States in which fires tend to occur in the most rugged terrain include **Himachal Pradesh, Jammu and Kashmir, Manipur, Nagaland, Tamil Nadu, and Uttarakhand.**
- **Fuel:** Fuels determine the potential for fires to ignite, grow, intensify, and spread. Combustible material in forests includes grasses, ground litter, small shrubs, living and dead trees, and decomposing humus in soils.

### Why are Uttarakhand forests prone to forest fires?

Historically, in Uttarakhand, dense broadleaf forests covered the hillsides and valleys, while chir pine trees were found in poorer soils along the crest of ridges and very steep slopes. However, the British cleared the broadleaf forests and replanted with commercially useful species, generally chir pine. The extensive area under chir pine has led to problem of increased forest fire. The shedding of pine needles and cones at the beginning of summer ensures plenty of fuel for forest fires. Since 1980s, most of the fires in Uttarakhand have been human-induced. Timber contractors set fire in the region to illegally fell trees. This has predominantly started after the government banned felling of trees over 1000m above sea-level

## Causes

**Natural: Lightning and volcanic explosion** are **natural causes of forest fires.** For example: According to the report, a record number of wildfires in Canada's Northwest Territories in 2014, and in Alaska in 2015 were resulted due to lightning

**El-Nino and Forest Fires:** El Nino event is known to trigger forest fires. This is because; El Nino causes less rain to fall in many areas of the tropics, making forests more vulnerable to human-ignited fires. According to a US Report, El Nino even in 1997-98 witnessed forest fires in many continents. Further, the 2016 Indonesian Forest Fire has also been linked to El Nino.

### Anthropogenic:

- **Negligence:** Negligent use of fire (during **agricultural burning** of on farmlands near forests, **clearing of paths** through forests, **burning weeds and bushes** on privately-owned lands next to reserved forests) is one of the prime reason for forest fire. Further, **accidental fires break out due to campfires and cigarette butts**
- **Collection of non-timber forest products (NTFPs):** According to the World bank report **collection of NTFPs was the main cause of forest fire in** Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, and Telangana. People in Central India burn to aid in the collection of flowers from the mahua plant, during collection of tendua leaves for bidi making etc.
- **Shifting Cultivation (Jhum):** Jhum cultivation is the primary reason for forest fires in **north-eastern states** of Assam, Meghalaya and Tripura, and also in Odisha.
- **Burning to Deter wildlife:** People burn **pine needles, cones, weeds,** and so on during the dry season to keep away wild boars, birds, and leopards which may ignite forest fires

## Impact of Forest Fire:

### Positive impacts:

- Cleaning up forests of dead and decaying matter and **help forests to regenerate**
- **Maintaining ecosystem balance** by removing diseased plants and harmful insects

### Negative impacts:

- **Loss of forest cover, timber resources and associated economic cost:** According to FSI, the annual forest loss because of fires is estimated at Rs 440 crore. However, this estimate only account for the replacement cost of the seedlings and does not include the losses to biodiversity, timber, carbon sequestration capacity, soil moisture and nutrient loss.
- **Degradation of water catchment areas:** Forest fires result in the chemical and physical changes in upper layer of soil and make it impervious thus reducing water infiltration. Further, the removal of litter decreases water holding capacity of soil and most of the rainwater is washed away removing top fertile soil of the forest resulting into loss of soil fertility.
- **Loss of wildlife:** Forest fires lead to wildlife habitat destruction, decline in wildlife population and also post fire the food resources for the wildlife decreases. For example, **in the 2012 forest fire in UltaPani Forest in Assam, the number of butterfly species declined to 30 from 200.** Further, recurrent forest fires in the same area can lead to modifications in the ecosystem thus adversely affecting the biodiversity in the area
- **Change in micro climate of the area:** Forest fires may change the micro climatic conditions by **changing soil moisture balance; temperature increase.** Further, smoke and dust in the area reduces visibility and also adversely affect the health of wildlife and human population inhabiting near the forest.
- **Forest Fire and Climate Change:** The increased average annual temperatures due to change in land use (e.g. decrease in water resources) and climate change have **resulted in below-average rainfall in many areas which has elevated the risk and severity of forest fires.** According to a study, increased temperatures and resultant aridity have increased the number and spread of forest fires in USA in last 30 years. Further, forest fires also impact climate change. **When a forest gets burnt, the stored carbon is released into the atmosphere which further aggravates warming of the atmosphere.** Forest fires emit black and brown carbon which absorbs solar radiation and heats up the atmosphere. **It further results in changes in rainfall pattern.**
- **MoEFCC and World Bank** report states that **forest fires in India threaten India's ambition to expand its forest and tree cover by 2030** to create an additional carbon sink of 2.5 to 3 billion tons of CO2 equivalent
- **Invasive species:** Forest fragmentation, along with forest fire make forest ecosystems more vulnerable to invasion by alien species; e.g., lantana which in turn, fuel further fires
- **Socio-economic impact:** Loss of livelihood for tribal people and the rural poor- In India, nearly 300 million people are directly dependent upon collection of non-timber forest products from forest areas for their livelihood.

### MoEFCC issued a set of national guidelines for forest fire prevention and control in 2000.

#### These guidelines call for:

- identification and mapping of all fire prone areas,
- compilation and analysis of database on forest fire damages,
- development and installation of Fire Damage Rating System and Fire Forecasting system,
- all preventive measures to be taken before the beginning of the fire season



## National Master Plan for Forest Fire Control

### The main objectives are:

- To strengthen the organizations responsible for forest fire management
- To coordinate international transfer of technology and training in the field of forest fire management
- Creation of a strong database for: number of fires, area burnt, damage to flora and fauna, effect of fire on land and soil and measures taken
- Assessment of ecological, social, and economic impact of fires
- Strong national extension strategy for people's awareness and their participation in forest fire management through Joint Forest Management and NGOs

**Forest Fire Prevention and Management Scheme:** In 2017, Intensification of Forest Management Scheme was revised and replaced as Forest Fire Prevention & Management Scheme. **The main objectives of the scheme are as follows:**

- Minimise forest fire incidences and help in restoring productivity of forests in affected areas
- Encourage partnership with forest fringe communities for forest protection
- Prepare fire danger rating system and devise forest fire forecasting system
- Forest Survey of India has developed Pre Warning Alert System. It gives alerts to state forest departments based on parameters like forest cover, forest types, climatic variables (temperature, rainfall) and recent fire incidences over the area

**Draft National Forest Policy, 2018:** It calls for **safeguarding ecosystems from forest fires, mapping the vulnerable areas and developing and strengthening early warning systems** and methods to control fire, based on remote sensing technology and community participation.

