



# Disaster Management

**MPSC Mains**

General Studies III  
Class Notes





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**MPSC MAINS**

**Disaster Management**

**GENERAL STUDIES - III**

**(Class Notes)**

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**Year 2025-26**

# Features of Disaster Management Notes

## 1. Comprehensive Syllabus Coverage

- Complete coverage of natural and anthropogenic disasters as per MPSC GS syllabus
- Includes disaster management cycle, governance, legal, financial, and international frameworks

## 2. Conceptual Clarity with Exam-Ready Definitions

- Clear definitions of disaster, hazard, vulnerability, risk, and resilience
- Concepts explained in precise, MPSC-appropriate language for mains answers

## 3. Disaster-Wise Systematic Structure

- Uniform coverage of each disaster: causes, impacts, and mitigation
- Ensures consistent answer structure across different disaster questions

## 4. Integrated Static + Current Affairs Orientation

- Static concepts linked with recent disasters and climate-related events
- Enables direct application in GS-I, GS-III, Essay, and Disaster Management answers

## 5. Strong Indian Context & Case Studies

- Focus on India-specific vulnerability, disaster-prone regions, and zonation
- Includes high-value case studies for substantiating mains answers

## **6. Diagram, Map & Flowchart Friendly**

- Supports use of maps, zonation diagrams, and disaster management cycle charts
- Enhances presentation and score in descriptive answers

## **7. Governance, Legal & Institutional Coverage**

- Detailed coverage of DM Act 2005, NDMA, SDMA, DDMA, NDRF, and NIDM
- Includes institutional challenges and governance gaps for analysis

## **8. PYQ-Oriented Content Design**

- Previous Year Questions mapped with themes and core demands
- Helps align preparation with MPSC question trends

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## Navigating the Syllabus: What You Need to Know

### Disaster and Disaster Management

#### 1. Various Forms of Disasters

- Natural
- Anthropogenic

#### 2. Disaster Management

- Disaster Management Cycle
- Role of Government & Legal Framework
- Institutional Framework
- Financial Framework
- International Frameworks & Best Practices

## UPSC Previous Year Questions

Question	Nature of Question	Core Demand
What is disaster resilience? How is it determined? Describe various elements of a resilience framework. Also mention the global targets of Sendai Framework for Disaster Risk Reduction (2015-2030). (2024)	Disaster Resilience + Sendai Framework	Define resilience, explain indicators and framework elements, and list Sendai global targets
Flooding in urban areas is an emerging climate-induced disaster. Discuss the causes of this disaster. Mention the features of two such major floods in the last two decades in India. Describe the policies and frameworks in India that aim at tackling such floods. (2024)	Urban Floods + Climate Change + Policy	Analyse urban flood causes (drainage, planning, climate), give 2 case examples, and describe Indian flood management frameworks (NDMA, AMRUT, Smart Cities)
Dam failures are always catastrophic, especially on the downstream side, resulting in a colossal loss of life and property. Analyse the various causes of dam failures. Give two examples of large dam failures. (2023)	Dam Safety + Disaster Impact	Explain structural, design, maintenance, hydrological causes; give 2 examples (e.g. Machhu, Mullaperiyar concerns)
Explain the mechanism and occurrence of cloudburst in the context of the Indian subcontinent. Discuss two recent examples. (2022)	Cloudburst + Extreme Rainfall	Explain meteorology of cloudbursts, link with Himalayas, and give 2 recent instances
Explain the causes and effects of coastal erosion in India. What are the available coastal management techniques for combating the hazard? (2022)	Coastal Erosion + Management	Analyse natural and anthropogenic causes, effects on livelihood and environment, and list management techniques (sea walls, bio-shields, ICZM)

Describe the various causes and the effects of landslides. Mention the important components of National Landslide Risk Management strategy. (2021)	Landslides + NDMA Strategy	Discuss natural and man-made causes, impacts, and outline NDMA strategy components
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. (2021)	Earthquakes + Vulnerability + Case Studies	Explain seismic risk zones, socio-economic vulnerability, and give examples of major earthquakes with features
Discuss the recent measures initiated in disaster management by the Government of India departing from the earlier reactive approach. (2020)	Disaster Policy + Proactive Approach	Highlight policy shift to preparedness, risk reduction, early warning, capacity building
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. (2019)	Vulnerability + Risk Assessment	Explain concept of vulnerability (physical, social, economic, environmental) and types with examples
Disaster preparedness is the first step in any disaster management process. Explain how hazard zonation mapping will help disaster mitigation in the case of landslides. (2019)	Hazard Zonation + Landslide Mitigation	Explain hazard zonation mapping and its role in preparedness and mitigation
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'? (2018)	DRR + Sendai vs Hyogo	List India's DRR measures and compare Sendai's focus with Hyogo
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. (2017)	Tsunami + NDMA Guidelines	Explain causes, impacts of tsunami, and preparedness mechanisms per NDMA

<p>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. (2016)</p>	<p>Urban Floods + Preparedness</p>	<p>Analyse causes of urban floods and preparedness measures (NDMA guidelines, urban planning reforms)</p>
<p>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. (2016)</p>	<p>Cloudburst + NDMA Guidelines</p>	<p>Explain NDMA recommendations for preparedness and mitigation in Himalayan states</p>
<p>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. (2015)</p>	<p>Earthquakes + Preparedness Gaps</p>	<p>Discuss preparedness issues (building codes, early warning, awareness, enforcement gaps)</p>
<p>Drought has been recognized as a disaster in view of its spatial expanse, temporal duration, slow onset and lasting effects on vulnerable sections. With a focus on the September 2010 guidelines from the National Disaster Management Authority (NDMA), discuss the mechanisms for preparedness to deal with likely El Nino and La Nina fall outs in India. (2014)</p>	<p>Drought + NDMA + El Niño/La Niña</p>	<p>Discuss nature of droughts, NDMA guidelines, and preparedness mechanisms</p>
<p>How important are vulnerability and risk assessment for pre-disaster management? As an administrator, what are key areas that you would focus on in a Disaster Management System? (2013)</p>	<p>Risk &amp; Vulnerability Assessment + Administration</p>	<p>Highlight importance of risk/vulnerability analysis and outline priority areas for disaster management system</p>

### What is meant by disaster

- A **disaster** is a sudden, disruptive event that causes **serious harm to people, property, the economy, or the environment**. It usually overwhelms the affected community's ability to cope using its own resources, requiring outside help.
- **Disasters can be classified into two main types:**
  1. **Natural disasters** – caused by natural processes (e.g., earthquakes, floods, hurricanes, droughts, volcanic eruptions).
  2. **Anthropogenic / Man-made or human-induced disasters** – caused by human actions (e.g., industrial accidents, wars, terrorism, environmental pollution, nuclear accidents).

### 1. Natural disasters

#### 1. Cyclone

- Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation.
- Cyclones are usually accompanied by violent storms and bad weather.
- The air circulates inward in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere.
- Cyclones are classified as:
  - (i) extra tropical cyclones (also called temperate cyclones)
  - (ii) tropical cyclones.
- The criteria below has been formulated by the Indian Meteorological Department (IMD), which classifies the low pressure systems in the Bay of Bengal and the Arabian Sea on the basis of capacity to damage, which is adopted by the WMO.

Type of Disturbances	Wind Speed in Km/h	Wind Speed in Knots
Low Pressure	Less than 31	Less than 17
Depression	31-49	17-27
Deep Depression	49-61	27-33
Cyclonic Storm	61-88	33-47
Severe Cyclonic Storm	88-117	47-63
Super Cyclone	More than 221	More than 120

- Cyclones are classified into five different levels on the basis of wind speed. They are further divided into the following categories according to their capacity to cause damage

Cyclone Category	Wind Speed in Km/h	Damage Capacity
01	120-150	Minimal
02	150-180	Moderate
03	180-210	Extensive
04	210-250	Extreme
05	250 and above	Catastrophic

### Cyclone Prone Area in India

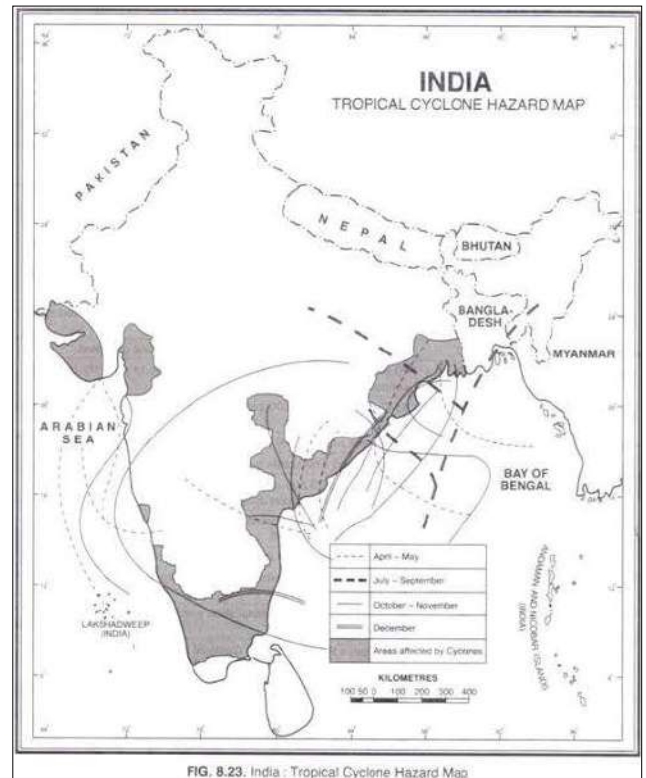


FIG. 8.23. India : Tropical Cyclone Hazard Map

### Impacts of Cyclones

Category	Impacts	Examples/Notes
<b>Environmental</b>	<ul style="list-style-type: none"> <li>• Coastal erosion, shoreline changes</li> <li>• Destruction of mangroves, wetlands, coral reefs</li> <li>• Soil &amp; water salinization</li> <li>• Loss of biodiversity &amp; forests</li> </ul>	Sundarbans mangroves damaged by <i>Cyclone Amphan (2020)</i>
<b>Economic</b>	<ul style="list-style-type: none"> <li>• Infrastructure damage (roads, bridges, ports, power lines)</li> <li>• Crop destruction, livestock deaths, soil infertility</li> <li>• Losses in fisheries &amp; coastal tourism</li> </ul>	<i>Cyclone Fani (2019)</i> caused ₹24,000 crore loss in Odisha
<b>Social</b>	<ul style="list-style-type: none"> <li>• Mass displacement, migration</li> <li>• Houses, schools, hospitals destroyed</li> <li>• Disruption of education &amp; essential services</li> <li>• Worsening poverty, livelihood insecurity</li> </ul>	Millions displaced in coastal states after major cyclones