### NDMA Guidelines:

- Incorporate Forest Fire Prevention and Management (FFPM) in existing policy and planning documents
- Establish National Forest fire Knowledge Network
- Capacity building of forest officials for better use of early warning systems
- Assess risk and prepare vulnerability and risk maps
- Document national and international good practices and utilise them for making forest fire management more effective and practical
- Increase community awareness

### Issues and Challenges:

- **Lack of appropriate policy:** In India there are no clear guidelines for forest fire management. **In November 2017, National Green Tribunal (NGT) had asked the Environment Ministry to evolve a national policy for prevention and control of forest fires.** However, no progress has been made so far.
- **Lack of funding:** The allocation of funds to the states for forest fire management is largely insufficient. Further, a large amount of the money allocated under the forest management schemes are not released
- **Early Warning:** Unlike western countries, **forest fire in India is largely man-made** which makes it difficult to predict
- **Emphasis on response only:** With regard to forest fire management in India, the **emphasis has been predominantly on response after the disaster.** There has been less focus mitigation, preparedness,



human resource development and awareness generation. Also, **Post-fire management is not being treated as part of the FFPM process**

- **Lack of community participation:** In most of the Indian states, community participation in forest fire management has been poor
- **Lack of manpower:** Lack of manpower hinders clearing of fire lines and also affects the patrolling of forest areas.
- **Climate Change:** The forest fire management in India do not include climate change aspects in planning, policy formulations and implementation stages

## Best Practices

**1. Canadian Forest fire Danger Rating System:** The system collects **data on fuels, weather, topography, foliar moisture content (how much moisture is in the leaves and pine needles), and type and duration of prediction.** The data helps managers of various fire agencies determine the areas that are most vulnerable to fires and allocate their resources accordingly. Further, the Canadian Forest Fire Behaviour Prediction (FBP) System helps managers assess how far a specific fire can spread and its severity.

## **2. Role of forest community: Best Practice in India:**

**Bilapaka village in Mayurbhanj District of Odhisa:** The villagers have set up **the Bilapaka Jangal Surakshya Parichalana Committee (BJSPC).** The villagers have developed an effective warning mechanism and a process to immediately stop small fire incidents

## Way Ahead:

- **Policy:** At the national level, a cohesive policy or action plan should be formulated to set forth the guiding principles and framework for FFPM. **The policy and programmes for forest fire management should incorporate the dimension of climate change**
- **Management:** Forest fire prevention and management practices used by state forest departments also need to be strengthened
- **Funding and Human Resource:** Greater funding for construction of watchtowers and crew stations and for frontline officers and seasonal firewatchers to spot fires is needed. Further, adequate training should be provided to field officers, seasonal firewatchers, and community volunteers involved in firefighting.
- **Technology:** Modern firefighting techniques such as the radio-acoustic sound system for early fire detection and Doppler radar should be adopted.
- **Data and information:** There is a need to support forest fire management through improved data and research to fill critical knowledge gaps
- **Awareness:** Awareness generation for forest communities and visitors is important to prevent loss of life and injuries. Further, regular drills on escape methods and routes based on forest types should be conducted.

## 4. Anthropogenic Disasters Biological Disasters

### a. What is Biological Disaster?

Biological disasters are scenarios involving disease, disability or death on a large scale among humans, animals and plants due to toxins or disease caused by live organisms or their products.

**Such disasters may be natural in the form of epidemics or pandemics or man-made by the intentional use of disease causing agents in Biological Warfare (BW) operations or incidents of Bioterrorism (BT).**

### Causes of Epidemics

- Poor sanitary conditions leading to contamination of food and water or
- Due to **inadequate disposal of human or animal carcasses** in post disaster situations
- They become **real dangers during floods and earthquakes.**
- Poor solid waste management may create epidemics like plague.

Incidence of plague is quite uncommon now but it can still occur claiming many human lives and disrupting normal life as it did in Surat in 1994.

### Major sources of Epidemics in India

**In India, the major sources of epidemics can be broadly categorized as follows:**

- **Water-borne diseases** like cholera (and forms of gastroenteritis), typhoid, Hepatitis A, Hepatitis B etc. -major epidemics of such diseases have been recorded in the past and continue to occur;
- **Vector-borne (often mosquito-borne) epidemics** like dengue fever, chikungunya fever, Japanese encephalitis, malaria, kala-azar etc., which usually occur in certain regions of the country;
- **Person to person transmission of diseases** e.g. AIDS and other venereal diseases; and
- **Air-borne diseases** like influenza and measles that can also be transmitted through fomites (used clothes etc.).

In addition to the above, there are **certain types of emerging infectious diseases such as epidemic of Severe Acute Respiratory Syndrome (SARS), which had occurred in China or the recent outbreak of avian flu in poultry in certain parts of the country** and which has the potential of being transmitted to human beings. Epidemics due to the Dengue virus have occurred in many metropolitan cities of India and outbreak of various other types of viral diseases is also a recurring phenomenon.

### Trends Favouring Biological Disaster

- Low cost and wide spread availability
- More **efficient in terms of coverage per kilogram of payload**
- Advances in biotechnology has made production easy
- Used agents are largely natural pathogens to simulate existing diseases
- Have unmatched destructive potential
- **Lethal biological agents** can be produced easily and cheaply
- The lag time between infection and appearance of symptoms are longer than with chemical exposure.

### Consequences of Biological Disaster

- It can result into heavy mortalities in the short term leading to a depletion of population with a

corresponding drop in economic activity

- It leads to diversion of substantial resources of an economy to contain the disaster.
- **Bio weapons of mass destruction**

### Prevention and Mitigation Measures

- The **general population should be educated and made aware of the threats and risks associated with it.**
- Only cooked food and boiled/chlorinated/filtered water should be consumed.
- Insects and rodent control measures must be initiated immediately.
- Clinical isolation of suspected and confirmed cases is essential.
- A network of laboratories should be established for proper laboratory diagnosis.
- **Existing diseases surveillance system** as well as **vector control measures** have to be pursued more rigorously.
- **Mass immunization programs** in suspected areas have to be followed more rigorously.
- More focus should be given on the **research of the vaccines** which are not available.

### Nodal Agencies for dealing with Biological Disasters in India

- **The nodal agency for handling epidemics – Ministry of Health and Family Welfare.** It is the chief decision-making, advisory body.
- As **Health is a State Subject under Schedule VII of the Indian Constitution**, the primary responsibility of dealing with biological disasters is with the State Governments.
- The nodal agency for investigating outbreaks – **National Institute of Communicable Diseases (NICD)**
- **Nodal ministry for Biological Warfare – Ministry of Home Affairs** (Biological warfare is the use of biological agents as an act of war)

### Steps Required for Biological Disaster Management in India

- **Legal framework - The Epidemic Diseases Act was enacted in 1897 and needs to be repealed.** This Act does not provide any power to the centre to intervene in biological emergencies. It has to be **substituted by an Act** which takes care of the prevailing and foreseeable public health needs including emergencies such as **BT attacks and use of biological weapons by an adversary, cross-border issues, and international spread of diseases**
- **Operational framework -** At the national level, there is no policy on biological disasters. **The existing contingency plan of MoH&FW is about 10 years old and needs extensive revision.** All components related to public health, namely apex institutions, field epidemiology, surveillance, teaching, training, research, etc., need to be strengthened.
- **Command, control and coordination -** One of the lessons learned during the **plague outbreak in Surat in 1994 and avian influenza in 2006** is the need to strengthen coordination with other sectors like animal health, home department, communication, media, etc., on a continuous basis for the management of outbreaks of this nature
- **Augmentation in human resource -** There is a shortage of medical and paramedical staff at the district and sub-district levels. There is also an **acute shortage of public health specialists, epidemiologists, clinical microbiologists and virologists.** There have been limited efforts in the past to establish teaching/training institutions for these purposes.
- **Basic infrastructural setup –** Biosafety laboratories for prompt diagnosis, network of sub centres, PHCs and CHCs, dispensaries with stockpile of essential vaccines and medicines need to be expanded to handle epidemic.

## b. Industrial Chemical Disasters

### What are Industrial Chemical Disasters?

Industrial hazards are **threats to people and life-support systems that arise from the mass production of goods and services**. Increased industrial activities and the risks associated with hazardous chemicals and enhanced vulnerability lead to industrial and chemical accidents. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems they give rise to industrial disasters.

### Sources and Initiators of Industrial Disasters

Industrial hazards can occur at any stage in the production process, including extraction, processing, manufacture, transportation, storage, use, and disposal. Chemical disasters in general may result from Fire, Explosion, Toxic release, Poisoning and various such combinations. **Factors that may spark off chemical accidents may be categorized as follows:**

1. **Process and System Failures:** Design defects, fatigue, corrosion may cause technical failure in the equipment. Human errors may include neglecting safety instructions or deviating from specified procedures. Lack of information or organizational errors such as poor emergency planning or coordination, non-compliance with mock drills are also initiators of chemical disasters.
2. **Natural Calamities:** Natural calamities may trigger chemical reactions. **Release of acrylonitrile during 2001 earthquake in Kandla and damage to phosphoric acid sludge containment during 1999 Odisha cyclones are some such examples.**
3. **Sabotage or Terrorist Attack:** Vulnerability to chemical disasters is further compounded by likely terrorist and warfare activities.

### Institutional Framework and Statutory Laws:

- The regulatory framework on chemical safety can be traced to the Factories Act, 1948 and chemical class-specific regulations like the Explosives Act, 1884; the Insecticide Act, 1968; and The Petroleum Act, 1934. Later, **an umbrella Act, the Environment (Protection) Act, 1986, was enacted, which also deals with chemical management and safety.**
- The Ministry of Labour and Employment along with its technical organ - the Directorate General Factory Advice Service and Labour Institutes (DGFASLI) - **amended the Factories Act, 1948 notifying activities as hazardous processes.** Various Central and state ministries are responsible for the enforcement of these guidelines.
- In the **aftermath of the Bhopal disaster, the environment ministry came up with the Manufacture, Storage and Import of Hazardous Substances Rules, 1989.** In addition, the Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008, provide for means of safe storage and disposal of "hazardous waste" (which is listed in its schedules) with the help of central and state pollution control boards.
- **The Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules, 1996, seek to address gas leaks and similar events. These rules define both "chemical accident" and a "major chemical accident".** They set up a Central Crisis Committee with the secretary of the environment ministry as chairman "to deal with major chemical accidents and to provide expert guidance for handling major chemical accidents". **It has provisions for state-, district- and even local-level crisis groups.** The central crisis group is required to constantly monitor post-accident situations, conduct analyses of these accidents and suggest preventive steps to avoid recurrence.



- The Public Liability Insurance Act, 1991 provides for immediate and interim relief to disaster victims till their claims of compensation are finally decided. **The National Green Tribunal (NGT) was set up by an Act of Parliament in 2010 for this purpose.** The Act also provides for the “principle of no fault liability”, which means that the company can be held liable even if it had done everything in its power to prevent the accident. **The compensation that is ordered to be paid by the NGT is credited to the Environmental Relief Fund scheme, 2008, established under Public Liability Insurance Act, 1991.**

### Industrial Disaster Risk in India

- There are about **1861 Major Accident Hazard (MAH) units, spread across 301 districts and 25 states & 3 Union Territories, in all zones of country.** Besides, there are thousands of registered and hazardous factories (below MAH criteria) and un-organized sectors dealing with numerous range of hazardous material posing serious and complex levels of disaster risks. With rapid industrialization, the threat of industrial disasters has increased.

### Industrial Disaster Prevention and Mitigation Strategies

- **Design and Pre-modification review:** This involves proper layout, facilities and material selection. Research should be done try to substitute extremely toxic chemicals with safer ones. **Less chemicals should be stored; a reduction in inventory** will automatically mean less damage if an accident is to occur.
- **Chemical Risk Assessment:** Chemicals are assessed based on compatibility, flammability, toxicity, explosion hazards and storage.
- **Process Safety Management:** reliability assessment of process equipment, incorporating safety trips and interlocks, scrubbing system, etc. should be done before effecting major process changes. Management should try to develop a culture of safety in industrial organizations
- **Safety Audits:** Periodical assessment of safety procedures and practices, performance of safety systems and gadgets along with follow up measures should be carried out.
- **Emergency Planning:** A comprehensive risk analysis indicating the impact of consequences and specific written down and practiced emergency procedures along with suitable facilities should be done. This can be done by communities as well as national or regional corporation authorities
- **Training:** Proper training of employees and protective services should be done.
- Special times and escorts for dangerous vehicles
- **Public Cooperation on the road:** The public should cooperate with the police and any tankers and heavy duty vehicles to avoid accidents and allow for the shortest possible on road time for dangerous vehicles.
- **Public awareness:** Everyone should be aware of potential disasters and informed of protective and safety measures. Cautions must be placed to stand out on dangerous household and car care products.
- **Proper storage of hazardous Materials:** All chemicals and hazardous materials should be kept at proper storage temperature and in locked cupboards away from children and animals. Also, **if reactive substances are stored, it should be stored in a watertight container.**
- **Proper and safe disposal of hazardous waste** to be ensured as per existing regulations.
- **Transition towards the use of safer alternatives** and adoption of safer, affordable and sustainable technologies and processes.
- Strict implementation of land use policy should be there. **A legislation on the buffer zone (or to be referred as ‘no man’s’ zone) should be introduced so that residential/ slum colonies are not established in proximity to industries.** The already settled residential colonies need to be relocated.

- A **scheme for giving good performance awards to industries** for achieving exemplary safety standards and statutory compliance shall be developed and implemented.

### Existing Challenges

- In spite of the existence of a large number of laws, their enforcement has left much to be desired.
- There is a **lack of understanding and research towards devising a sustainable solution to the issue of industrial disasters.**
- No adequate separation of parameters, awareness and preparedness for such disasters. Absence of national regulations on occupational safety and health and medical emergency management.
- Harmonization of classification and definitions in existing regulations including petroleum and petroleum products.
- Absence of regulations on storage and transportation of cryogenics. **Lack of legislation on risk assessment requirements and classification, labelling and packaging for industrial chemicals.**
- **Non-availability of statutes for grant of compensation to chemical accident victims.** Harmonisation and incorporation of international laws in chemical management

## C. Nuclear Disasters

### What is a Nuclear Hazard?

Risk or danger to human health or the environment exposed by the **radiation emanating from the atomic nuclei is called as nuclear hazard.**

### Sources of Nuclear Hazard

- **Natural Resources:** Cosmic rays from the outer space, emissions from the radioactive materials from the earth's crust.
- **Man-Made Sources:** Nuclear power plants, X-Rays, nuclear bombs, nuclear accidents, nuclear weapons, mining and processing of radioactive ores.

Nuclear emergencies can also **arise due to factors beyond the control of the operating agencies;** e.g., human error, system failure, sabotage, earthquake, cyclone, flood, etc.

### Nuclear Hazard risk in India:

**India has traditionally been vulnerable to natural disasters on account of its unique geo climatic conditions.**

India has a flourishing and largely indigenous nuclear power programme. **It aims to supply 25% of electricity from nuclear power by 2050.** Nuclear and Radiological Emergency can arise in a nuclear facility at plant level leading to plant/ site or offsite emergency depending upon the extent of its impact on the surroundings.