<b>Humanitarian / Health</b>	<ul style="list-style-type: none"> <li>Deaths due to drowning, collapsed structures, electrocution</li> <li>Outbreaks of cholera, diarrhea, malaria</li> <li>Malnutrition due to food scarcity</li> </ul>	<i>Cyclone Amphan (2020)</i> displaced 4.9 million people
<b>Psychological</b>	<ul style="list-style-type: none"> <li>Trauma, anxiety, depression</li> <li>Long-term mental health issues</li> <li>Women &amp; children most vulnerable</li> </ul>	Often under-reported but severe
<b>Political / Governance</b>	<ul style="list-style-type: none"> <li>Strain on disaster relief &amp; response systems</li> <li>Inter-state/international coordination challenges</li> <li>Diversion of funds from development to relief</li> </ul>	Seen during <i>Cyclone Tauktae (2021)</i> response

### Disaster Mitigation Strategies for Cyclones

- **Hazard Mapping & Land Use Planning**
  - Cyclone hazard maps display frequency and intensity of events.
  - Land use regulation with strict zoning laws and building code enforcement.
  - Vulnerable areas reserved for parks, grazing grounds, or flood diversion instead of settlements.
- **Structural Measures**
  - Cyclone shelters in high-risk regions for safe evacuation.
  - Embankments along rivers and sea walls along coasts to prevent flooding.
  - Construction of cyclone-resistant infrastructure.
- **Ecosystem-Based Measures**
  - Mangrove plantations act as natural shields against storm surges and winds.
  - Community, NGOs, and local authorities to collaborate on plantation drives.
- **Public Awareness & Education**
  - Education and awareness campaigns reduce casualties and livelihood losses.
  - Training at community and school levels for preparedness.

- **Early Warning Systems**

- Development of end-to-end early warning systems for quick alerts.
- Effective dissemination ensures timely community response.

- **Community Participation**

- Local communities best understand regional strengths and vulnerabilities.
- Community-led mitigation ensures cultural acceptance and sustainability.

## 2. Floods

### Brief overview

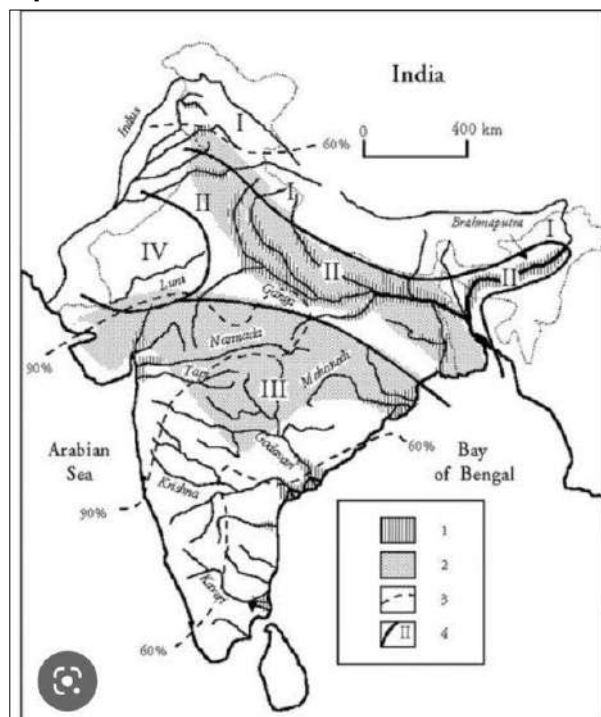
- India is highly vulnerable to floods.
- Out of the total geographical area of 329 million hectares (mha), more than 40 mha is flood prone.
- Floods are a recurrent phenomenon, which cause huge loss of lives and damage to livelihood systems, property, infrastructure and public utilities.
- It is a cause for concern that flood related damages show an increasing trend.
- The average annual flood damage in the last 10 years period from 1996 to 2005 was Rs. 4745 crore as compared to Rs. 1805 crore, the corresponding average for the previous 53 years.
- This can be attributed to many reasons including a steep increase in population, rapid urbanization, growing developmental and economic activities in flood plains coupled with global warming.
- An average every year, 75 lakh hectares of land is affected, 1600 lives are lost and the damage caused to crops, houses and public utilities is Rs.1805 crores due to floods. The maximum number of lives (11,316) was lost in the year 1977. The frequency of major floods is more than once in five years.

### Impacts of Floods in India

Category	Impacts	Examples
<b>Environmental</b>	<ul style="list-style-type: none"> <li>● Soil erosion and loss of fertile topsoil</li> <li>● Waterlogging and decline in agricultural productivity</li> <li>● Degradation of wetlands, forests, and habitats</li> <li>● Pollution spread into rivers and ecosystems</li> </ul>	Bihar & Assam floods lead to waterlogging and soil degradation

<p><b>Economic</b></p>	<ul style="list-style-type: none"> <li>• Destruction of roads, bridges, railways, power lines</li> <li>• Crop damage, livestock deaths, fisheries loss</li> <li>• Disruption of trade, transport, supply chains</li> <li>• Huge expenditure on relief and rehabilitation</li> </ul>	<p>2018 Kerala floods caused ₹31,000+ crore losses</p>
<p><b>Social</b></p>	<ul style="list-style-type: none"> <li>• Large-scale displacement and migration</li> <li>• Destruction of houses, schools, hospitals</li> <li>• Disruption of education, healthcare, essential services</li> <li>• Rising poverty and livelihood insecurity</li> </ul>	<p>Assam floods annually displace lakhs of people</p>
<p><b>Humanitarian / Health</b></p>	<ul style="list-style-type: none"> <li>• Deaths due to drowning, collapsing houses, electrocution</li> <li>• Waterborne &amp; vector-borne diseases (cholera, diarrhea, malaria, dengue)</li> <li>• Malnutrition from food scarcity</li> <li>• Long-term health challenges</li> </ul>	<p>Post-flood outbreaks common in Bihar, Uttar Pradesh</p>
<p><b>Psychological</b></p>	<ul style="list-style-type: none"> <li>• Trauma, anxiety, depression</li> <li>• Long-term psychological stress</li> <li>• Children and women most affected</li> </ul>	<p>Often under-reported in flood-hit regions</p>
<p><b>Political / Governance</b></p>	<ul style="list-style-type: none"> <li>• Pressure on disaster management &amp; relief mechanisms</li> <li>• Strain on local/state administrations</li> <li>• Diversion of development funds to relief &amp; rehab</li> </ul>	<p>Recurring problem during annual monsoon floods</p>

### Flood prone area of India



### Disaster Mitigation Strategy for Flood

- Need hazard Zonation mapping for flood management
- Effective flood warning systems can help take timely action during natural calamities and can save lives. Pre-planning can significantly reduce the effects of floods, giving people time to migrate to safer locations and stock up essentials.
- Building flood-resilient housing systems in flood prone area concreting floors can be very useful during floods. Houses should be waterproofed and electric sockets should be placed at higher levels up the walls to reduce the chances of shocks.
- Buildings should be constructed a metre above from the ground to prevent flood damage and evacuation during floods.
- creating more and more wetlands can help soak up excessive moisture since wetlands act as sponges. Wooded areas can also slow down heavy water flow, minimizing the effects of floods. Reforesting upstream regions can significantly reduce the effects of flood damage.
- Improve soil conditions: improper soil management, animal hooves, and machinery can make soil compacted. As a result, instead of holding water in and absorbing moisture, the water runs off immediately. Properly drained soil can absorb large amounts of rainwater and can prevent it from flowing into the rivers.
- Installing flood barriers: these are flood gates designed to prevent the area behind the barrier from flooding. They can also be kept around buildings to keep flood waters outside the boundary created.

- Development of GIS– Geographical Information System (GIS) based National Database for disaster management. GIS is an effective tool for emergency responders to access information in terms of crucial parameters for disaster-affected areas.
- Creation of 2nd flood commission– (Rashtriya Barh Ayog, created in 1976) to study the flood situation in India under rising challenges of climate change and propose a national-level flood resilience and management plan.

### Urban Flash Flood Disaster in India

#### Definition

- **Urban Flooding:** Overflow of water in urban areas due to intense rainfall, poor drainage, and unplanned urbanization.
- **Flash Floods:** Sudden, short-duration floods caused by heavy rainfall or rapid water flow.
- **Urban Flash Flood** = Combination of both → high-intensity rainfall + concrete surfaces + inadequate drainage → sudden flooding in cities.

#### Causes of Urban Flash Floods

- **Natural Factors**
  - **High-intensity rainfall** (monsoon bursts, cyclones, cloudbursts).
  - **Climate change** → more extreme rainfall events.
  - **Topography** (cities on floodplains, low-lying areas).
- **Anthropogenic Factors**
  - Unplanned urbanization : concretization reduces groundwater recharge.
  - Encroachment of wetlands, lakes, and drains.
  - Poor drainage & sewage clogging.
  - Destruction of natural flood buffers (mangroves in Mumbai, floodplains in Delhi).
  - Solid waste mismanagement : choking of drains.
  - Urban heat island effect intensifying localized convectional rainfall.