## Nuclear Hazard Mitigation Strategies

**There are four ways in which people are protected from identified radiation sources:**

- **Limiting time:** In occupational situations, dose is reduced by limiting exposure time.
- **Distance:** The intensity of radiation decreases with distance from its source.
- **Shielding:** Barriers of lead, concrete or water give good protection from high levels of penetrating radiation such as gamma rays. Intensely radioactive materials are therefore often stored or handled

under water, or by remote control in rooms constructed of thick concrete or lined with lead.

- **Containment:** Highly radioactive materials are confined and kept out of the workplace and environment. Nuclear reactors operate within closed systems with multiple barriers which keep the radioactive materials contained.

### Institutional and Legislative Framework in India

- **The Atomic Energy Act, 1962 is the main Nuclear Legislation in India.** With increased emphasis on power generation through nuclear technology, the threat of nuclear hazards has also increased.
- **The Department of Atomic Energy (DAE) has been identified as the nodal agency in the country in respect of manmade radiological emergencies in the public domain.** A Crisis Management Group (CMG) chaired by the Additional Secretary, DAE has been set up. In the event of any nuclear/radiological emergency in the public domain, CMG is immediately activated and it coordinates with the local authority in the affected area and all the concerning authorities at the centre (NCMC/ NEC/NDMA) to ensure that the necessary technical inputs are available to respond to the nuclear/radiological emergency
- **The Atomic Energy Regulatory Board is the nuclear regulatory authority in India which, as per the legal framework of Atomic Energy Act, 1962,** has the mandate for issuance of licenses to nuclear and radiation facilities upon ensuring compliance with the applicable standards and codes.

### d. Stampede/ Crowd Management

A quick rush of a multitude of people is referred to as a stampede, which typically leaves many people injured and dead through suffocation and trampling. A surge of people inside a crowd as a result of excitement, a sense of impending danger, or a lack of personal space is what leads to stampedes.

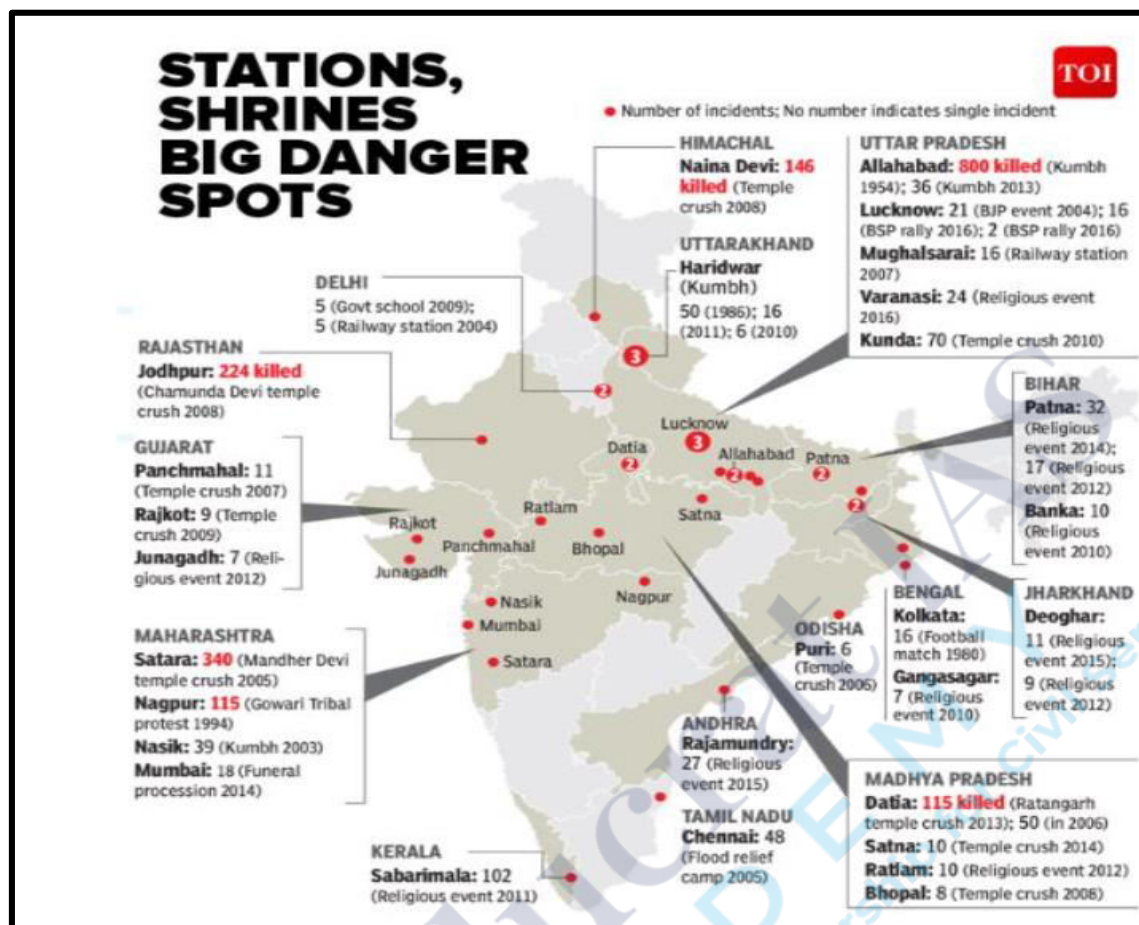
#### Statistics on Crowd disasters in India

- **Over 2,000 individuals perished in stampedes from 2000 to 2013,** according to data from the National Crime Records Bureau. According to a 2013 study by the International Journal of Disaster Risk Reduction (IJDRR), 79% of the stampedes in India have occurred at religious gatherings and pilgrimages

#### Causes of stampede or crowd disaster

There are many causes of crowd disasters.

- **Demolition of temporary constructions,** stairways that rise vertically, small buildings because of errant structures, hawkers, and parking.
- **Electric/Fire Mishaps:** While celebrating in temporary kitchens, improper use of firecrackers or poor wiring are common causes.
- **Failure of the electricity supply** causes panic and prompts a hasty evacuation.
- Reducing the size of the crowd, **failing to coordinate with management,** overselling tickets, and causing a general panic due to a sudden rush or rumours of getting freebies or signatures from celebrities.
- To manage their motions, people require at least 1 square yard of space per person. In large crowds, asphyxiation rather than trampling is the most common cause of death.
- **People can become brain-dead** in as little as 6 minutes after being crushed for just 30 seconds.
- **Insufficient deployment of safety teams** results in drastic actions, such as using tear gas.
- **Insufficient cooperation** between administrative agencies, including the management of the shrine, the fire department, and the police.



## National Guide on Crowd Management-NDMA

In view of the recurring stampedes at places of mass gathering, including religious places, and typically ad-hoc responses to those, the **National Disaster Management Authority (NDMA)** had prepared 'Suggestive Framework for Preparation of Crowd Management Plan for Events/Venues of Mass Gathering'

### The major recommendations include:

#### 1. Understanding venue, visitors and stakeholders:

- The basic element for event planning and crowd management is understanding the venue, visitors and different stakeholders.
- It **requires understanding of Type of event** (such as religious, schools/ university, sports event, music event, political event, product promotion etc.); **Expected Crowd** (age, gender, economic strata), **Crowd Motives** (such as social, academic, religious, entertainment, economic etc.); **Venue** (location, topography of area, temporal or permanent, open or closed), and **role of other stake holders** (such as NGOs, neighbours of event venue, local administrators etc.)