#### Recent Examples

- **Mumbai (2005, 2017, 2019, 2021, 2023)** – heavy rainfall, Mithi river overflow.
- **Chennai (2015, 2023)** – blocked stormwater drains, encroached wetlands.
- **Hyderabad (2020)** – extreme rainfall, unregulated urban growth.
- **Bengaluru (2022)** – IT corridor submerged due to lake encroachments.
- **Delhi & Gurugram (2023–24)** – Yamuna floods, waterlogging due to poor drainage.

#### Impacts

- **Humanitarian:** loss of lives, displacement, health hazards (dengue, cholera).

- **Economic:** damage to property, transport, business, supply chains.
- **Infrastructure:** collapse of roads, bridges, power, communication.
- **Environment:** contamination of water bodies, loss of biodiversity.
- **Governance:** exposes weak disaster preparedness and urban planning.

#### Institutional Framework

- **NDMA Guidelines on Urban Flooding (2010)** : first recognition of urban flooding as distinct from rural floods.
- **AMRUT, Smart Cities Mission** : urban drainage, stormwater management.
- **Atal Bhujal Yojana** : groundwater recharge.
- **National Flood Management Programmes.**
- **State Disaster Management Authorities (SDMAs).**

#### Mitigation & Solutions

##### Structural Measures

- Stormwater drains, desilting, rainwater harvesting.
- Flood-resilient infrastructure (embankments, retention ponds).
- Restoration of wetlands, lakes, mangroves.
- Sponge cities model (China) – absorb & reuse rainwater.

##### Non-Structural Measures

- Strict enforcement of land-use & building codes.
- Flood forecasting & early warning systems.
- Community awareness & participation.
- Integrated Urban Flood Management – coordination among agencies
- Use of **GIS & Remote Sensing** for risk mapping.

##### Way Forward

- Climate-resilient urban planning.
- Nature-based solutions (wetlands, green roofs, permeable pavements).
- Convergence of urban missions (AMRUT + Smart Cities + Jal Jeevan).
- People-centric disaster governance → community-based disaster management.
- Learning from global best practices (e.g., Netherlands flood management, Japan drainage tunnels).

### 3.Landslide

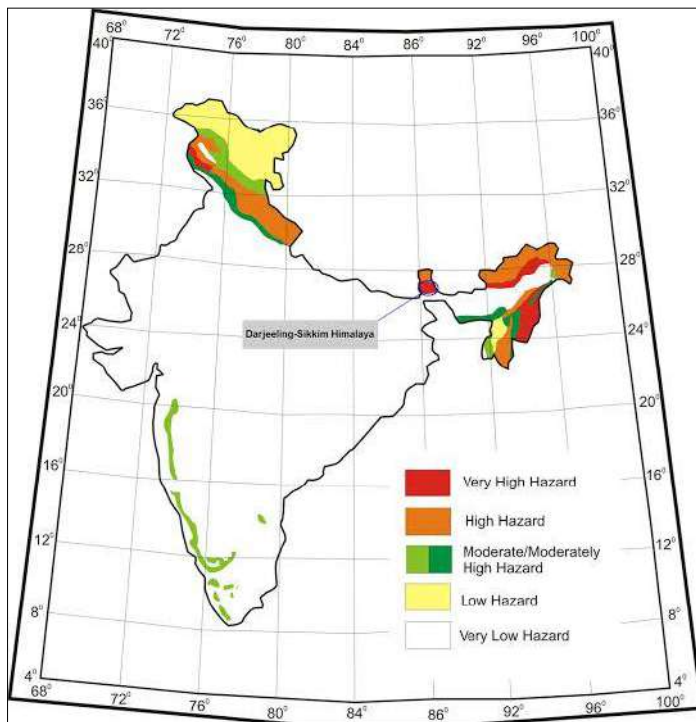
#### Brief Overview

- Landslides are a downward and outward movement of slope materials like rock debris and earth, under the influence of gravity. when the shear stress exceeds the shear strength of the material, the down-

slope movement of the mass of rocks & debris initiates.

- Landslide cause huge losses of life and property
- The force flow of mud, debris, and rocks because of a landslide can cause serious damage to property. Infrastructure like roads, railways, leisure destinations, buildings and communication systems are often decimated by a single landslide.
- The material sliding downhill can intrude into rivers and block their natural flow. River lifelike fish can die because of the interference of natural flow of water. Communities counting on the river water for household activities and irrigation will suffer if the flow of water is blocked.
- The erosion left behind by landslides leaves behind rugged landscapes that are unsightly. The pile of material that comes downhill can cover land utilized by the community for agricultural or social purposes.

**Landslide prone area in india**



**Impacts of Landslides in India**

Category	Impacts	Examples
<b>Environmental</b>	<ul style="list-style-type: none"> <li>• Loss of forest cover and biodiversity</li> <li>• Siltation of rivers, streams, and reservoirs</li> <li>• Alteration of natural drainage systems</li> <li>• Land degradation and loss of soil fertility</li> </ul>	Frequent landslides in Western Ghats, Himalayan regions

<b>Economic</b>	<ul style="list-style-type: none"> <li>• Destruction of roads, bridges, railways, and power lines</li> <li>• Blockage of highways and disruption of trade/transport</li> <li>• Loss of agricultural land and productivity</li> <li>• Increased expenditure on rehabilitation and reconstruction</li> </ul>	2013 Uttarakhand floods + landslides disrupted Char Dham route
<b>Social</b>	<ul style="list-style-type: none"> <li>• Displacement of communities in hilly/tribal areas</li> <li>• Damage to houses, schools, health centers</li> <li>• Loss of cultural heritage sites and pilgrim routes</li> </ul>	Darjeeling, Himachal Pradesh, and NE India frequently affected
<b>Humanitarian / Health</b>	<ul style="list-style-type: none"> <li>• High casualties due to sudden collapse of slopes</li> <li>• Injuries and long-term disability for survivors</li> <li>• Risk of epidemics due to blocked sanitation and contaminated water</li> </ul>	Malin village landslide (Maharashtra, 2014) killed over 150 people
<b>Psychological</b>	<ul style="list-style-type: none"> <li>• Trauma, stress, and insecurity among affected populations</li> <li>• Fear of recurring landslides leading to migration</li> </ul>	Common in disaster-prone Himalayan villages
<b>Political / Governance</b>	<ul style="list-style-type: none"> <li>• Burden on disaster management agencies</li> <li>• Interruption of development projects like roads, hydroelectric dams</li> <li>• Pressure on state budgets for relief and rehabilitation</li> </ul>	Himachal Pradesh & Uttarakhand govt. face recurring costs

**Disaster Mitigation strategy for Landslide**

- Implementation of hazard zone mapping and flood plain zoning must be done on a war footing.

- The legal framework needs to be developed to avoid construction on unstable slopes without vulnerability studies.
- Hydropower projects must be balanced with critical local environmental needs.
- The developmental projects must be carried only after a proper Environmental Impact Assessment.
- Landslide risk microzonation using ground truth of landscape, geology, ecology, vegetation, soil characteristics, human settlements, landslide and flood history of the site is a must.
- Blasting for developmental activities must be regulated as frequent blasting may destabilize the weak surface.
- Unsustainable mining of the riverbeds and illegal mining must be stopped immediately
- Review of the alignments of existing roads according to scientific analysis.
- Separate evacuation routes must be constructed for major pilgrim centres.
- In fact, the entire Himalayan belt is considered prone to great earthquakes of magnitude exceeding 8.0; and in a relatively short span of about 50 years, four such earthquakes have occurred: 1897 Shillong (M8.7); 1905 Kangra (M8.0); 1934 Bihar-Nepal (M8.3); and 1950 Assam-Tibet (M8.6).
- Scientific publications have warned of the likelihood of the occurrence of very severe earthquakes in the Himalayan region, which could adversely affect the lives of several million people in India.
- At one time regions of the country away from the Himalayas and other inter-plate boundaries were considered to be relatively safe from damaging earthquakes.
- However, in the recent past, even these areas have experienced devastating earthquakes, albeit of lower magnitude than the Himalayan earthquakes.
- The Koyna earthquake in 1967 led to revision of the seismic zoning map, resulting in deletion of the non-seismic zone from the map.
- The areas surrounding Koyna were also re-designated to Seismic Zone IV, indicating high hazard. The occurrence of the Killari earthquake in 1993 resulted in further revision of the seismic zoning map in which the low hazard zone or Seismic Zone I was merged with Seismic Zone II, and some parts of Deccan and Peninsular India were brought under Seismic Zone III consisting of areas designated as moderate hazard zone areas.
- Recent research suggests that as understanding of the seismic hazard of these regions increases, more areas assigned as low hazard may be re-designated to higher level of seismic hazard, or vice-versa.
- The North-Eastern part of the country continues to experience moderate to large earthquakes at frequent intervals including the two great earthquakes mentioned above.
- On an average, the region experiences an earthquake with a magnitude greater than 6.0 every year.
- The Andaman and Nicobar Islands are also situated on an inter-plate boundary and frequently experience damaging earthquakes.
- The increase in earthquake risk is due to a spurt in developmental activities driven by urbanization, economic development and the globalization of India's economy.
- The increase in use of high-technology equipment and tools in manufacturing and service industries has also made them susceptible to disruption due to relatively moderate ground shaking.
- As a result, loss of human life is not the only determinant of earthquake risk any more.
- Severe economic losses leading to the collapse of the local or regional economy after an earthquake may

## 4. Earthquake

### Brief Overview

- An earthquake is a phenomenon that occurs without warning and involves violent shaking of the ground and everything over it.
- It results from the release of accumulated stress of the moving lithospheric or crustal plates.
- The earth's crust is divided into seven major plates, that are about 50 miles thick, which move slowly and continuously over the earth's interior and several minor plates.
- Earthquakes are tectonic in origin; that is the moving plates are responsible for the occurrence of violent shakes.
- The occurrence of an earthquake in a populated area may cause numerous casualties and injuries as well as extensive damage to property.

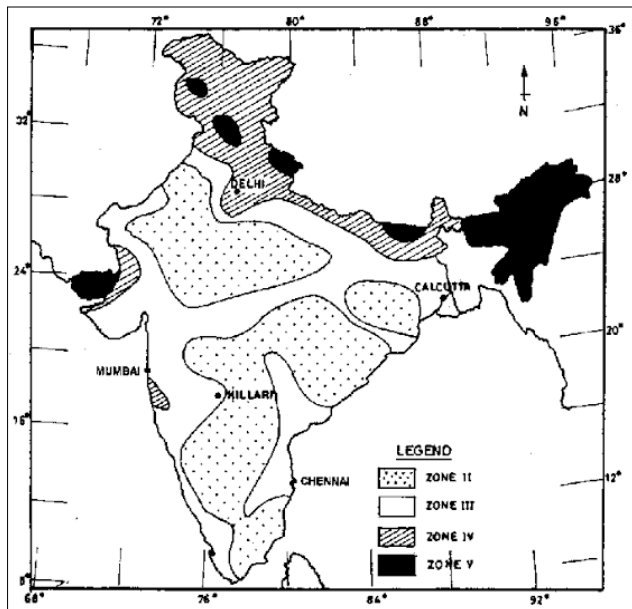
### The Earthquake Risk in India

- India's increasing population and extensive unscientific constructions mushrooming all over, including multistoried luxury apartments, huge factory buildings, gigantic malls, supermarkets as well as warehouses and masonry buildings keep - India at high risk.
- During the last 15 years, the country has experienced 10 major earthquakes that have resulted in over 20,000 deaths.
- As per the current seismic zone map of the country (IS 1893: 2002), over 59 per cent of India's land area is under threat of moderate to severe seismic hazard; that means it is prone to shaking of MSK Intensity VII and above (BMTPC, 2006).

have long-term adverse consequences for the entire country.

- This effect would be further magnified if an earthquake affects a mega-city, such as Delhi or Mumbai.

### Seismic zones of India



### Disaster Mitigation strategy for Earthquakes

- Establishing earthquake monitoring centres (seismological centres) for regular monitoring and fast dissemination of information among the people
- Preparing a vulnerability map of the country and dissemination of vulnerability risk information among the people and educating them about the ways and means minimising 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.
- Finally, making it mandatory to adopt earthquake-resistant designs and use light materials in major construction activities in the vulnerable areas.

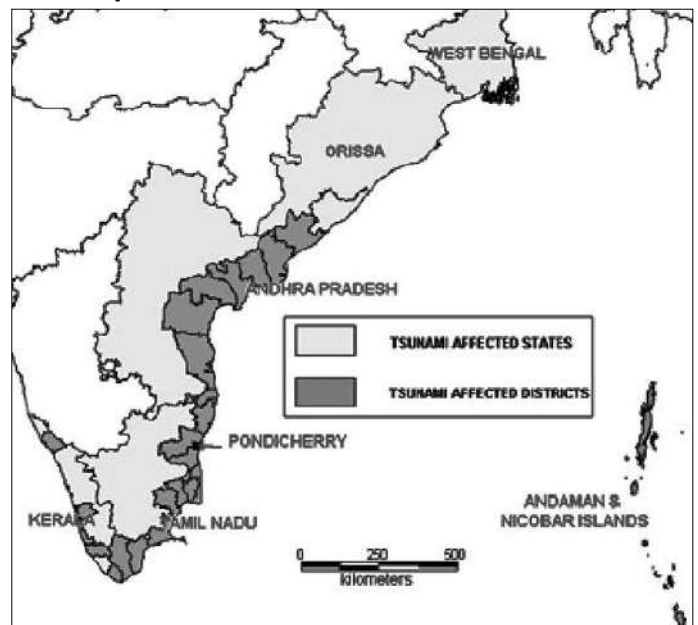
## 5. Tsunami

### Brief Overview

- The seismic waves traveling through the ocean and seawater results in high sea waves which are known as tsunami.
- Tsunami' is a Japanese term represented by two characters: "tsu" and "nami". The character "tsu" means harbor, while the character "nami" means wave. which has been universally adopted to describe a large seismically generated sea wave.
- These waves are responsible for causing considerable destruction in certain coastal areas where submarine earthquakes occur.

- It is a series of waves of extremely long wavelengths and long periods generated in a body of water by an impulsive disturbance that displaces water.

### Tsunami prone area of India



### Disaster mitigation strategies for Tsunami

- Land-use planning in coastal areas should include restricted development and sustainable development strategies.
- Protection of coastal ecosystems like mangroves and coral reefs may help in lowering tsunami-related hazards.
- Moving important community assets and vulnerable populations out of tsunami hazard zones.
- Educating the public (residents and visitors) about tsunamis and tsunami safety before a tsunami strikes.
- A hazard assessment includes using computer models and information from past tsunamis to identify and map the areas likely to be flooded during a tsunami could help for better mitigation strategies.
- Setting up tsunami prediction and warning systems.
- Evacuation strategies should include the construction of tsunami evacuation structures and improvement in evacuation routes.

## 6. Cloudburst

### Brief overview

- As per IMD If rainfall of about 10 cm or above per hour is recorded over a place that is roughly 10 km<sup>2</sup> in area, it is classified as a cloudburst event.
- Cloudburst is an extreme amount of precipitation, sometimes with hail and thunder, which normally lasts no longer than a few minutes but is capable of creating flood conditions.

- Cloudbursts do happen in plains as well, but there is a greater probability of them occurring in mountainous zones – it has to do with the terrain.
- Cloudbursts happen when saturated clouds are unable to produce rain because of the upward movement of very warm current of air.
- Raindrops, instead of dropping down, are carried upwards by the air current. New drops are formed and existing raindrops gain in size.
- After a point, the raindrops become too heavy for the cloud to hold on to, and they drop down together in a quick flash.
- Cloudburst may cause Flash floods, Landslides and Mudflows due to these houses and establishments getting swept away and also harms largely to infrastructure.

### Recent Cloudburst Events in India

Place & Date	Impacts / Casualties
<b>Kishtwar, J&amp;K – Aug 2025</b>	Flash floods along Machail Mata Yatra route; camps, homes, bridges destroyed; ~60–68 dead, ~300 injured, many missing.
<b>Uttarkashi, Uttarakhand – Aug 2025</b>	Cloudburst at Dharali village; houses, shops, hotels damaged; Gangotri Dham route disrupted; 5 dead, 50+ missing.
<b>Rudraprayag &amp; Chamoli, Uttarakhand – Aug 2025</b>	Multiple cloudbursts; debris flows trapped families; 4 dead, several missing.

### Disaster Mitigation Strategies for Cloudbursts

- **Scientific Classification & Zoning**
  - Identify and map regions vulnerable to cloudbursts.
  - Classify risk zones scientifically for better planning and preparedness.
- **Early Warning & Forecasting Mechanisms**
  - Install Doppler radars and advanced weather forecasting systems.
  - Strengthen real-time monitoring and dissemination of alerts to communities.
- **Land Use & Settlement Planning**
  - Reduce habitation in low-lying and high-risk areas.
  - Promote sustainable settlement planning in cloudburst-prone regions.
  - Enforce building codes suitable for hilly and fragile terrains.
- **Sustainable Development Practices**
  - Regulate construction activities in vulnerable zones.

- Encourage eco-friendly, slope-stabilizing, and water-sensitive infrastructure.
- **Climate Change Mitigation**
  - Address root causes by reducing greenhouse gas emissions.
  - Promote afforestation, watershed management, and climate-resilient practices.
  - Strengthening adaptation policies to minimize extreme weather events.

### Glacial Lake Outburst Flood (GLOF)

#### Definition

- A Glacial Lake Outburst Flood (GLOF) is a sudden release of water from a glacial lake due to the failure of its natural dam (ice or moraine).
- It results in catastrophic flooding, landslides, and debris flow in downstream areas.

#### Causes of GLOF

- **Natural Triggers**
  - Ice or rock avalanches falling into a glacial lake, which displaces water and causes overflow.
  - Earthquakes or ground tremors that destabilize the moraine dam.
  - Rapid glacial melting due to global warming and climate change.
  - Heavy rainfall or cloudbursts that increase the water level and pressure within the lake.
- **Anthropogenic Triggers**
  - Construction of hydropower projects and tunnels in fragile Himalayan zones.
  - Deforestation and slope destabilization due to road cutting and unplanned development.
  - Increased tourism and unregulated construction near glacial lakes.

#### Vulnerability in India

- The Himalayan region is the most vulnerable because it consists of young fold mountains with fragile geology.
- States like Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh face high GLOF risks.
- According to studies by ICIMOD and the Ministry of Environment, Forest and Climate Change, India has more than 300 potentially dangerous glacial lakes.

#### Recent Examples

- **Sikkim (October 2023):** The Lhonak Lake burst triggered flooding in the Teesta River, caused destruction of the Teesta III dam, and led to heavy loss of lives.
- **Chamoli, Uttarakhand (2021):** A glacier break combined with a GLOF destroyed hydropower projects and killed over 200 people.

- **Kedarnath (2013):** The bursting of Chorabari Lake along with a cloudburst led to massive devastation and thousands of deaths.

#### Impacts

- **Humanitarian Impact:** Large-scale loss of life, displacement of communities, and health crises.
- **Economic Impact:** Destruction of roads, bridges, power projects, and agricultural land.
- **Environmental Impact:** Riverbank erosion, landslides, loss of biodiversity, and sediment deposition.
- **Strategic Impact:** Disruption in border states, affecting connectivity and security.

#### Mitigation and Preparedness

- **Structural Measures**
  - Engineering interventions such as siphoning, controlled breaching, and creation of drainage channels.
  - Strengthening of moraine dams with structural support.
  - Building check dams and retention basins in downstream areas to absorb sudden water surges.
- **Non-Structural Measures**
  - Installation of early warning systems using satellite monitoring, remote sensing, and automatic sensors.
  - Mapping and zonation of GLOF-prone areas for better risk management.
  - Disaster preparedness drills and awareness programs for local communities.
  - Designing hydropower projects with climate and disaster resilience in mind, avoiding high-risk areas.