#### 2. Crowd Handling

- Traffic around the mass gathering venues should be properly regulated.
- There should be a **route map for venues along with emergency exits route maps**.
- There should be **Barricade facility** to control the movement of crowd queues.
- **Snake line approach** should be followed in case large crowd queues
- The organizers of crowded events/venue managers should discourage general admissions and have plans



To handle VIP visitors or, alternatively, refuse entry to VIPs where it adds to safety concerns.

3. **Safety and Security:**

- The venue Organisers should ensure authorised use of electricity, fire safety extinguishers and other arrangements as per the safety guidelines.
  - It **suggests use of CCTV cameras** to monitor crowds and use of mini UAV incase crowd spread is too big
4. **Communication:** A public address system, with loudspeakers installed at all crowded points, to communicate with the crowds.
5. **Medical and Emergency care:** Medical first-aid rooms and emergency operations centres to handle post-disaster emergencies should be set up.
6. **Role of Event Managers:** The event organizers and venue managers should develop, implement, review and revise the disaster management plan in coordination with others including local administration and police.
7. **Role of Civil society:** Event/venue managers can involve NGOs and civil defence in traffic control, people flow control, medical assistance, sanitation and mobilization of local resources in case of disaster.
8. **Role of police:** The police should actively participate in venue assessment and preparedness checks and guide crowd and traffic movements.
9. **Capacity Building:** Capacity building, conducting drills, periodic assessment of training of security personnel, police is essential to prevent crowd disasters



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## 5. Global Framework on Disaster Management

### Sendai Framework for Disaster Reduction 2015-30

It was adopted at the Third United Nations World Conference on Disaster Risk Reduction, held from March 14 to 18, 2015 in Sendai, Miyagi, Japan.

The present Framework applies to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risks.

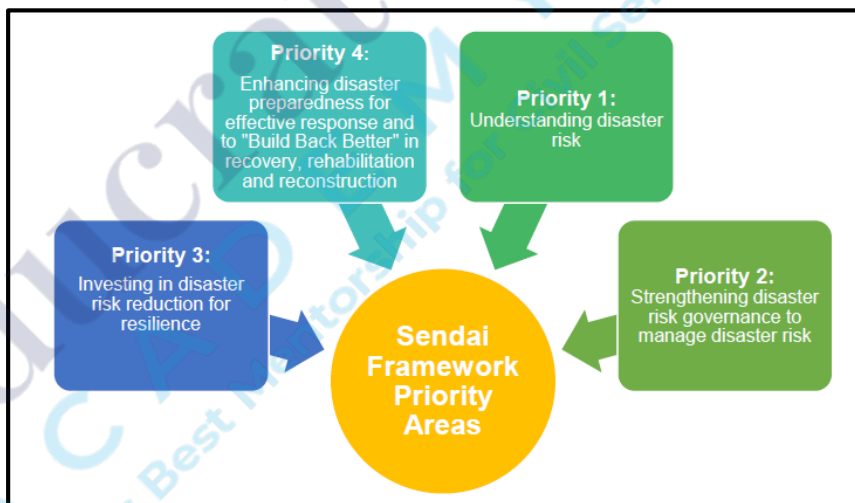
It aims to guide the multi hazard management of disaster risk in development at all levels as well as within and across all sectors.

It is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters.

### Actions to be taken in four Priority Areas

#### 1. Understanding Disaster Risk:

- To promote the collection, analysis, management and use of relevant data and practical information and ensure its dissemination, taking into account the needs of different categories of users, as appropriate.
- To systematically **evaluate, record, share and publicly account for disaster losses** and understand the economic, social, health, education, environmental and cultural heritage impacts.
- To build the **knowledge of government officials at all levels, civil society, communities and volunteers, as well as the private sector**, through sharing experiences, lessons learned, good practices and training and education on disaster risk reduction.
- To ensure the **use of traditional, indigenous and local knowledge and practices**, as appropriate, to **complement scientific knowledge in disaster risk assessment** and the development and implementation of policies.
- To promote and enhance, through international cooperation, including technology transfer, access to and the sharing and use of non-sensitive data and information for supporting national measures for successful disaster risk communication.
- To **develop effective global and regional campaigns** for promoting a **culture of disaster prevention, resilience and responsible citizenship**.



#### 2. Strengthening disaster risk governance to manage disaster risk:

- To carry out an **assessment of the technical, financial and administrative disaster risk management capacity** to deal with the identified risks at the local and national levels.
- To encourage the **establishment of necessary mechanisms and incentives to ensure high level of**

**compliance with the existing safety-enhancing provisions of sectoral laws and regulations**, including those addressing land use and urban planning, building codes, environmental and resource management and health and safety standards.

- To **establish and strengthen government coordination forums composed of relevant stakeholders at the national and local levels**, such as national and local platforms for disaster risk reduction, and a designated national focal point for implementing the Sendai Framework for Disaster Risk Reduction 2015–2030.
- To promote the **development of quality standards**, such as **certifications and awards for disaster risk management**, with the participation of the private sector, civil society, professional associations, scientific organizations and the United Nations.
- To **formulate public policies** on addressing the issues of **prevention or relocation of human settlements** in disaster risk-prone zones.
- To **promote the strengthening of international voluntary mechanisms** for monitoring and assessment of disaster risks, including relevant data and information, benefiting from the experience of the Hyogo Framework for Action Monitor.

### 3. Investing in disaster risk reduction for resilience:

- To allocate the necessary resources, including **finance and logistics, as appropriate, at all levels of administration for the development** and the implementation of disaster risk reduction strategies, policies, plans, laws and regulations in all relevant sectors.
- To **promote mechanisms for disaster risk transfer and insurance, risk-sharing and retention and financial protection**, as appropriate, for both public and private investment in order to reduce the financial impact of disasters on Governments and societies, in urban and rural areas.
- To promote the **mainstreaming of disaster risk assessment, mapping and management into rural development planning and management of**, inter alia, mountains, rivers, coastal floodplain areas and all other areas prone to droughts and flooding.
- To increase resilience of country's critical infrastructure.
- To **strengthen and broaden international efforts aimed at eradicating hunger and poverty** through disaster risk reduction.

### 4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction:

- To establish community centres for the **promotion of public awareness** and the stockpiling of necessary materials to **implement rescue and relief activities**.
- To **train the existing workforce and voluntary workers** in disaster response and strengthen technical and logistical capacities to ensure better response in emergencies.
- To promote the cooperation of diverse institutions, multiple authorities and related stakeholders at all levels, including affected communities and business, in view of the complex and costly nature of post-disaster reconstruction, under the coordination of national authorities.
- To develop guidance for preparedness for disaster reconstruction.
- To **establish a mechanism of case registry and a database of mortality** caused by disaster in order to improve the prevention of morbidity and mortality.
- To enhance recovery schemes to provide psychosocial support and mental health services for all people in need.
- To enhance international mechanisms, such as the **International Recovery Platform**, for the sharing of experience and learning among countries and all relevant stakeholders.