#### Government Initiatives

- The NDMA Guidelines on GLOF (2020) provide strategies for risk assessment, monitoring, and community preparedness.
- The National Mission on Sustaining the Himalayan Ecosystem (NMSHE) under NAPCC focuses on monitoring glaciers and associated risks.
- ISRO and IMD conduct satellite monitoring of glaciers and climate conditions.
- India also collaborates with ICIMOD for monitoring glacial risks in the Hindu Kush Himalaya region.

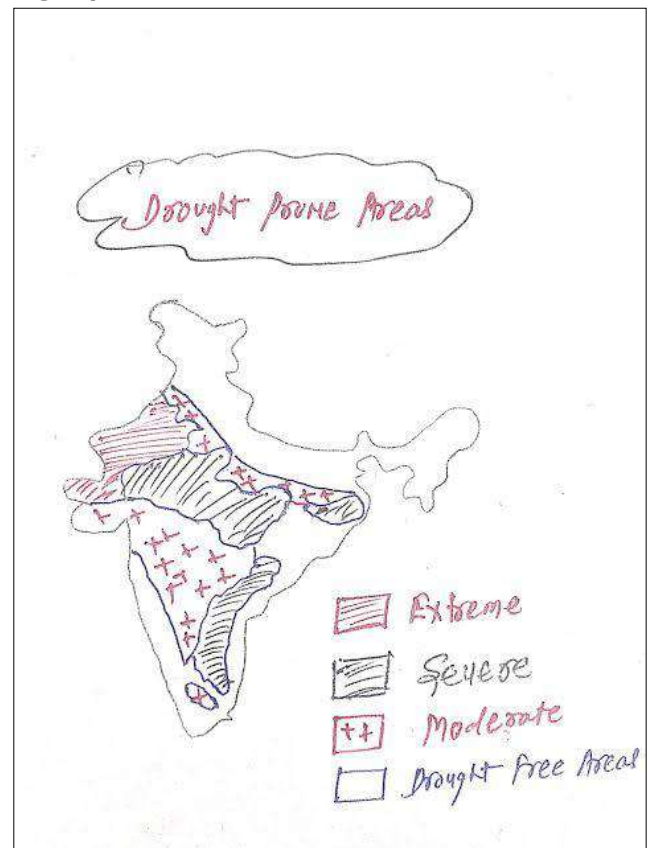
## 7. Drought

### Brief overview

- Drought is characterised by a temporary decline in the availability of water or moisture that is significantly below the average or expected level for a certain period of time.

- According to the High-Powered Committee on Disaster Management Report, drought is defined as “any shortage of water to satisfy the usual needs of agriculture, livestock, industry, or a human population,”.
- Droughts have a wide range of effects on the masses, especially in developing countries like India.
- adverse effect of drought on the recharge of soil moisture, surface runoff and groundwater table.
- Indian agriculture is largely dependent on monsoon rainfall. Approx two-thirds of the arable land is rainfed and lacks irrigation facilities. The effect results in the shortfalls of agricultural production in drought years.
- A drought can have more severe social and economic effects than it does physically or agriculturally. Drought is associated with famine which has its own social and economic consequences.

#### Drought prone area in india



#### Disaster mitigation strategies for Drought

- Development of real-time drought related information by using information and communication technology.
- Preparation of vulnerability maps for each state by the State Disaster Monitoring cells.
- The watershed development approach would be taken up for drought management.
- Development of drought resistant crop varieties through large scale research.

- The mitigation measures to be taken would include cloud-seeding and conduct of pilot studies in all categories of drought prone areas for suggesting long term mitigation measures.
- Irrigation is the most effective drought-proofing mechanism and the single biggest factor of stability in agriculture production. Construction of storage dams and early completion of projects by extending technical and financial assistance to irrigation projects are best mitigation measures for Drought.

## **2. Anthropogenic Disasters**

### **1. Nuclear and Radiological Disaster**

- The growth in the application of nuclear science and technology in the fields of power generation, medicine, industry, agriculture, research and defence has led to an increase in the risk of occurrence of Nuclear and Radiological emergencies.
- Any radiation incident resulting in or having a potential to result in exposure and/or contamination of the workers or the public in excess of the respective permissible limits can lead to a nuclear/radiological emergency.
- Dropping of nuclear weapons on Hiroshima and Nagasaki, and Chernobyl in erstwhile USSR, have strongly influenced the public perception of any nuclear emergency or disaster to be most often linked, erroneously though, to only these events.
- For improving the quality of life in society, India has embarked upon a large programme of using nuclear energy for the generation of electricity.
- Due to the inherent safety culture, the best safety practices and standards followed in applications and effective regulation by the Atomic Energy Regulatory Board, the radiation dose to which the persons working in nuclear/radiation facilities are exposed to, is well within the permissible limits and the risk of its impact on the public domain is very low.
- However, nuclear emergencies can still arise due to factors beyond the control of the operating agencies; e.g., human error, system failure, sabotage, earthquake, cyclone, flood, etc. Such failures, even though of very low probability, may lead to an on-site or off-site emergency.
- To combat this, proper emergency preparedness plans must be in place so that there is the minimum avoidable loss of life, livelihood, property and impact on the environment.

### **Mitigation strategies**

- The handling of nuclear emergencies requires coordination among different service groups of the nuclear facility. In the event of potential radiological consequences in the public domain, all the

authorities at the three levels, i.e., district, state and central, will play a vital role.

- The Nuclear Power Plant facility should have arrangements which promptly classify an emergency, mitigate the emergency, notify and recommend protective actions off the site consistent with international guidelines, protect those both on-site, and off-site.
- The operators of nuclear facilities must make an assessment of the type and quantum of the release of radioactivity under various accident conditions and the extent to which it can spread into the environment.
- Formation of rescue teams and activation of a treatment area and decontamination centre.
- Equipment and materials for handling a nuclear emergency are kept at a designated place of the nuclear facility and ERC.

### **2. Chemical Disasters**

- Chemical, being at the core of modern industrial systems, has attained a very serious concern for disaster management within government, private sector and community at large.
- Chemical disasters may be traumatic in their impacts on human beings and have resulted in the casualties and also damages nature and property.
- The elements which are at highest risk due to chemical disaster primarily include the industrial plant, its employees & workers, hazardous chemicals vehicles, the residents of nearby settlements, adjacent buildings, occupants and surrounding community.
- Chemical disasters may arise in a number of ways, such as:-
  - Process and safety systems failures
  - Human errors
  - Technical errors
  - Management errors
  - Induced effect of natural calamities
  - Accidents during transportation
  - Hazardous waste processing/ disposal.

### **Mitigation strategies**

- A knowledgeable and dedicated team of qualified professionals to evaluate the hazards and risks arising from day to day activities is essential.
- Proper maintenance, regular site safety and health inspection need to be carried out to ensure that plant facility is safe and equipments are operating in intended method
- Installation of Vapour/Gas Detection System: This with alarms will help to detect leak even at micro levels, and ensure that leaks are attended to at the early stage.

- Frequent mock drills need to be conducted so that workers become adequately knowledgeable to react to emergency.
- mutual aid group can be setup to organise the general public in case of any disaster & provide training and awareness about the potential action to be taken in case of any chemical leakage.

### 3. Biological Disaster

- Biological disasters are causative of process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic microorganisms, toxins and bioactive substances that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
- Examples of biological disasters include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestation. The recent covid19 outbreak was one of the striking biological disasters of the century.

#### Mitigation strategies

- Engineering controls – to help prevent the spread of such disasters including proper ventilation, installing negative pressure, and usage of UV lamps.
- Personal hygiene – washing hands with liquid soap, proper care for clothes that have been exposed to a probably contaminated environment.
- Personal protection equipment – masks, protective clothing, gloves, face shield, eye shield, shoe covers.
- Sterilization – Using ultra heat or high pressure to eliminate bacteria or using biocide to kill microbes.
- Respiratory protection – surgical masks, respirators, powered air-purifying respirators (PAPR), air-supplying respirators.

### 4. Fire disasters

- Bush fires, forest fires, and mine fires are generally started by lightning, but also by human negligence or arson. They can burn thousands of square kilometres.
- If a fire intensifies enough to produce its own winds and “weather”, it will form into a firestorm.
- For example, Pennsylvania started in 1962, it ruined the town and continues to burn today, The Great Chicago Fire, The Peshtigo Fire (both of 1871) and the Great Fire of London in 1666.
- Casualties resulting from fires, regardless of their source or initial cause, can be aggravated by inadequate emergency preparedness.
- Such hazards as a lack of accessible emergency exits, poorly marked escape routes, or improperly maintained fire extinguishers or sprinkler systems

may result in many more deaths and injuries than might occur with such protections.

- Recently some of Australia’s largest cities were affected by the Victoria bushfire, including Melbourne and Sydney — where fires damaged homes in the outer suburbs and thick plumes of smoke blanketed the urban centre.

#### Mitigation strategies

- There is an urgent need for bringing about updated laws and legislations to deal with the ever-changing nature of fire problems in India.
- Improved and increased cooperation among various agencies dealing with fire safety in India is the need of the hour.
- Updating fire safety equipment and regular maintenance of the devices used in putting out a fire is another need.
- Regular inspection of congested residential areas and high-risk areas must be carried out.
- Regular audits need to be carried out to check if the laws and legislations are properly implemented and rules and regulations are strictly adhered to.
- Proper and regular training of firefighters on modern lines is one such area which needs to be looked into.
- Spreading awareness among people about fire safety and mitigation strategies.

#### Case Studies of Anthropogenic Disasters

##### Chemical Disaster: Bhopal Gas Tragedy (1984)

- In Bhopal, Madhya Pradesh, a leak of methyl isocyanate gas from the Union Carbide pesticide plant caused one of the world’s worst industrial disasters. Thousands of people died within days, while lakhs suffered long-term respiratory, ocular, and neurological problems. The tragedy highlighted the dangers of hazardous industries, lack of safety mechanisms, and weak regulatory frameworks, leading to stronger environmental and industrial safety laws in India.