## Expected Role of Stakeholders

- Women and their participation is critical for effectively managing disaster risk and designing, resourcing and implementing gender-sensitive disaster risk reduction policies, plans and programmes.
- **Children and youth are agents of change** and should be given the space and modalities to contribute to disaster risk reduction.
- Older persons have years of knowledge, skills and wisdom, which are invaluable assets to reduce disaster risk, and they should be included in the design of policies, plans and mechanisms, including for early warning.
- **Indigenous peoples**, through their experience and traditional knowledge, **provide an important contribution to the development and implementation of plans and mechanisms, including for early warning.**
- **Academia, scientific and research entities and networks** need to focus on the disaster risk factors and scenarios.
- Business, professional associations and private sector financial institutions as well as philanthropic foundations need to integrate disaster risk management into business models and practices through disaster- risk-informed investments.
- Media need to take an active and inclusive role at the **local, national, regional and global levels in contributing to the raising of public awareness** and understanding and disseminate accurate and non-sensitive disaster risk, hazard and disaster information, including on small-scale disasters.

## Expected Role of International Organizations

- The **United Nations and other international and regional organizations**, engaged in disaster risk reduction are expected to enhance the coordination of their strategies in this regard.
- The entities of the United Nations system through the **UN Plan of Action on Disaster Risk Reduction for Resilience, UN Development Assistance Frameworks and country programmes** need to promote the optimum use of resources and to support developing countries, at their request, in the implementation of the present Framework.
- The **United Nations Office for Disaster Risk Reduction** is expected to support the implementation, follow-up and review of the present Framework.
- **International financial institutions, such as the World Bank and regional development banks** are expected to consider the priorities of the present Framework for providing financial support and loans for integrated disaster risk reduction to developing countries.
- The **United Nations Global Compact**, as the main United Nations initiative for engagement with the private sector and business, needs to further engage with and promote the critical importance of disaster risk reduction for sustainable development and resilience.
- The **Inter-Parliamentary Union and other relevant regional bodies** and mechanisms for parliamentarians, as appropriate, to continue supporting and advocating disaster risk reduction and the strengthening of national legal frameworks.
- The United Cities and Local Government organization and other relevant bodies of local governments to continue supporting cooperation and mutual learning among local governments for disaster risk reduction and the implementation of the present Framework.

## 2005-15 Stats

- Over the 10 year time frame, more than 700 thousand people lost their lives, over 1.4million got injured and approximately 23 million got homeless as a result of disasters.



- Overall, more than **1.5 billion people have been affected by disasters** in various ways, with women, children and people in vulnerable situations disproportionately affected.
- In addition, between **2008 and 2012, 144 million people** were displaced by disasters.
- Recurring small-scale disasters and slow-onset disasters particularly affect communities, households and small and medium-sized enterprises, constituting a high percentage of all losses.
- **All countries – especially developing countries**, where the mortality and economic losses from disasters are disproportionately higher – faced increasing levels of possible hidden costs and challenges in order to meet financial and other obligations.
- Evidence indicates that exposure of persons and assets in all countries has increased faster than vulnerability has decreased, thus generating new risks and a steady rise in disaster-related losses, with a significant economic, social, health, cultural and environmental impact in the short, medium and long term, especially at the local and community levels.
- Even **ten years after the adoption of the Hyogo Framework for Action, disasters continue to undermine efforts to achieve sustainable development**, though the framework has provided critical guidance in efforts to reduce disaster risk and has contributed to the progress towards the achievement of the Millennium Development Goals.

### Suggestions

- It is **urgent to anticipate, plan for and reduce disaster risk** in order to more effectively protect persons, communities and countries.
- Enhanced work to reduce exposure and vulnerability, thus preventing the creation of new disaster risks, and accountability for disaster risk creation are needed at all levels.
- It is necessary to **continue strengthening good governance in disaster risk reduction strategies at the national, regional and global levels** and improving preparedness and national coordination for disaster response, rehabilitation and reconstruction
- **Disaster risk reduction practices need to be multi-hazard and multi sectoral**, inclusive and accessible in order to be efficient and effective.
- Developing countries need special attention and support to augment domestic resources and capabilities through bilateral and multilateral channels in order to ensure adequate, sustainable, and timely means of implementation in capacity-building i.e. financial and technical assistance in accordance with international commitments.
- As per the outcome document of the **United Nations Conference on Sustainable Development, held in 2012, entitled “The future we want”**, the building of resilience to disasters needs to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication and, as appropriate, to be integrated at all levels.

## CDRI

### What is Coalition for Disaster Resilient Infrastructure (CDRI) About?

- CDRI is a **global partnership of national governments, United Nations agencies and programmes, multilateral development banks and financing mechanisms**, the private sector, and academic and research institutions.
- It **aims to increase the resilience of infrastructure systems** to climate and disaster risks, thereby ensuring sustainable development.
- It was **launched in 2019**, at the **United Nations Climate Action Summit in New York**.
- It is **the Government of India's second major global initiative after the International Solar Alliance**, and it demonstrates India's leadership in climate change and disaster resilience issues.

### What is its Significance of the CDRI?

**Expert Consultations:** It would help in **delegating experts to other countries that are particularly vulnerable to disaster risk and/or require assistance with post-disaster recovery**, as well as bringing experts from member countries to India for similar purposes. It will make technical expertise available to assist countries in developing resilient infrastructure in accordance with their disaster and climate risks and resources; It will provide assistance to countries in developing appropriate risk governance arrangements and resilient infrastructure strategies.

**Enhanced Funding and Cooperation:** It will help in deploying funds globally and receiving contributions from member countries for CDRI activities. It will provide all possible assistance to member countries in upgrading their systems to ensure disaster and climate resilience of existing and future infrastructure, in accordance with the **Sustainable Development Goals (SDGs), the Paris Climate Agreement, and the Sendai Framework for Disaster Risk Reduction**.

It will **use international engagement to foster disaster-resilient infrastructure** at home and providing an opportunity for Indian scientific and technical institutions as well as infrastructure developers to interact with global experts.

### Suva Expert Dialogue

**The Suva Expert Dialogue on loss and damage**, one of the **main consultation sessions** planned at the ongoing **intersessional climate summit at Bonn**. The dialogue was organised to deliberate on issues in the mechanisms set up so far to address losses and damages caused by climate change impacts.

- The expert dialogue came about in response to a call by developing nations during last year's COP for a separate agenda item on loss and damage to tackle issues related to finance, technology transfer and capacity building while dealing with climate change impacts.
- Six informal discussions held over the two days were attended by experts from various fields, from the civil society as well as national delegation members.
- The **idea** behind the discussions was **to capture the gaps in the way loss and damages** are being assessed and compensated around the world, and options to bridge these gaps.

## Fair and just redressal mechanism for loss and damage:

- **The various aspects of risk management**—risk assessment, risk transfers, risk reduction and risk retention, held in two parallel sessions.
- Over the course of the deliberations, **participants circled around longstanding issues and gaps in the loss and damage addressal systems** that have been put in place within the UNFCCC framework.
- Several participants **raised the issue of communication gaps and support not reaching** those who require it the most. Further, **technological gaps** regarding downscaling were also raised in the context of risk assessment and reduction.
- Over the discussions, it became clear that differential vulnerability, highly variable impacts and novel conditions of current climate-related risks had put a spoke in the wheel when it came to pursuing fair and just redressal mechanisms for losses and damages.

## Quantitative probabilistic risk assessment approach:

- One current approach elaborated in detail during the Dialogue is a **case from the Philippines, the quantitative probabilistic risk assessment approach**.
- It is **based on a multi-hazard risk analysis** using **dynamic risk modelling**, and is applicable to all sectors and Government levels.
- This **approach aims to calculate the risk levels of local government units** as a basis for risk reduction measures and efforts to address residual risks.
- **It requires the following data:** a. Exposure (to hazard) for all local government units, comprising geo-tagged disaggregated socioeconomic information, including infrastructure, information on population and ecosystems; b. Frequency of (hazardous) events; c. Sectoral impacts and corollary information.
- **Current mechanisms and financial instruments for managing climate risks inadequate:** To bring focus on management options for risks posed by extreme weather events and slow onset events, respectively. Active engagement ensued in laying out how current mechanisms and financial instruments set up under the aegis of the UNFCCC were inadequate to deal with the mounting pressure of climate change on vulnerable populations.
- Interestingly, **the aspect of “risk creation” due to human activity was also introduced in the discussions**. However, how this shall be handled in terms of redressal is anybody’s guess. The mandate of the dialogue was clear: “to explore a wide range of information, inputs and views on ways for facilitating the mobilization and securing of expertise, and enhancement of support, including finance, technology and capacity building for averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events.”
- **Finance even emerged the single biggest concern among participants** in a snap poll conducted by the facilitators at the beginning of the meet. But while **lack of access to financial mechanisms of addressing loss and damage as well as lack of technical and institutional capacities were brought up repeatedly** during the course of discussions and from various different perspectives, **the options to effectively tackle the same were few and far between**

## Gaps in current loss and damage mechanisms:

- Another gaping hole in the **loss and damage mechanisms** currently in place is slow onset events.
- We have known for decades how **climate change is causing major alterations in ecosystems**, contributing to anomalously high sea level rise and land degradation by ways of desertification across large parts of the world.
- Still, there has been **no effort till date to address displacements and food and water insecurity** felt across the globe.
- That slow onset events had stumped the international community was clear in the final session of the two-day dialogue.
- Given the predictable but unavoidable nature of slow onset events, insurance is scarcely an option to address them, but currently, there seems to be no alternative that could be relied upon but the institution of new mechanisms, specifically to address just these kinds of events that build up over years and decades.
- As expected, **issues of finance dominated discussions**. However, overreliance on financial options overshadowed two other aspects of the mandate for the expert dialogue—those of technology and capacity building.
- While the successes and failures of insurance dominated discussions, there was rarely a mention of how technology and capacity could be built in vulnerable countries to reduce the cost of climate-related disasters by means of improved assessment and reduction of risks.
- The need and ways to streamline adaptation efforts for the same was another big miss over the two days. Discussions on these issues have been going on for more than a decade now, but there has been little progression on the ground.

**The expert dialogue was undoubtedly an important step in the review process of the Warsaw International Mechanism.** It missed opportunity to present fresh ideas and look beyond just direct financial options to deal with the mounting impacts of climate change.



## 6. Role of community in Disaster Management

*"Each of us as human beings has a responsibility to reach out to help our brothers and sisters affected by disasters. One day it may be us or our loved ones needing someone to reach out and help."*

**Michael W. Hawkins, American Red Cross**

Disaster management can be effective only if the communities participate in it. As a community is the repository of knowledge and skills which have evolved traditionally, these needs to be integrated in the management strategy. **Community is the first line of responders, thus, it is necessary to educate the community and impart skills and assign specific roles regarding disaster management** to ensure a coordinated response while disaster. This can be achieved by:

- Undertaking **location specific training programmes for the community: Cascading approach** should be used **to impart training** as the number of people to be imparted skills is very large. Thus this responsibility can be entrusted at the local level, say, to the village Panchayats.
- **Disaster management education needs to be integrated** within the formal and informal systems of education.
- The leaders and personnel in critical sectors should be given disaster management training as well.
- **A proper safety plan including all pre-disaster planning** to reduce risk should be made to enhance community preparedness.
- **The entire process of damage assessment and distribution of the relief packages** can be conducted very smoothly with the active involvement of local community leaders and SHGs.

### Role of media and social media in disaster management

**The role of the media is very important.** The media can influence the Government to prioritize Disaster Risk Issues. For example, it may expose excessive and inefficient expenditure on disaster preparedness in a particular region. During the onslaught of the disaster, **Continuous and factual coverage, particularly by local media, can assist the authorities, voluntary organizations and volunteers in reaching the affected with assistance and relief.** However, the media may exaggerate some elements of the disaster and create unnecessary panic. Biased coverage for the purposes of sensationalism by choosing to capture only small incidents of horrific devastations leads to misreporting.

**Social media is different from conventional media** in that it **allows for one-to-one, one-to-many and many- to-many communications.** It enables communication to take place in real time or asynchronously over time. It is also device indifferent and can take place via a computer, tablets and smartphones which are relatively mobile and easy to carry around. It also allows participants to create or comment on social media networks.

During disasters all the conventional communications generally stop functioning at the time while social media or networking services stay active.

During the devastating **Hudhud cyclone that struck Visakhapatnam, PWD officials created a WhatsApp group that acted as the main tool of communication for sharing information.** No meetings and discussions were organised at the district level as the WhatsApp group helped identify and access required resources.

**Online social networking services and social media like Facebook, Twitter, Google+, Etc. try to solve many problems during natural disasters by establishing link with closed ones.** Concerns such as the threat of technology failure, hackers, stalkers, viruses will have to be addressed in the development of emergency online networks. Also, the spread of rumours can be quick leading to spread of panic.



Therefore, social media cannot and should not supersede current approaches to disaster management communication or replace existing infrastructure, but if managed strategically, they can be used to bolster current systems.

## PRI's and Disaster Management

**Panchayati Raj Institutions in India:** The system of **2,60,512 Panchayati Raj Institutions** present across the country, **acts as the backbone of Indian democracy**. It is a **local self-governance system** which represents about 31 lakh members across India.

**PRIs' Response to Covid-19:** Amid the peak months of the pandemic, the PRIs played a remarkable role by providing essential leadership at the local level.

- **Performed Regulatory and Welfare Functions:** PRIs set up containment zones, arranged transport, identified buildings for quarantining people and provisioned food for the incoming migrants.
- Effective implementation of welfare schemes like **MGNREGA and the National Rural Livelihood Mission** quickened the pace of recovery while ensuring support to the vulnerable population.
- **Made Effective Collaborations:** During the pandemic, gram sabhas resolved to adhere to Covid-19 norms.
- Also, regular engagement with frontline workers like **ASHA workers and Anganwadi workers** through committees further assisted in handling the pandemic at local levels.
- **Organised Local Monitoring Bodies:** PRIs organised community-based surveillance systems involving village elders, the youth and self-help groups (SHGs) to keep a strict vigil in quarantine centres and monitor symptoms in households.

### Significance of PRIs in Disaster Management

- **Handling Disasters at Grass-root Level:** The devolution of power and responsibilities to the Panchayats will result in flexible and committed response at the grass- root level in the case of natural calamities. Effective and Strong PRIs, working in harmony with the state government, will help tackle the disaster through early warning systems.
- **Ensuring Better Relief Operations:** Local bodies being nearer to the people are in a better position to undertake relief tasks as they are more familiar to the requirements of the local people. This ensures total transparency in working and usage of funds as in every disaster situation. They can also be relied upon for undertaking day to day running of civic services, providing shelter and medical assistance to affected people etc.
- **Spreading Awareness and Gaining Cooperation:** Local government institutions have grass root level contact with people and they can help effectively in spreading awareness and ensure people's participation in fighting the crisis. They are also ideal channels for NGOs and other agency's participation in the rescue and relief operations.