##### Nuclear Disaster: Chernobyl (1986)

- The explosion of Reactor No. 4 at the Chernobyl Nuclear Power Plant in Pripjat, Ukraine, released massive amounts of radioactive material. The disaster caused immediate deaths of plant workers and firefighters, and long-term health impacts such as cancers and genetic disorders across Europe. Considered the most severe nuclear accident in history, it underlined the importance of nuclear safety protocols, international monitoring, and emergency preparedness.

**Biological Disaster: COVID-19 Pandemic (2019–Present)**

- First detected in Wuhan, China, the COVID-19 pandemic spread rapidly across the globe due to the novel coronavirus SARS-CoV-2. It caused millions of deaths, overwhelmed healthcare systems, disrupted economies, and altered social behavior worldwide. The crisis emphasized the importance of public health infrastructure, rapid testing, contact tracing, vaccines, and global cooperation in biological disaster management.

**Environmental Disaster: Australian Bushfires (2019–2020)**

- Prolonged drought, record heat, and lightning strikes triggered widespread bushfires across Australia. The fires killed dozens of people, destroyed thousands of homes, and devastated wildlife populations and ecosystems. The disaster drew international attention to the links between climate change, land management, and wildfire risks, reinforcing the need for climate-resilient disaster strategies.

**Nuclear Incident: Three Mile Island (1979)**

- At Harrisburg, Pennsylvania, USA, a partial meltdown occurred at the Three Mile Island nuclear plant. Quick and coordinated actions by plant operators, emergency responders, and government agencies limited damage. The containment structure prevented significant radioactive leakage, but the event shook public confidence in nuclear energy. It led to strengthened safety regulations, operator training, and improved emergency response systems.

**Public Health Success: Bhilwara Model (2020)**

- During the early outbreak of COVID-19, Rajasthan's Bhilwara district implemented strict lockdowns, extensive door-to-door surveys, aggressive testing, and contact tracing. Health facilities were strengthened, and community engagement ensured compliance. The model effectively contained the outbreak and became an example of successful local-level pandemic management.

**Chemical Disaster: Visakhapatnam Gas Leak (2020)**

- In Visakhapatnam, Andhra Pradesh, styrene gas leaked from the LG Polymers plant, killing at least seven people and hospitalizing over a thousand. More than 3,000 residents were evacuated. Victims reported breathlessness, burning eyes, vomiting, and unconsciousness. The incident revealed gaps in industrial safety compliance and the need for better monitoring of hazardous material storage.

**Institutional Role: International Atomic Energy Agency (IAEA)**

- Established in 1957, the IAEA promotes peaceful use of nuclear energy while preventing its military application. As part of the United Nations system, it plays a critical role in ensuring nuclear safety, providing technical support, and monitoring compliance with global treaties. Awarded the Nobel Peace Prize in 2005, the IAEA remains central to international nuclear disaster prevention and management.

**Industrial Disaster: Piper Alpha Oil Rig Explosion (1988)**

- In the North Sea, a maintenance error led to the Piper Alpha oil rig explosion, killing 167 workers. The disaster was caused by human error when a pump was reactivated without a safety valve, leading to gas leakage and fire. It demonstrated the catastrophic consequences of lapses in safety management and became a landmark case in strengthening offshore safety regulations worldwide.

**Radiological Incident: Mayapuri, Delhi (2010)**

- In Delhi's Mayapuri scrapyard, workers unknowingly dismantled a research irradiator containing radioactive cobalt-60. Without radiation detectors or safety gear, several workers suffered radiation exposure, with one fatality. The incident revealed poor awareness and weak regulation of radioactive material disposal, leading to stricter norms for handling and scrapping radioactive equipment.

**Industrial Disaster: Korba Chimney Collapse (2009)**

- In Chhattisgarh, a thermal power plant chimney under construction collapsed, killing 45 workers. Rescue operations were hampered by torrential rains. Investigations revealed substandard materials, technical flaws, and supervisory negligence as major causes. The tragedy highlighted the importance of construction safety standards, quality control, and accountability in industrial projects.

### Introduction

- As per Disaster Management Act of 2005, Disaster Management has an integrated process of planning, organizing, coordinating and implementing measures which are necessary for-Prevention of threat of any disaster.
- disaster management means the range of activities, prior to, during and after the disasters, designed to maintain control over disasters and to provide a framework for helping at-risk persons and/or communities to avoid, minimise or recover from the impact of the disasters.

### Importance of Disaster Management

- Protection of Life and Property**
  - Reduces loss of human lives through evacuation and rescue.
  - Minimizes damage to houses, infrastructure, crops, and livestock.
- Quick and Effective Response**
  - Provides timely relief such as food, water, shelter, and medical aid.
  - Ensures organized and coordinated rescue operations.
- Preparedness and Risk Reduction**
  - Identifies disaster-prone areas and vulnerable populations.
  - Promotes safer building codes, flood control, and land-use planning.
  - Reduces the severity of future disasters.
- Rehabilitation and Recovery**
  - Restores homes, livelihoods, and essential services after disasters.
  - Provides psychological and social support to survivors.
  - Ensures long-term economic and community recovery.
- Strengthening Community Resilience**
  - Spreads awareness and provides training in disaster preparedness.
  - Encourages volunteer participation and community-based disaster management.
  - Builds a culture of safety and self-reliance.
- Support for Sustainable Development**
  - Prevents developmental setbacks caused by disasters.
  - Integrates disaster risk reduction with environmental protection.
  - Promotes climate-resilient and eco-friendly planning.
- Legal and Governance Importance**
  - Defines roles and responsibilities of government agencies.

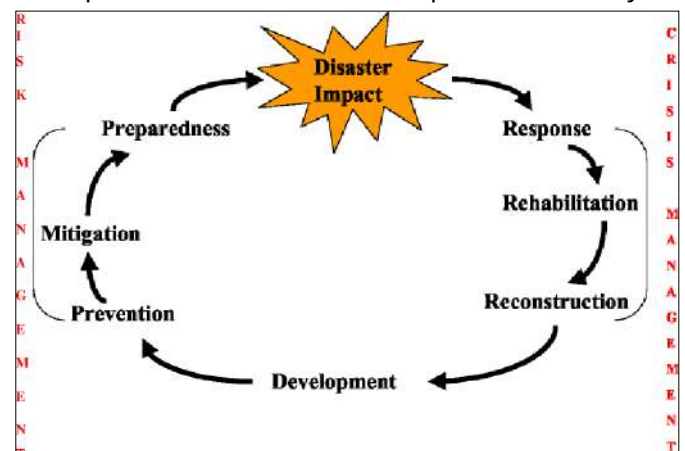
- Improves coordination across national, state, district, and local levels.
- Ensures efficient use of funds and resources.

- National and Global Relevance**

- Helps meet international commitments like the Sendai Framework for Disaster Risk Reduction.
- Addresses risks from terrorism, industrial accidents, pandemics, and climate change.

### Disaster Management Cycle

- When properly implemented, the disaster-management cycle can lessen the impact of a catastrophic event.
- It can also incorporate the policies and emergency responses needed for a full, expedited recovery.



### Phases of Disaster Management

- Prevention**
  - Focuses on proactive steps to reduce disaster risk.
  - Involves identifying potential hazards and creating safeguards.
  - Examples:
    - Evacuation plans in schools to ensure safe movement during fire/tornado.
    - Designing cities with flood-control measures such as locks, dams, or diversion channels.
- Mitigation**
  - Aims to minimize the loss of life and property.
  - Can be **structural** or **non-structural**:
    - Structural measures:** Modifying physical features, e.g., clearing trees near houses to reduce storm-related damage.
    - Non-structural measures:** Adopting/amending building codes to improve long-term safety.
- Preparedness**
  - A continuous process of planning and training for disaster scenarios.
  - Ensures readiness through regular practice, evaluation, and corrective action.

- Examples: fire drills, active-shooter drills, evacuation rehearsals, community awareness programs.
- **Response**
  - Immediate actions taken after a disaster occurs.
  - Involves short- and long-term measures to restore safety and stability.
  - Disaster leaders coordinate personnel, supplies, and equipment for relief.
  - Examples: extinguishing lingering fires after a wildfire, stabilizing highly flammable areas, removing hazards.
- **Recovery**
  - Long-term stage focusing on restoring community life and functions.
  - Requires prioritization:
    - Essential services (food, clean water, healthcare, utilities, transport) restored first.
    - Less-essential services restored gradually.
  - May take years or decades; aims to return society to normal or a “new normal.”
  - Recovery requires prioritization: first, essential services like food, clean water, utilities, transportation and healthcare will be restored, with less-essential services being prioritized later.
  - Ultimately, this stage is about helping individuals, communities, businesses and organizations return to normal or a new normal depending on the impact of the disaster.

## Role of Government in Disaster Management

### A. Legislative Framework

#### 1. National Disaster Management Act 2005:

- The Act calls for the establishment of NDMA, with the Prime Minister of India as chairperson.
- All State Governments are mandated under Section 14 of the Act to establish a State Disaster Management Authority (SDMA). The SDMA consists of the Chief Minister of the State, who is the Chairperson, and no more than eight members appointed by the Chief Minister. The State Executive Committee is responsible for drawing up the state disaster management plan and implementing the National Plan. The SDMA is mandated to ensure that all the departments of the State prepare disaster management plans as prescribed by the national and state authorities.
- The Act directs the establishment of the District Disaster Management Authority (DDMA). The Chairperson of DDMA will be the Collector or the District Magistrate or the Deputy Commissioner of the district. The elected representative of the area is

member of the DDMA as an ex-officio. The district authority shall act as the planning, coordinating and implementing body for disaster management in the district and take all measures for the purposes of disaster management in the district in accordance with the guidelines laid down by the national and state authorities.

- The Act provides for constituting a National Disaster Response Force. For the purpose of specialist response to a threatening disaster situation or disaster' under the Director General to be appointed by the Central
- The Act contains provision for constitution of National Disaster Response Fund and National Disaster Mitigation Fund and similar funds at the state and the district levels.
- The Act also provides for specific roles to local bodies, including Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs) in disaster. At the district level, the DM Act 2005 provides for the constitution of District Disaster Management Authorities under the chairmanship of the District Magistrate/Collector while the elected representative of the local authority would be the co-chairperson. In those districts where Zilla Parishads exist, the chairman would be the ex-officio co-chairperson of the District Disaster Management Authority.

#### 2. Other Supporting Legislations & Policies

Legislation / Policy	Role in Disaster Management
<b>Factories Act, 1948</b>	Ensures health and safety of workers; regulates handling of hazardous substances.
<b>Environment Protection Act, 1986</b>	Provides powers to control pollution and environmental hazards; enacted after Bhopal Gas Tragedy.
<b>Factories Amendment Act, 1987</b>	Mandates on-site and off-site emergency plans; disclosure of industrial hazards to workers and communities.
<b>Explosives Act</b>	Regulates manufacture, possession, use, transport, and sale of explosives to prevent industrial accidents.
<b>Boilers and Pressure Vessels Rules</b>	Ensures safe operation of boilers to avoid explosions and industrial disasters.
<b>Epidemic Diseases Act, 1897</b>	Grants powers to control spread of dangerous diseases; widely used during COVID-19.
<b>Drugs and Cosmetics Act, 1940</b>	Regulates quality and availability of medicines during health emergencies.

<b>Indian Penal Code (IPC), 1860</b>	Provides punishment for negligence leading to disasters (e.g., fire, building collapse).
<b>Criminal Procedure Code (CrPC), 1973</b>	Authorizes magistrates/police to maintain law and order during disasters (e.g., curfews, restrictions).
<b>National Building Code of India</b>	Provides guidelines for disaster-resilient construction (earthquake, cyclone, fire safety).
<b>Land Use Zoning Regulations</b>	Prevents unsafe construction in disaster-prone or ecologically sensitive areas.
<b>Environmental Impact Assessment (EIA), 2006</b>	Requires risk assessment before starting large projects to avoid environmental disasters.
<b>National Policy on Disaster Management, 2009</b>	Comprehensive policy on prevention, mitigation, preparedness, response, relief, and rehabilitation.
<b>National Action Plan on Climate Change (NAPCC), 2008</b>	Links climate change adaptation with disaster risk reduction; includes missions on agriculture, water, and renewable energy.

### Critical Analysis of Disaster Management Act, 2005 Background

- Enacted after the **2004 Indian Ocean Tsunami**, which exposed gaps in India's disaster preparedness.
- Aims to provide a **legal and institutional framework** for disaster management across the country.

### Strengths of the Act

- **Comprehensive Legal Framework**
  - First legislation in India exclusively dedicated to disaster management.
  - Covers prevention, mitigation, preparedness, response, and recovery.
- **Institutional Setup**
  - Established National Disaster Management Authority (NDMA) chaired by the Prime Minister.
  - State Disaster Management Authorities (SDMAs) chaired by Chief Ministers.
  - District Disaster Management Authorities (DDMAs) chaired by District Collectors.
  - Clear chain of command ensures accountability.

- **Financial Mechanisms**
  - Provides for National Disaster Response Fund (NDRF) and State Disaster Response Fund (SDRF).
  - Ensures availability of resources for emergency response.
- **Integration with Development**
  - Stresses mainstreaming disaster risk reduction into development planning.
  - Encourages ministries and departments to prepare disaster management plans.
- **Legal Powers**
  - Empowers authorities to requisition resources, issue binding directions, and ensure compliance during disasters.
  - Provides penalties for obstruction of disaster management work.

### Limitations and Criticisms

- **Over-Centralization of Power**
  - Strong emphasis on national and state authorities, leaving limited autonomy for local bodies.
  - Panchayats and municipalities (closest to the community) are weakly integrated.
- **Top-Down Approach**
  - Focuses on bureaucratic structures rather than **community-based disaster management (CBDM)**.
  - Citizens' participation is not explicitly emphasized.
- **Reactive, Not Preventive**
  - Despite mentioning prevention and mitigation, actual implementation leans heavily on **response and relief**.
  - Disaster risk reduction (DRR) is not effectively institutionalized.
- **Coordination Gaps**
  - Multiple overlapping agencies (NDMA, SDMA, NDRF, armed forces, NGOs) sometimes create confusion.
  - Lack of synergy with existing environmental and health laws.
- **Funding Challenges**
  - Although NDRF/SDRF exist, states often face delays in fund release.
  - Mitigation funding is inadequate compared to response funding.
- **Accountability Issues**
  - No clear accountability mechanism for lapses or negligence by authorities.
  - Weak monitoring and evaluation of disaster management plans.

- **Neglect of Climate Change Linkages**
  - Does not adequately integrate **climate change adaptation** despite increasing climate-related disasters.
  - Relies on separate climate policies like NAPCC.
- **Limited Private Sector Role**
  - Act does not strongly mandate private sector participation despite their crucial role in infrastructure, supply chains, and insurance.

#### Lessons from COVID-19 (2020–21)

- Both **Disaster Management Act, 2005** and **Epidemic Diseases Act, 1897** were invoked.
- Showed the Act's flexibility, but also:
  - Excessive centralization (national lockdown imposed without local consultation).
  - Migrant crisis exposed weak planning for vulnerable populations.
  - Health sector preparedness not adequately covered in the Act.

#### Suggestions for Improvement

- Strengthen **local governance role** (Panchayati Raj, Urban Local Bodies) in disaster planning and response.
- Institutionalize **community participation** in disaster risk reduction.
- Increase emphasis on **mitigation and preparedness**, not just relief.
- Ensure **faster and transparent fund flow** for states and districts.
- Establish strong **monitoring, evaluation, and accountability** mechanisms.
- Integrate **climate change adaptation and disaster management** into a single framework.
- Encourage **public-private partnerships** (infrastructure, logistics, insurance, technology).
- Include specific provisions for **vulnerable groups** (women, children, elderly, differently-abled, migrants).

- It take such other measures, as it may consider necessary, for the prevention of disasters, or mitigation, or preparedness and capacity building, for dealing with a threatening disaster situation or disaster.
- NDMA has the power to authorise the Departments or authorities concerned, to make emergency procurement of provisions or materials for rescue and relief in a threatening disaster situation or disaster.
- The NDMA has the mandate to deal with all types of disasters – natural or human-induced.
- **Shortcomings and challenges in NDMA**
  - NDMA's role during Uttarakhand Flooding in 2013 was questioned, where it failed to timely inform people about the flash floods and landslides. The post disaster relief response had not been upto NDMA's benchmarks. Experts blamed unfinished projects for flood and landslide mitigation which were resulted due to poor planning of NDMA.
  - A CAG report observed that there were delays in completion of projects under the flood management programmes. It also stated that the projects were not taken up in an integrated manner and blamed NDMA for institutional failures for poor flood management.
  - There were huge delays in completion of river management activities and works related to border areas projects which were long-term solutions for the flood problems of Assam, north Bihar and eastern Uttar Pradesh.
  - Devastations caused by Kerala Floods in 2018 and Chennai Floods in 2015 showed shortcomings in the institutions regarding preparedness for the disaster situation.
  - CAG report, 2015 Chennai Floods termed it as a "man-made disaster" and holds Tamil Nadu government responsible for the catastrophe.
  - The NDRF lack sufficient training, equipment, facilities and residential accommodation to deal with the crisis situation properly.
  - Misutilization of Funds-
    - Audit findings shows that some states have mis-utilised funds for expenditures that were not authorised for disaster management.
  - There was significant delay in releasing funds. Additionally, some States didn't invest the funds thereby incurring huge interest losses. This shows financial indiscipline in states regarding management of funds.
- **2.National Institute of Disaster Management (NIDM)**
  - As per the provisions of the Chapter-VII of the DM Act, Government of India constituted the National

## B. Institutional framework

### 1. National Disaster Management Authority (NDMA)

- The Government of India established the NDMA in 2005, headed by the Prime Minister, Under the DM Act 2005, the NDMA, as the apex body for disaster management, shall have the responsibility for laying down the policies and guidelines for disaster management for ensuring timely and effective response to disaster.
- The guidelines of NDMA will assist the Central Ministries, Departments, and States to formulate their respective DM plans.
- It approves the National Disaster Management Plan and DM plans of the Central Ministries/ Departments.

Institute of Disaster Management (NIDM) under an Act of Parliament with the goal of being the premier institute for capacity development for disaster management in India and the region.

- The vision of NIDM is to create a Disaster Resilient India by building the capacity at all levels for disaster prevention and preparedness.
- NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation, and policy advocacy in the field of disaster management.
- The NIDM has built strategic partnerships with various ministries and departments of the central, state, and local governments, academic, research and technical organizations in India and abroad and other bi-lateral and multilateral international agencies.
- It provides technical support to the state governments through the Disaster Management Centres (DMCs) in the Administrative Training Institutes (ATIs) of the States and Union Territories.
- Some of them are emerging as centres of excellence in the specialised areas of risk management – flood, earthquake, cyclone, drought, landslides, and industrial disasters.

### 3. National Disaster Response Force (NDRF)

- The NDRF has been constituted as per the Chapter-VIII of the DM Act 2005 as a specialist response force that can be deployed in a threatening disaster situation or disaster.
- As per the DM Act, the general superintendence, direction and control of the NDRF shall be vested and exercised by the NDMA.
- The command and supervision of the NDRF shall vest with the Director General appointed by the Government of India.
- The NDRF will position its battalions at different locations as required for effective response.
- NDRF units will maintain close liaison with the designated State Governments and will be available to them in the event of any serious threatening disaster situation.
- The NDRF is equipped and trained to respond to situations arising out of natural disasters and CBRN emergencies.
- The NDRF units will also impart basic training to all the stakeholders identified by the State Governments in their respective locations.

### C. Financial Framework

- **Constitutional Basis**
  - Disaster management financing is guided by the recommendations of the Finance Commission.
  - Resources are shared between the Union and States as per constitutional provisions.