### Issues Faced by PRIs

- **Interference from MPs and MLAs:** The interference of area MPs and MLAs in the functioning of panchayats adversely affects the performance of Panchayats.
- **Unavailability of Funds:** The Panchayats are not given enough funds and are bypassed by State-controlled line departments that continue to implement programmes falling within the rightful domain of the former.
- **Incomplete Autonomy:** Panchayats lack systems, resources and capacities to act independently due to numerous constraints imposed by district administrations and state governments.
- Instead of becoming 'institutions of local self-governance', as envisaged by the constitution,

panchayats mostly act as field implementers of decisions made by state and central governments.

- **Unclear Domains of Panchayats:** Though PRIs are a three tier integrated arrangement of the village, block and district level, they have remained largely ineffective as a consequence of ambiguous jurisdictions and unclear linkages.
- Even in respect of National Disaster Management Act 2005, the powers and responsibilities of panchayats are inadequately defined and left to be determined by respective state governments.

### Way Forward

- **Legal Backing for Disaster Management Programmes:** It is crucial to include disaster management chapters in Panchayat Raj Acts and making disaster planning and spending a part of Panchayati Raj development plans and local-level committees. This will ensure citizen-centric mapping and planning of resources.
- **Resource Availability and Self-Reliance:** Local governance, local leaders and local communities, when empowered, respond to any disaster rapidly and effectively. The local bodies require information and guidance and must have resources, capacities and systems in place to act with confidence, without waiting for instructions from above.
- **Shift in Disaster Management Paradigm:** There is an urgent need for a shift from a risk mitigation cum relief-centric approach in disaster management into an integrated plan for economic development with social justice.
- Early warning systems, preparedness, preventive measures and awareness among people are as much an important part of disaster management as is recovery planning, rehabilitation and other relief measures.
- **Collective Participation:** Conducting regular, location-specific disaster-management programmes for the community and organising platforms for sharing best practices will strengthen individual and institutional capacities.
- Assigning roles to individual members and providing them with the necessary skills can make such programmes more meaningful.
- **Financial Contributions from People:** Financial contributions from the community should be encouraged through the establishment of community disaster funds in all gram panchayats.
- It is imperative to make disaster resilience an inherent part of the community culture now more than ever.



## 7. Previous Year Questions

Q.1) Discuss about the vulnerability of India to earthquake related hazards. Give examples including the salient features of major disasters caused by earthquakes in different parts of India during the last three decades. **(UPSC 2021)**

Q.2) Describe the various causes and the effects of landslides. Mention the important components of the National Landslide Risk Management Strategy. **(UPSC 2021)**

Q.3) Discuss the recent measures initiated in disaster management by the Government of India departing from the earlier reactive approach. **(UPSC 2020)**

Q.4) Disaster preparedness is the first step in any disaster management process. Explain how hazard zonation mapping will help in disaster mitigation in the case of landslides. **(UPSC 2019)**

Q.5) Vulnerability is an essential element for defining disaster impacts and its threat to people. How and in what ways can vulnerability to disasters be characterized? Discuss different types of vulnerability with reference to disasters. **(UPSC 2019)**

Q.6) Describe various measures taken in India for Disaster Risk Reduction (DRR) before and after signing 'Sendai Framework for DRR (2015-2030)'. How is this framework different from 'Hyogo Framework for Action, 2005'? **(UPSC 2018)**

Q.7) On December 2004, tsunami brought havoc on 14 countries including India. Discuss the factors responsible for occurrence of Tsunami and its effects on life and economy. In the light of guidelines of NDMA (2010) describe the mechanisms for preparedness to reduce the risk during such events. **(UPSC 2017)**

Q.8) The frequency of urban floods due to high intensity rainfall is increasing over the years. Discussing the reasons for urban floods, highlight the mechanisms for preparedness to reduce the risk during such events. **(UPSC 2016)**

Q.9) With reference to National Disaster Management Authority (NDMA) guidelines, discuss the measures to be adopted to mitigate the impact of the recent incidents of cloudbursts in many places of Uttarakhand. **(UPSC 2016)**

Q.10) The frequency of earthquakes appears to have increased in the Indian subcontinent. However, India's preparedness for mitigating their impact has significant gaps. Discuss various aspects. **(UPSC 2015)**

Q.11) Drought has been recognised as a disaster in view of its party expense, temporal duration, slow onset and lasting effect on various vulnerable sections. With a focus on the September 2010 guidelines from the National disaster management authority, discuss the mechanism for preparedness to deal with the El Nino and La Nina fallouts in India. **(UPSC 2014)**

Q.12) How important are vulnerability and risk assessment for pre-disaster management. As an administrator, what are key areas that you would focus in a disaster management **(UPSC 2013)**

## Miscellaneous Mains Questions

Q.1) Forest fires have become a recurring environmental issue with severe implications. Along with the causes and consequences of forest fires, discuss the measures to mitigate the effect of such natural disasters. (150 words)

Q.2) Natural disasters such as floods, cyclones, and earthquakes are becoming increasingly frequent and severe in India. In this context, discuss the challenges faced by the country in managing such disasters. (250 words)

Q.3) What is the role of vulnerability assessment in defining disaster impacts and how can it be used to identify the threat to vulnerable communities? (150 words)

Q.4) Discuss about the vulnerability of India to earthquake related hazards. Give examples including the salient features of major disasters caused by earthquakes in different parts of India during the last three decades. (150 Words)

Q.5) Describe the various causes and the effects of landslides. Mention the important components of the National Landslide Risk Management Strategy. (250 Words)

Q.6) Climate change is a threat to the future of our planet, but there is still time for us to 'adapt' to it and 'mitigate' its effects. Bring out the differences between the two strategies for Climate Change solution. (250 words)

Q.7) India has traditionally followed a reactive approach of disaster management. Do you think there is a need to shift our focus from the way we perceive disaster management at present? (250 words)

Q.8) 'India, as a whole, must integrate disaster preparedness into its core system, starting from the ground-level.' In light of the statement, discuss the role of Panchayati Raj institution (PRI) in effective Disaster management. (250 Words)

Q.9) The novel coronavirus outbreak has become a worldwide disaster. How far is it correct to say such frequent viral outbreaks are man-made disasters? (250 words)

Q.10) Heat waves are among the most dangerous of natural hazards, the frequency and intensity of which will rise in the 21st century due to climate change. Discuss. (250 Words).

Q.11) What do you understand about disaster-resilient infrastructure? Highlight the role that can be played by the Coalition for Disaster Resilient Infrastructure (CDRI) in this regard. (250 words)

Q.12) Himalaya may be entering a phase of irreversible decline because of losses to its ecology. Discuss in the light of frequent disasters in the region. (250 Words)

Q.13) Disasters are not an 'act of God' alone, but are also determined by human interventions. Comment. (250 Words)

Q.14) India being a responsible regional power, should invest in regional frameworks for disaster management. Discuss the statement in light of the increasing vulnerability of the South Asia region. (250 words)



Q.15) India's aspirations to industrialise should be founded on safety. Comment. (250 words)

Q.16) Discuss whether the frequent viral outbreaks can be termed as man-made disasters. (250 words)

Q.17) Response to disasters must be proactive not reactive. Discuss. (250 words)