### • Funds Created under the Disaster Management Act, 2005

- **National Disaster Response Fund (NDRF)**
  - Used for meeting expenses for emergency response, relief, and rehabilitation after disasters.
  - Financed through budgetary provisions and levy of cess if required.
- **State Disaster Response Fund (SDRF)**
  - Primary fund available with states for immediate relief in case of disasters.
  - Funded by both Central and State governments (the Centre contributes a major share, usually 75% for general category states and 90% for special category states).
- **National Disaster Mitigation Fund (NDMF)**
  - Intended for activities relating to mitigation, preparedness, and capacity building.
  - Less operationalized compared to NDRF.
- **State Disaster Mitigation Fund (SDMF)**
  - Created at state level for mitigation and risk reduction measures.

### • Role of the Finance Commission

- Recommends allocations for SDRF and guidelines for utilization.
- Ensures periodic review of fund adequacy for disaster management.

### • Budgetary Allocations

- Separate allocations made in Union and State budgets for disaster management schemes and projects.
- Ministries and departments must integrate disaster risk reduction into development planning and budgets.

### • Insurance Mechanisms

- Encouragement of crop insurance, property insurance, and health insurance to reduce government burden.
- Pradhan Mantri Fasal Bima Yojana (PMFBY) for agricultural risk coverage.

### • International Assistance

- India generally follows a policy of not seeking foreign aid but accepts it on a case-to-case basis (e.g., UN agencies, World Bank for reconstruction projects).

### • Corporate Social Responsibility (CSR)

- Companies encouraged to contribute to disaster relief and rehabilitation under CSR obligations.
- Contributions can be made to recognized funds such as the Prime Minister's Relief Fund or the Chief Minister's Relief Fund.

- **Challenges in Financial Framework**

- Greater focus on response funds (NDRF, SDRF) compared to mitigation funds (NDMF, SDMF).
- Delays in fund release and utilization at the state and district levels.
- Limited use of innovative financing tools like catastrophe bonds, microinsurance, and disaster risk pooling.

### **Role of People and Community in Disaster Management**

- Act as **first responders** during disasters, often before official help arrives.
- Participate in **preparedness activities** such as mock drills, evacuation planning, and awareness campaigns.
- Help in **early warning dissemination** within local networks, ensuring rapid communication.
- Contribute to **rescue and relief efforts**, including evacuation, first aid, and distribution of essentials.
- Provide **local knowledge** of geography, resources, and vulnerabilities to aid planning.
- Engage in **risk reduction measures** like safe construction practices, flood-proofing, and maintaining drainage systems.
- Promote **social cohesion and mutual support**, which strengthens resilience.
- Assist in **monitoring and reporting hazards**, for example, rising water levels or cracks in land.
- Take part in **rehabilitation and reconstruction** through voluntary labor, rebuilding homes, and restoring livelihoods.
- Act as **pressure groups** to demand accountability, better planning, and disaster-resilient infrastructure.

#### **Case Study 1: Gujarat Earthquake (2001)**

After the devastating earthquake in Bhuj, Gujarat, community participation became a cornerstone of recovery and rehabilitation. Local people, NGOs, and self-help groups came together to rebuild homes, schools, and public infrastructure. Villagers actively engaged in decision-making about the design of earthquake-resistant houses and the layout of new settlements. Women's groups played a key role in mobilizing relief materials, organizing community kitchens, and supporting livelihood restoration. This bottom-up approach ensured that reconstruction was not only faster but also more sustainable and suited to local needs.

#### **Case Study 2: Kerala Floods (2018)**

During the unprecedented floods in Kerala, community participation was crucial in rescue and relief operations. Fishermen used their traditional boats to rescue thousands of stranded people, often in places where official agencies could not reach. Local youth groups and residents set up community relief camps, collected

food, clothes, and medicines, and coordinated through social media. The community-driven response greatly reduced mortality and suffering, showing how local capacity can complement government efforts during large-scale disasters.

#### **Case Study 3: Odisha Super Cyclone (1999) and Cyclone Phailin (2013)**

The 1999 Odisha Super Cyclone claimed over 10,000 lives, partly due to lack of preparedness and community awareness. Learning from this tragedy, the state government developed a strong community-based disaster preparedness program. When Cyclone Phailin struck in 2013, village committees, volunteers, and local leaders were actively involved in early warning dissemination, evacuation, and shelter management. More than a million people were safely evacuated, and the death toll was drastically reduced compared to 1999. This highlighted the importance of empowering communities with knowledge, resources, and responsibility.

### **International Framework for disaster Management**

#### **1. Hyogo Framework of Action**

- Hyogo Framework of Action (HFA) (2005-2015) was adopted to work on a global level for sustainable reduction of disaster related losses of lives and the social, economic and environmental assets of communities and countries
- The framework set three strategic goals given as under:
  - More effectual assimilation of disaster risk reduction into planning and programming at all levels, sustainable development policies, having a special emphasis on disaster prevention, mitigation, preparedness and reduction in vulnerability
  - At every community level, institutions, capacities, and mechanisms that can systematically contribute to increasing disaster resilience are being developed and reinforced
  - The systematic integration of risk reduction approaches into the design and application of emergency readiness, response and recovery packages in the reconstruction of the affected communities.
- India is one of the participants, and it collaborates closely with the UNDRR (United Nations Office for Disaster Risk Reduction) to implement the HFA for DRR (Disaster risk reduction) Priority Areas.

#### **2. Sendai Framework for Disaster Risk Reduction (SFDRR), 2015-2030**

- Adopted at the **3rd UN World Conference on Disaster Risk Reduction in Sendai, Japan (2015)**.

- **Succeeded** the Hyogo Framework for Action (2005–2015).
- It is the **first major agreement** of the post-2015 development agenda and aligns with **SDGs, Paris Agreement, and Addis Ababa Action Agenda**.
- **Goal** : To prevent new disaster risks, reduce existing risks, and strengthen resilience.
- **Seven Global Targets**
  - Substantially reduce global disaster mortality.
  - Substantially reduce the number of affected people.
  - Reduce direct disaster economic loss in relation to global GDP.
  - Reduce damage to critical infrastructure and basic services (health, education).
  - Increase the number of countries with national and local disaster risk reduction strategies.
  - Enhance international cooperation to developing countries.
  - Increase availability and access to multi-hazard early warning systems and disaster risk information.
- **Four Priority Areas for Action**
  - **Understanding disaster risk** (risk knowledge, data, awareness).
  - **Strengthening disaster risk governance** (policies, institutions, coordination).
  - **Investing in disaster risk reduction** (resilient infrastructure, ecosystem-based approaches).
  - **Enhancing disaster preparedness for effective response and building back better** during recovery, rehabilitation, and reconstruction.
- **India's Alignment with Sendai Framework**
  - **NDMA Guidelines, National Disaster Management Plan (2016, updated 2019)** aligned with Sendai priorities.
  - Programs like **AMRUT, Smart Cities Mission, Coalition for Disaster Resilient Infrastructure (CDRI)** promote resilience.
  - **Early Warning Systems** by IMD and ISRO in line with Sendai's targets.

### 3.Coalition for Disaster Resilient Infrastructure (CDRI)

- The CDRI was launched by the Prime Minister of India during the United Nations Climate Action Summit on the 23rd September, 2019, at New York.
- It is a global partnership of National Governments, UN agencies and programmes, multilateral development banks and financing mechanisms, the private sector, academic and knowledge institutions .
- It aims to promote the resilience of infrastructure systems to climate and disaster risks, thereby ensuring sustainable development.

### 4.Yokohama Strategy and Plan of Action for a Safer World, 1994

- Adopted at the World Conference on Natural Disaster Reduction in Yokohama, Japan (1994).
- Predecessor to later frameworks like Hyogo Framework (2005–2015) and Sendai Framework (2015–2030).
- Marked the first comprehensive international framework for disaster risk reduction (DRR).
- **Core Principles of Yokohama Strategy**
  - **Risk Assessment is essential** for disaster prevention and preparedness.
  - **Disaster prevention and preparedness** are more effective than disaster response and relief.
  - **Early warning systems** must be developed and widely disseminated.
  - **Community involvement and participation** are central to DRR.
  - **Environmental protection** is key to disaster prevention.
  - **International cooperation and technology transfer** are necessary for capacity building.
  - **Integration of disaster reduction into development policy** is critical.

### Best International Practices

#### 1.Japan: Community-Based Earthquake Preparedness

- Japan is globally recognized for its earthquake and tsunami preparedness. The country has strict building codes that require earthquake-resistant structures, and regular nationwide disaster drills are conducted involving schools, offices, and communities. Local communities are trained to respond immediately during disasters through early warning systems, evacuation plans, and first-aid training. The success of these practices was seen during the 2011 Tōhoku earthquake and tsunami, where despite massive destruction, preparedness minimized loss of life in several regions.

#### 2.Bangladesh: Cyclone Preparedness Programme (CPP)

- Bangladesh, highly vulnerable to cyclones and floods, developed the Cyclone Preparedness Programme in collaboration with the Red Crescent Society. This program relies on thousands of trained volunteers who disseminate warnings, manage shelters, and conduct community awareness campaigns. The result has been a dramatic reduction in cyclone-related deaths, from hundreds of thousands in the 1970 Bhola Cyclone to only a few dozen during Cyclone Amphan in 2020. Community ownership and volunteerism make this program one of the most successful disaster management models in the world.

### **3. United States: Federal Emergency Management Agency (FEMA)**

- The United States has institutionalized disaster management through FEMA, which coordinates national response during hurricanes, wildfires, floods, and other emergencies. FEMA integrates local, state, and federal efforts, while also involving private companies and NGOs. Strong insurance mechanisms and use of modern technologies such as GIS mapping, satellite monitoring, and early warning systems make disaster response faster and more efficient. Community resilience programs also emphasize preparedness at the household level.

### **4. Cuba: Hurricane Preparedness and Evacuation Planning**

- Cuba is a global example of effective disaster management despite limited economic resources. The country has a robust early warning system and a culture of preparedness built into education and community activities. Before hurricanes, nearly the entire at-risk population is evacuated to safe shelters, supported by well-coordinated local committees. As a result, Cuba consistently records very low casualties compared to other Caribbean nations facing similar storms.



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